frontiers | Research Topics

Reducing consumption of animal products

Edited by
Christopher John Bryant, Christopher J. Hopwood and Jared Piazza

Published in
Frontiers in Nutrition
Frontiers in Psychology
Frontiers in Sustainable Food Systems

ISSN 1664-8714
ISBN 978-2-8325-3458-8
DOI 10.3389/978-2-8325-3458-8

About Frontiers

Frontiers is more than just an open access publisher of scholarly articles: it is a pioneering approach to the world of academia, radically improving the way scholarly research is managed. The grand vision of Frontiers is a world where all people have an equal opportunity to seek, share and generate knowledge. Frontiers provides immediate and permanent online open access to all its publications, but this alone is not enough to realize our grand goals.

Frontiers journal series

The Frontiers journal series is a multi-tier and interdisciplinary set of open-access, online journals, promising a paradigm shift from the current review, selection and dissemination processes in academic publishing. All Frontiers journals are driven by researchers for researchers; therefore, they constitute a service to the scholarly community. At the same time, the *Frontiers journal series* operates on a revolutionary invention, the tiered publishing system, initially addressing specific communities of scholars, and gradually climbing up to broader public understanding, thus serving the interests of the lay society, too.

Dedication to quality

Each Frontiers article is a landmark of the highest quality, thanks to genuinely collaborative interactions between authors and review editors, who include some of the world's best academicians. Research must be certified by peers before entering a stream of knowledge that may eventually reach the public - and shape society; therefore, Frontiers only applies the most rigorous and unbiased reviews. Frontiers revolutionizes research publishing by freely delivering the most outstanding research, evaluated with no bias from both the academic and social point of view. By applying the most advanced information technologies, Frontiers is catapulting scholarly publishing into a new generation.

What are Frontiers Research Topics?

Frontiers Research Topics are very popular trademarks of the *Frontiers journals series*: they are collections of at least ten articles, all centered on a particular subject. With their unique mix of varied contributions from Original Research to Review Articles, Frontiers Research Topics unify the most influential researchers, the latest key findings and historical advances in a hot research area.

Find out more on how to host your own Frontiers Research Topic or contribute to one as an author by contacting the Frontiers editorial office: frontiersin.org/about/contact

Reducing consumption of animal products

Topic editors

Christopher John Bryant — University of Bath, United Kingdom
Christopher J. Hopwood — University of Zurich, Switzerland
Jared Piazza — Lancaster University, United Kingdom

Citation

Bryant, C. J., Hopwood, C. J., Piazza, J., eds. (2023). *Reducing consumption of animal products*. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-8325-3458-8

Table of contents

05 Editorial: Reducing consumption of animal products
Christopher Bryant, Christopher J. Hopwood and Jared Piazza

08 Plant-based diets and body composition in Chinese omnivorous children aged 6–9 years old: A cross-sectional study
Gengdong Chen, Mengyang Su, Xinwei Chu, Yuanhuan Wei, Shanshan Chen, Yingyu Zhou, Zhengping Liu and Zheqing Zhang

19 The relationship between meat disgust and meat avoidance—A chicken-and-egg problem
Elisa Becker, Stella Kozmér, Matthias B. Aulbach and Natalia S. Lawrence

33 A taste of things to come: Effect of temporal order of information and product experience on evaluation of healthy and sustainable plant-based products
Marija Banovic, Anne Arvola, Kyösti Pennanen, Denisa E. Duta, Kolbrún Sveinsdóttir, Nesli Sozer and Klaus G. Grunert

51 *'Say Cheese!'*: Humane halos from environmental practices in dairy production
Heidi Zamzow and Frédéric Basso

65 Understanding individual and collective response to climate change: The role of a self-other mismatch
Rosie Harrington, Armelle Nugier, Kamilla Khamzina, Serge Guimond, Sophie Monceau and Michel Streith

77 Framing the futures of animal-free dairy: Using focus groups to explore early-adopter perceptions of the precision fermentation process
Garrett M. Broad, Oscar Zollman Thomas, Courtney Dillard, Daniel Bowman and Brice Le Roy

91 Inspiration or risk? How social media marketing of plant-based meat affects young people's purchase intention
Tingting Li, Desheng Wang and Zhihao Yang

105 Comparing meat abstainers with avid meat eaters and committed meat reducers
Muriel C. D. Verain and Hans Dagevos

122 Ideological resistance to veg*n advocacy: An identity-based motivational account
Ben De Groeve, Brent Bleys and Liselot Hudders

143 Autonomous motivation, goal-facilitating behaviours, and dietary goal progress in individuals transitioning to a veg*n diet: A longitudinal study
Marta Kolbuszewska, Jo Anderson and Marina Milyavskaya

156 Explaining vegetarian and vegan dietary behavior among U.S. and Dutch samples applying a reasoned action approach
Emma L. Zaal, Yfke P. Ongena and John C. J. Hoeks

178 Effects of experimentally induced self-affirmation on the openness to meat reduction and alternative protein sources
Marija Branković, Anastasija Budžak, Nađa Tulić and Jovana Janković

188 Why don't politicians talk about meat? The political psychology of human-animal relations in elections
Sparsha Saha

frontiers | Frontiers in Nutrition

TYPE Editorial
PUBLISHED 28 August 2023
DOI 10.3389/fnut.2023.1249873

OPEN ACCESS

EDITED AND REVIEWED BY
Dorota Formanowicz,
Poznan University of Medical Sciences, Poland

*CORRESPONDENCE
Christopher Bryant
✉ c.j.bryant@bath.ac.uk

RECEIVED 29 June 2023
ACCEPTED 18 August 2023
PUBLISHED 28 August 2023

CITATION
Bryant C, Hopwood CJ and Piazza J (2023) Editorial: Reducing consumption of animal products. *Front. Nutr.* 10:1249873. doi: 10.3389/fnut.2023.1249873

Editorial: Reducing consumption of animal products

Christopher Bryant[1,2]*, Christopher J. Hopwood[3] and Jared Piazza[4]

[1]Bryant Research, London, United Kingdom, [2]Department of Psychology, University of Bath, Bath, United Kingdom, [3]Department of Psychology, University of Zurich, Zurich, Switzerland, [4]Department of Psychology, Lancaster University, Lancaster, United Kingdom

KEYWORDS

animal product consumption, psychology, veganism, vegetarianism, meat

Editorial on the Research Topic
Reducing consumption of animal products

Animal production and consumption is at the root of many of the world's most pressing environmental, public health, and ethical issues. As well as contributing directly to greenhouse gas emissions, animal agriculture is incredibly resource-intensive and disruptive to ecosystems, driving water use, land use, biodiversity loss, and deforestation (1–3). Moreover, animal farms act as an incubator for emerging diseases, and a catalyst for antibiotic resistance (4, 5). Globally, over 90% of farmed animals are on factory farms, entailing small cage confinement, painful mutilations, and overall low welfare (6).

Increasingly, institutions including governments, public services, universities, and commercial food outlets are playing a role in reducing animal production and consumption (7). We have seen initiatives such as investments in alternative proteins (8), mandatory carbon and animal welfare labeling (9, 10), and nudges to encourage more sustainable food choices (11). While these institutions have an important role to play, they are ultimately beholden to individuals: generally, governments cannot implement policies without the support of voters, and companies cannot reshape their offerings without buy-in from consumers. Therefore, research into the public's attitudes about animal-product reduction and alternative proteins is a vital field of study.

This Research Topic called upon psychologists, behavioral scientists, and the broader scientific community to investigate the psychology of meat reduction, design and test interventions, and recommend ways forward to reduce the consumption of animal products. The resulting Research Topic contains over a dozen high-quality scientific studies covering a range of topics including vegetarian and vegan identity, moral psychology, behavior change, alternative proteins, health outcomes, and political science. All of these papers contribute to our understanding of relevant issues, which, in turn, can help to advance a more sustainable food system.

On vegetarian identity and moral psychology, behavioral scientists in Belgium provided an identity-based motivational account of resistance to veg*n advocacy. They theorized that veg*n (i.e., vegetarian and/or vegan) advocacy can threaten the moral and meat-eating identities of omnivores, which often causes them to engage in motivated reasoning to justify their consumption. They argue, however, that this apparent resistance often masks privately held beliefs that align with veg*n attitudes, and can precede later behavioral change (De Groeve et al.).

Scientists in Serbia found that individual and group affirmations of personally or collectively important values—for example, perceiving one's group as valuing democracy, trust, social connectedness, and solidarity in society—increased openness to meat reduction, including openness to cultured meat (Branković et al.). Likewise, psychologists in France showed how a perceived mismatch between an individual's own meat reduction and that of their group can motivate individuals to engage in behaviors (e.g., veg*n advocacy) aimed at positively shifting group norms (Harrington et al.).

Meanwhile, psychologists in the UK demonstrated a "halo effect" occurring for participants who were given positive environmental information about a cheese product. Relative to a no-environmental-information control condition, these individuals tended to infer that the environmentally-friendly product entailed higher animal welfare (their dairy cows treated better)—despite no information being given about the latter (Zamzow and Basso). As a result of this spreading positivity, they were more likely to endorse the product.

On behavioral change, psychologists in the Netherlands employed a reasoned action approach to investigate the attitudes that predict an intention to follow a vegetarian or vegan diet. They found that, in the Netherlands and the USA, instrumental and experiential attitudes (e.g., perceptions of dietary necessity and enjoyment, respectively) predicted dietary change intent. Additionally, in the Netherlands, descriptive norms about other people's intent to reduce their animal-product consumption predicted dietary change intent (Zaal et al.).

Economists in the Netherlands proposed that, with regard to animal products, dietary consumer groups can be modeled on a continuum. They investigated relative differences between meat abstainers, committed meat reducers, and avid meat eaters. They found that, compared to meat reducers, meat abstainers had more positive attitudes toward plant-based products and alternatives, such as tofu, veggie burgers, pulses and mushrooms. In comparison with avid meat eaters, committed meat reducers had a preference for non-meat animal proteins, such as eggs and cheese, and their diets were motivated more by environmental concerns and animal welfare (Verain and Dagevos). Compared to both other groups, avid meat eaters tended to be male and preferred to eat animal products over plant-based products.

Psychologists in Canada investigated the role of autonomous motivation—pursuing goals because one wants to, rather than has to—in maintaining a meat-free diet. In a longitudinal study of individuals transitioning to a veg*n diet, the researchers found no directional effect of autonomous motivation on dietary goal progress or goal facilitating behaviors. Nonetheless, goal progress within the study was related to subsequent reports of autonomous motivation suggesting that progress toward a veg*n diet may help build competence around meat-free eating (Kolbuszewska et al.).

A team led by psychologists in the UK followed Veganuary participants—meat eaters practicing a vegan diet for a month. They found that those who engaged with the pledge and reduced their meat consumption tended to develop stronger disgust reactions to meat afterwards, supporting the view that increased meat disgust follows (rather than precedes) meat reduction (Becker et al.). This demonstrates how meat avoidance—pursued through a pledge—can promote meat disgust and, possibly, spearhead future reduction.

On alternative proteins, marketing researchers in China demonstrated that increased intensity of social media marketing of plant-based meat can increase purchase intentions by influencing cognitive fluency, which broadens consumers' imaginations and reduces their perception of risk (Li et al.). Meanwhile, food and marketing scientists from across Europe investigated the impact of giving consumers health-related information for plant-based products, such as egg-free pasta, before or after tasting. They found that giving health information before tasting—rather than after or without—was associated with higher purchase intentions and stable taste perceptions across three phases of the experiment (Banovic et al.).

Further, a research team spanning Germany, the UK, and the USA investigated consumer perceptions of animal-free dairy from precision fermentation. In focus groups of potential early adopters from the United States, Germany, and Singapore, animal welfare considerations were among the most convincing, while concerns about consumer health, process safety and "messing with nature" were also shared. The researchers observed a cautious openness to animal-free dairy—an overall promising result for stakeholders investing in this emerging market (Broad et al.).

On political science, a researcher in the USA investigated the impact of emphasizing the environmental or animal rights case for meat reduction on simulated election performance. They found that, while the environmental case for meat reduction provoked a voter backlash, especially among Republicans, there was no such backlash for candidates who focused on farmed animal rights. In fact, candidates who demonstrated a personal concern for farmed animals received substantial boosts in voter support (Saha).

On health outcomes, medical researchers in China demonstrated that adherence to healthy plant-based diets was associated with better body composition in children aged 6–9. In particular, greater adherence was associated with lower abdominal obesity risk in girls, and stronger handgrip strength in boys (Chen et al.).

While environmental scientists continue to stress the importance of a shift away from industrially-farmed animal products, and food scientists develop ever-higher-quality alternatives, the social and psychological dimensions of consumer attitudes and behavior continue to present a challenge. All of the contributions in this Research Topic can help improve our understanding of the nexus of factors that impact on consumer decisions and individuals' choices and, ultimately, help to advance a more just and sustainable food system.

Author contributions

All authors contributed to the writing of this editorial and the final version was agreed upon by all co-authors.

Conflict of interest

CB is the Director of Bryant Research, which works with animal charities and alternative protein companies to advance the protein transition.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

1. Poore J, Nemecek T. Reducing food's environmental impacts through producers and consumers. *Science.* (2018) 360:987–92. doi: 10.1126/science.aaq0216

2. Benton TG, Bieg C, Harwatt H, Pudasaini R, Wellesley L. *Food System Impacts on Biodiversity Loss. Three Levers for Food System Transformation in Support of Nature*. London: Chatham House (2021).

3. Clark M, Springmann M, Rayner M, Scarborough P, Hill J, Tilman D, et al. Estimating the environmental impacts of 57,000 food products. *Proc. Natl. Acad. Sci. U. S. A.* (2022) 119:e2120584119. doi: 10.1073/pnas.2120584119

4. Espinosa R, Tago D, Treich N. Infectious diseases and meat production. *Environ Resour Econ.* (2020) 76:1019–44. doi: 10.1007/s10640-020-00484-3

5. Tiseo K, Huber L, Gilbert M, Robinson TP, Van Boeckel TP. Global trends in antimicrobial use in food animals from 2017 to 2030. *Antibiotics.* (2020) 9:918. doi: 10.3390/antibiotics9120918

6. Anthis K, Reese-Anthis J. *Global Farmed and Factory Farmed Animals Estimates*. Sentience Institute. (2019). Available online at: https://www.sentienceinstitute.org/global-animal-farming-estimates (accessed June 29, 2023).

7. Krattenmacher J, Casal P, Dutkiewicz J, Huchard E, Sanders E, Treich N, et al. Universities should lead on the plant-based dietary transition. *Lancet Planetary Health.* (2023) 7:e354–5. doi: 10.1016/S2542-5196(23)00082-7

8. Government of Canada. *Government of Canada Invests Over $1.4 Million in Plant-Based Food Production in British Columbia*. (2022). Available online at: https://www.canada.ca/en/agriculture-agri-food/news/2022/07/government-of-canada-invests-over-14-million-in-plant-based-food-production-in-british-columbia.html (accessed June 29, 2023).

9. Kateman B. *Carbon Labels are Finally Coming to the Food and Beverage Industry*. Frobes. (2020). Available online at: https://www.forbes.com/sites/briankateman/2020/07/20/carbon-labels-are-finally-coming-to-the-food-and-beverage-industry (accessed June 29, 2023).

10. Department for Environment Food and Rural Affairs. *Call for Evidence—Labelling for Animal Welfare*. (2021). Available online at: https://consult.defra.gov.uk/animal-welfare-market-interventions-and-labelling/labelling-for-animal-welfare (accessed June 29, 2023).

11. Lepitak S. *Burger King Austria Now Asks Customers, "Regular or With Meat?"* Ad Week. (2022). Available online at: https://www.adweek.com/brand-marketing/burger-king-austria-now-asks-customers-regular-or-with-meat/ (accessed June 29, 2023).

frontiers | Frontiers in Nutrition

TYPE Original Research
PUBLISHED 29 July 2022
DOI 10.3389/fnut.2022.918944

OPEN ACCESS

EDITED BY
Christopher J. Hopwood,
University of Zurich, Switzerland

REVIEWED BY
Christopher John Bryant,
University of Bath, United Kingdom
Lauren E. O'Connor,
United States Department of Agriculture (USDA), United States

*CORRESPONDENCE
Zhengping Liu
liuzphlk81@outlook.com
Zheqing Zhang
zzqaa501@smu.edu.cn

†These authors have contributed equally to this work and share first authorship
‡These authors have contributed equally to this work and share last authorship

SPECIALTY SECTION
This article was submitted to Nutrition and Sustainable Diets, a section of the journal Frontiers in Nutrition

RECEIVED 13 April 2022
ACCEPTED 08 July 2022
PUBLISHED 29 July 2022

CITATION
Chen G, Su M, Chu X, Wei Y, Chen S, Zhou Y, Liu Z and Zhang Z (2022) Plant-based diets and body composition in Chinese omnivorous children aged 6–9 years old: A cross-sectional study.
Front. Nutr. 9:918944.
doi: 10.3389/fnut.2022.918944

Plant-based diets and body composition in Chinese omnivorous children aged 6–9 years old: A cross-sectional study

Gengdong Chen[1†], Mengyang Su[2†], Xinwei Chu[2], Yuanhuan Wei[2], Shanshan Chen[2], Yingyu Zhou[2], Zhengping Liu[1*‡] and Zheqing Zhang[2*‡]

[1]Department of Obstetrics, Foshan Institute of Fetal Medicine, Southern Medical University Affiliated Maternal & Child Health Hospital of Foshan, Foshan, China, [2]Guangdong Provincial Key Laboratory of Tropical Disease Research, Department of Nutrition and Food Hygiene, School of Public Health, Southern Medical University, Guangzhou, China

Evidence suggests that plant-based diets are beneficial for alleviating metabolic diseases. Childhood is a crucial period for body growth and development. However, it is unknown whether adherence to a plant-based diet is related to a healthy body composition in children. We aimed to assess the relationship between a plant-based diet and body composition in children. A total of 452 Chinese children aged 6–9 years old participated in this cross-sectional study. Lean mass (LM), fat mass, and fat mass percentage (FMP) were assessed via dual-energy X-ray absorptiometry. An age- and sex-specific abdominal FMP ≥85th percentile was defined as abdominal obesity. Handgrip strength was measured using a hydraulic hand dynamometer. A validated 79-item food frequency questionnaire was used to collect dietary information. Overall plant-based diet index (PDI), healthful plant-based diet index (hPDI), and unhealthful plant-based diet index (uPDI) scores were calculated. After adjusting for potential covariates, a higher hPDI score (per 10-score increment) was associated with a higher LM in the android area (0.038 kg, 3.2%), gynoid area (0.048 kg, 1.9%), and trunk (0.102 kg, 1.2%) and with a lower FMP (1.18%) in the android area. In contrast, a higher uPDI score (per 10-score increment) was associated with a lower LM in the trunk (0.091 kg, 1.1%) and android area (0.023 kg, 1.9%) and with a higher FMP (0.74%) in the android area. No significant associations were observed between the overall PDI and body composition or abdominal obesity. After stratifying by sex, higher (vs. lower) hPDI scores was associated with lower abdominal obesity risk in girls and higher handgrip strength in boys. In conclusion, in this cross-sectional study, we found that stronger adherence to a healthful plant-based diet, and less adherence to an unhealthful plant-based diet was associated with better body composition in Chinese omnivorous children aged 6–9 years old. Our results highlight the need to distinguish between healthy and unhealthy plant foods within investigating how to obtain a healthy body composition in children.

KEYWORDS

plant-based diet, body composition, abdominal obesity, handgrip strength, children

Introduction

The prevalence of obesity and/or overweight has increased sharply worldwide in recent decades to become one of the most important public health issues (1, 2), and the rate of increasing obesity and overweight prevalence is greater in children than in adults (1). Childhood adiposity can lead to obesity in adulthood and increase the risk of metabolic consequences, such as diabetes, cardiovascular events, and non-alcoholic fatty liver disease (3). Furthermore, detrimental precursor metabolic processes might occur in children with obesity or overweight, even at an early age (4). Thus, additional public health strategies to reduce the prevalence of overweight and obesity in children are urgently needed.

Nutrition is one of the most important factors that affects body composition. Previous studies have suggested that a plant-based diet, defined as a high intake of plant foods and a low intake of animal foods in an omnivorous diet, might contribute to improved body composition in adults (5–7). These findings are in agreement with those of studies that have investigated healthy dietary patterns, such as the Mediterranean diet (8) and the DASH diet (9), in adults. These diets are characterized by a high intake of healthy plant foods (e.g., fruits and vegetables). However, some plant foods are high in sugar (10) or contain refined carbohydrates (11), such as potatoes and refined grains, and therefore might be detrimental to health. To define a healthy plant-based diet and distinguish between healthy and unhealthy plant foods, Hu et al. developed three plant-based diet indexes to assess the degree of adherence to a plant-based diet: the overall plant-based diet index (PDI), the healthful plant-based diet index (hPDI), and the unhealthful plant-based diet (uPDI) (12). In adults, a higher hPDI and lower uPDI were associated with a lower risk of cardiovascular events (13), type two diabetes and gestational diabetes (12), and metabolic syndrome (14). These findings indicate the possible value of a healthy plant-based diet for preventing adiposity and adverse metabolic consequences. However, relevant studies investigating plant-based diets in children are scarce. Vegan or vegetarian diets were found to be associated with lower BMI, fat mass index, or FMP in three cross-sectional studies in Polish children, while null associations between LM and these diets were observed (15–17). In children, the diet must meet the daily physiological activity needs and maintain body growth and development, particularly in young children. Animal foods contain potentially harmful compositions (i.e., saturated fat, cholesterol) that increase the risk of chronic disease, including: coronary heart disease, and cancer (18–20). However, animal foods are also an important source of protein for the development of LM (21). A systematic review including 17 studies discover that plant based diet pattern was negatively associated with both FM and LM in middle aged and elderly population (22). In another cross-sectional study of 3,322 meat eaters and 1,186 vegetarians held in UK, compared with meat eaters, vegetarians of Indian British women had lower LM (23). No consistent results could be achieved whether adherence to a plant-based diet can improve children's body composition (lower FM and/or higher LM).

We explored the associations between plant-based diets and body composition, abdominal obesity, and handgrip strength in a cross-sectional study of Chinese omnivorous children aged 6–9 years old.

Materials and methods

Participants

This cross-sectional study was conducted in children 6–9 years of age in Guangzhou City, Guangdong Province, China. It was carried out from December 2015 to March 2017; the recruitment procedure has been previously described (24). Briefly, 521 of 1,600 children agreed to participate in the study. The participants were recruited through invitation letters, advertisements, and personal referrals. Among them, 69 children were excluded for the following reasons: preterm birth, a twin, a relevant medical condition (e.g., digestive tract disease, kidney stones or nephritis, thyrotoxicosis, hepatitis, anaphylactoid purpura, and metabolic bone disease), or core data were missing. A final sample of 452 singleton children (255 boys and 197 girls) was included in the analysis. The children voluntarily participated in the study and received a free general physical examination and a dual energy X-ray absorptiometry (DXA) scan, with permission from and accompanied by their parent or legal guardian. Before the examination, the study procedures and consent were explained to the guardian and child, and written consent was obtained from each guardian on behalf of the child participant. This cross-sectional study was carried out in accordance with the Declaration of Helsinki and was approved by the ethics committee of the School of Public Health at Sun Yat-sen University (no. 201549).

Dietary information

Through face-to-face interviews, dietary data for the prior year were obtained from each participant using a 79-item food frequency questionnaire (FFQ), which was the same as used in the Guangzhou Nutrition and Health Study (25). The FFQ used had been previously validated in our population (26). The FFQ consisted of 79 food items, grouped under subheadings like cereals (12 food items), soy and beans (8 items), vegetables (total: 13 items; leafy vegetable: 6 items; melon and fruit vegetable: 4 items; root vegetable: 3 items), fruits (10 items), meats (total: 17 items; livestock meat or visceral organ:

7 items; poultry meat: 3 items; fish: 4 items; other seafoods: 3 items), eggs (1 items), dairy products (8 items), Fungous and nuts (2 items), and beverage and drinks (8 items). The food items were organized on the basis of cultural use and physical composition. Colorful photographs of standard food portion sizes were used to help estimate the exact quantity of each food. The children reported their consumption frequencies (never; yearly; monthly; weekly; or daily) and the estimated average amount of each food item per time over the last 12 months with the help of their guardian/caregiver, then FFQs were filled out by the children in conjunction with their guardians/caregiver. We used the Chinese Food Composition (2009) (27) to calculate the mean daily intake of energy and other nutrients. To attenuate the influence of energy, the daily intakes of specific food groups were adjusted for energy using the residual method.

Hu et al. developed three plant-based diet indexes to assess the degree of adherence to a plant-based diet: the overall plant-based diet index (PDI), the healthful plant-based diet index (hPDI), and the unhealthful plant-based diet index (uPDI) (12). Eighteen food groups classified into three broad categories (healthy plant foods, unhealthy plant foods, and animal foods) are used to calculate the PDIs. Fruits, whole grains, vegetables, vegetable oils, legumes, nuts, and tea/coffee are defined as healthy plant foods. Refined grains, potatoes, fruit juices, sugar-sweetened beverages, and sweets/desserts are defined as unhealthy plant foods. Animal fats (including butter added to food and butter or lard used for cooking), dairy products, seafood/fish, eggs, meat (including red/processed meat and poultry), and miscellaneous animal-based foods are included in the animal food group. More detail information of the original description of these food groups could be found in the Appendix table of the article of Satija et al. (12). In our study, sweets/desserts, animal fats, and miscellaneous animal-based foods were not included in the FFQ and were therefore excluded; the remaining 15 food groups were included in the PDI score calculations. These 15 food groups were ranked in sex-specific quintiles and assigned a score ranging from 1 to 5. For the overall PDI, higher scores were given to the participants with higher intakes of plant food groups and lower intakes of animal food groups. For the hPDI, higher scores were given to those with higher intakes of healthy plant food groups, lower intakes of unhealthy plant food groups and animal food groups. For the uPDI, unhealthy plant food groups received positive scores, whereas healthy plant and animal food groups received reverse scores. The quintile scores of each food group were summed to obtain the final PDI scores (overall PDI, hPDI, or uPDI), which ranged from 15 to 75 in this study. A higher PDI score indicated stronger adherence to a specific plant-based diet. Examples of foods constituting the healthy plant food groups, unhealthy plant food groups, and animal food groups in this study were presented in Supplementary Table 1.

DXA scans and handgrip strength

Body mass index (BMI) is a simple measure that is widely used to evaluate a person's adiposity status. However, body composition analysis can better distinguish fat and lean mass and can be used to examine their distributions within the body, which provides a better evaluation of adiposity. A higher lean mass and a lower fat mass and fat mass percentage (FMP) indicates a healthier body composition and is associated with a lower risk of metabolic diseases (28).

A whole-body DXA scanner (Discovery W; Hologic Inc., Waltham, MA, U.S.A.) was used to assess the participants' body composition. Experienced technicians operated the scanner and processed the resulting data. For the scan, the participants were asked to wear light clothing and to not wear metal or other high-density objects. The participants held a standard lying posture during the scan with the help of a technician. The lean mass (LM) and fat mass (FM) at multiple sites (whole body, trunk, limbs, android area, and gynoid area) were analyzed, and the FMP was calculated as follows: FMP $=$ 100% $\times$ FM/LM. To assess measurement variation, we conducted two consecutive measurements with repositioning in 35 randomly selected children, and the coefficients of variation (CV) were 0.77–5.67% for the LM and FM across the multiple sites. Fat can accumulate in different subcutaneous area of the body, and two different obesity phenotypes were classified. Fat deposition in the android area known as central or abdominal obesity, while fat deposition in the gynoid area known as peripheral obesity. Compared with peripheral (gynoid) obesity, abdominal (android) obesity confers increases risk of metabolic complications (29). Evidence also showed fat distribution in the android area, rather than gynoid region may be important factor in determining the risk of cardiovascular disease in the National Health and Nutrition Examination Survey 2003–2006 of America (30). Therefore, we aimed to explore the associations of PDIs and abdominal obesity in this study. An age- and sex-specific abdominal FMP (in the android area) $\geq$85th percentile was defined as abdominal obesity as previously described (24).

A Jamar® Plus+ hand dynamometer (Sammons Preston, Bolingbrook, IL, U.S.A.) was used to measure the children's handgrip strength, and the data were accurate to 0.1 kg. The children performed the measurement twice with a short break in between using both hands in a standing posture; the highest handgrip strength was used for the analyses. Twenty-eight randomly selected children repeated the handgrip strength test after a 30 min interval. The CVs were 8.2% for the right hand and 9.5% for the left hand.

Potential covariates

The height and weight were measured with the children wearing light clothing and without shoes. The data were accurate

to 0.1 cm for height and to 0.1 kg for weight. Face-to-face interviews using a structured questionnaire were performed to collect information about potential covariates over the last year of investigation, including age (years), birth information (vaginal delivery or cesarean section), household income (≤150,00 or >150,00 Yuan/month), maternal (≤12 or >12 years) and paternal education (≤12 or >12 years), and the supplemental use of calcium (yea or not) or multivitamin tablets (yea or not). The participants' physical activity was assessed using a continuous 3-day (2 weekdays and 1 weekend day) record for the prior week, which investigated the daily physical activities that children were engaged in, and time expenditure of each items (accurate to 15 min) as previously described (24).

Statistical analysis

The PDI scores were calculated and divided into sex-specific tertiles, with higher tertiles representing stronger adherence to one of the three PDIs. The characteristics of the participants in the bottom and top PDI tertiles are presented. Continuous variables are presented as the mean ± standard deviation or median (interquartile range). Categorical variables are presented as frequencies (percentages). Linear regression analysis was performed to explore the associations between the PDIs (per 10-score increment) and the body composition at multiple sites and handgrip strength. Logistic regression analysis was used to identify associations between the PDIs (per 10 scores increment or comparison between tertiles) and abdominal obesity (abdominal FMP ≥85th percentile). Two adjustment models were carried out; Model 1 was a univariate model, and Model 2 was a multivariate model adjusted for age, sex, delivery method, height, weight, household income, maternal and paternal education, supplemental use of calcium or multivitamin tablets, physical activity, and dietary intake of energy. According to former and the researcher's experiences, the covariates were introduced into the analysis using the "Enter" model in order to control possible confounding. Sensitivity analysis stratified by sex was also performed. In order to compare body composition between top tertile groups of hPDI and uPDI, analyses of covariates (ACNOVA analysis) were carried out with the adjustment of covariates in Model 2. The statistical analyses were conducted using SPSS 21.0 (SPSS Inc., Chicago, IL, U.S.A.). Statistical significance was defined as a two-sided *P*-value of <0.05.

Results

A total of 452 children with a mean age of 8.0 ± 0.9 years were included in this study. The participants with higher overall PDI, hPDI, or uPDI scores had stronger adherence to an overall plant-based diet, healthful plant-based diet, or unhealthful plant-based diet, respectively. Detail characteristic information and dietary information of daily intake of different foods were displayed in Tables 1, 2, respectively. The children with a higher overall PDI score tended to weigh more and to have higher maternal education, higher consumption of healthy and unhealthy plant foods, lower household income, lower paternal education, less use of calcium supplements, and lower consumption of animal foods. The children with a higher hPDI score tended to weigh less and to have higher maternal and paternal education, more use of calcium supplements, higher intake of healthy plant foods, and lower household income. The children with a higher uPDI score tended to be born through cesarean section and to have lower household income, lower parental education, less use of calcium and multivitamin supplements, lower consumption of healthy plant foods and animal foods, and higher intake of unhealthy plant foods.

As shown in Table 3, after adjusting for potential covariates, no significant associations were found between the overall PDI score and body composition (FM, LM, or FMP). A higher (vs. lower) hPDI score was associated with higher LM and lower FMP, whereas a higher (vs. lower) uPDI score was associated with lower LM and higher FMP, especially for the android area composition. Each 10-score increment in the hPDI score was associated with increment LMs in the areas of android area (0.038-kg, 3.2% of the mean), trunk area (0.102-kg, 1.2% of the mean), and the gynoid are (0.048-kg, 1.9% of the mean). Besides, each 10-score increment in the hPDI score was associated with a 1.18% (4.9% of the mean) decrease in the android area FMP. In contrast, each 10-score increment in the uPDI score was associated with a 0.023-kg (1.9% of the mean) decrease in the android area LM, a 0.091-kg (1.1% of the mean) decrease in the trunk area LM, and a 0.74% (3.0% of the mean) increment in the android area FMP. After stratification by sex, for girls, a higher hPDI score was associated with an increased android and gynoid area LM and a decreased android area FMP. In girls, an increased uPDI score was associated with a decreased gynoid area LM (Supplementary Table 2). In boys, a higher hPDI score was associated with an increased android and trunk area LM and with a decreased android and gynoid area FMP. A higher uPDI score in boys was associated with a decreased android and trunk area LM and an increased android area FMP (Supplementary Table 2).

We further compared body composition between top tertile groups of hPDI and uPDI scores. As shown in Table 4, compared with subjects in top uPDI tertiles, those with top hPDI tertiles scores tended to be with lower FMP at sites of whole body (0.99%), trunk (1.15%), android area (1.38%), and gynoid area (1.38%); and be with higher LM at sites of trunk (0.23 kg) and android area (0.05 kg).

We further explored the relationships between the plant-based diet indexes and abdominal obesity in children (Table 5). Although the children with a higher hPDI score (higher tertile or per 10-score increment in the hPDI score) tended to exhibit less

TABLE 1 Characteristic of subjects included in the study.

		PDI		hPDI		uPDI	
		T1	*T3*	*T1*	*T3*	*T1*	*T3*
Subjects, *N*		147	149	159	150	146	157
Mean scores		38.9 ± 3.23	51.6 ± 3.26	39.8 ± 2.62	51.0 ± 2.41	38.2 ± 2.57	51.1 ± 3.18
Age, years		7.94 ± 0.96	8.14 ± 0.85	8.04 ± 0.94	8.02 ± 0.95	7.93 ± 0.95	8.02 ± 0.98
Height, cm		128 ± 8.26	130 ± 7.63	129 ± 7.61	129 ± 8.39	128 ± 8.39	129 ± 8.27
Weight, kg		26.1 ± 6.60	26.9 ± 6.88	26.4 ± 6.62	25.7 ± 6.65	26.6 ± 7.52	26.7 ± 7.18
Physical activity, Met × h/d		39.8 ± 4.38	40.0 ± 4.14	40.0 ± 4.40	40.2 ± 4.43	40.2 ± 3.89	39.6 ± 4.30
Sex	Girls	63 (42.9)	68 (45.6)	68 (42.8)	66 (44.0)	63 (43.2)	70 (44.6)
	Boys	84 (57.1)	81 (54.4)	91 (57.2)	84 (56.0)	83 (56.8)	87 (55.4)
Delivery way, *N (%)*	Natural	74 (50.3)	77 (51.7)	79 (49.7)	73 (48.7)	71 (48.6)	85 (54.1)
	Cesarean	73 (49.7)	72 (48.3)	80 (50.3)	77 (51.3)	75 (51.4)	72 (45.9)
Household income, Yuan × month^{-1}, *N* (%)	≤150,00	66 (44.9)	75 (50.3)	73 (45.9)	75 (50.0)	68 (46.6)	79 (50.3)
	>150,00	81 (55.1)	74 (49.7)	86 (54.1)	75 (50.0)	78 (53.4)	78 (49.7)
Maternal education, *N* (%)	≤12 years	58 (39.5)	56 (37.6)	62 (39.0)	54 (36.0)	50 (34.2)	69 (43.9)
	>12 years	89 (60.5)	93 (62.4)	97 (61.0)	96 (64.0)	96 (65.8)	88 (56.1)
Paternal education	≤12 years	55 (37.4)	66 (44.3)	64 (40.3)	55 (36.7)	45 (30.8)	74 (47.1)
	>12 years	92 (62.6)	83 (55.7)	95 (59.7)	95 (63.3)	101 (69.2)	83 (52.9)
Use of calcium supplements, *N* (%)	No	82 (55.8)	95 (63.8)	99 (62.3)	86 (57.3)	83 (56.8)	100 (63.7)
	Yes	65 (44.2)	54 (36.2)	60 (37.7)	64 (42.7)	63 (43.2)	57 (36.3)
Use of multi-vitamin supplements, *N* (%)	No	123 (83.7)	124 (83.2)	130 (81.8)	121 (80.7)	118 (80.8)	135 (86.0)
	Yes	24 (16.3)	25 (16.8)	29 (18.2)	29 (19.3)	28 (19.2)	22 (14.0)

Continuous variables were presented as Mean ± standard deviation; Categorical variables were presented as frequency (percentage). a, adjusted for energy using residual methods.

abdominal obesity, and those with higher PDI and uPDI scores tended to exhibit more abdominal obesity, these associations did not reach statistical significance (*P*-values of 0.105 to 0.637). After stratifying by sex (Supplementary Table 3), in girls, there was a significant negative association between the highest hPDI scores and lower abdominal obesity (OR = 0.02, 95% CI: 0001, 0.48).

Associations between the plant-based diet indexes and handgrip strength were also investigated. For the total participant sample and for girls, there were no significant associations between handgrip strength and any of the three plant-based diet indexes (PDI, hPDI, and uPDI). After adjusting for potential covariates, a higher (vs. lower) hPDI score was positively associated with increased handgrip strength in boys (Table 6); every 10-score increment in the hPDI score was associated with a 0.61-kg (6.0% of the mean) increment in handgrip strength (mean: 10.1 kg).

Discussion

In this cross-sectional study, based on data of Chinese omnivorous children aged 6–9 years old, stronger adherence to a healthy plant-based diet (i.e., a higher hPDI score vs. lower hPDI score) was associated with a higher LM and a lower FMP in several body areas, particularly the android area. In contrast, greater consumption of an unhealthy plant-based diet (i.e., a higher uPDI score vs. lower uPDI score) was associated with less LM in the trunk and android areas and a higher FMP in the android area. After stratification by sex, higher (vs. lower) hPDI scores were associated with lower abdominal obesity risk in girls and higher handgrip strength in boys.

Stronger adherence to a healthy plant-based diet associated with better body composition in Chinese omnivorous children aged 6–9 years old in our study. Few related studies have been conducted in children. In a cross-sectional study of Polish children aged 5–10 years old, a vegan (but not vegetarian) diet was associated with a lower BMI and fat mass index compared with an omnivore diet (17). In two other cross-sectional studies performed in Poland, a vegetarian diet was associated with a lower FMP (19.1% vs. 21.2%, $p = 0.050$) and fat mass index (2.67 kg/m^2 vs. 2.99 kg/m^2, $p = 0.044$) in prepubertal children (15) and with a lower fat mass-to-lean mass ratio in children (16). More studies have been carried out in adults; however, firm conclusions cannot be made. In the Rotterdam Study (prospective, 7.1 years follow-up), which included 9,633 middle-aged and older adult participants, a higher PDI was associated with a lower BMI, FM, and FMP (6). A higher hPDI score (per 10-score increment) was associated with a 0.12% decrease in FMP in a cross-sectional study of

TABLE 2 Dietary information of intake of different foods in our study.

	PDI		hPDI		uPDI	
	T1	*T3*	*T1*	*T3*	*T1*	*T3*
Subjects, *N*	147	149	159	150	146	157
Total energy intake, kcal/d	1,450 ± 419	1,440 ± 425	1,441 ± 423	1,390 ± 443	1,411 ± 430	1,441 ± 454
Healthy plant foods						
Whole grains, g/d	0.0 (0.0, 2.0)	1.5 (0.0, 5.2)	0.0 (0.0, 1.6)	1.9 (0.0, 5.5)	1.7 (0.0, 5.3)	0.0 (0.0, 1.9)
Fruits, g/d	102 (68, 170)	142 (99, 220)	88 (58, 138)	162 (113, 219)	151 (111, 216)	87 (58, 143)
Vegetables, g/d	140 (99, 209)	186 (134, 241)	149 (111, 190)	202 (133, 254)	209 (159, 266)	143 (108, 188)
Nuts, g/d	2.9 (0.8, 7.7)	5.4 (2.6, 12)	2.6 (0.9, 5.3)	7.9 (3.3, 15)	6.3 (2.6, 15)	2.5 (0.9, 5.8)
Legumes, g/d	4.2 (2.0, 7.3)	9.4 (5.3, 16)	4.6 (2.1, 7.5)	9.7 (5.7, 17)	7.4 (3.7, 13.3)	4.9 (2.2, 9.2)
Vegetable oils, g/d	16 (10, 26)	21 (15, 33)	17 (10, 28)	20 (15, 32)	20 (11, 33)	20 (10, 25)
Tea and coffee, g/d	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)
Unhealthy plant foods						
Fruits juices, g/d	2.4 (0.0, 11)	16 (7.6, 29)	14 (5.4, 31)	4.1 (0.0, 15)	5.0 (0.0, 15)	15 (4.2, 36)
Refined grains, g/d	146 (118, 166)	164 (133, 186)	161 (140, 185)	147 (125, 174)	130 (112, 147)	179 (158, 201)
Potatoes, g/d	8.5 (4.2, 13.8)	18 (12, 30)	14 (7.6, 26)	12 (6.8, 22)	14 (7.8, 23)	15 (7.6, 26)
Sugar-sweetened beverages, g/d	3.0 (0.0, 12)	14 (3.5, 26)	14 (5.3, 33)	1.3 (0.0, 7.5)	1.2 (0.0, 6.4)	14 (3.2, 31)
Animal foods						
Dairy, g/d	259 (168, 367)	151 (104, 227)	228 (159, 318)	169 (113, 271)	239 (157, 357)	174 (114, 275)
Eggs, g/d	34 (21, 47)	23 (12, 35)	32 (19, 45)	26 (14, 40)	36 (25, 50)	23 (15, 32)
Fish or seafood, g/d	25 (13, 46)	20 (8.8, 32)	28 (13, 44)	17 (9.4, 31)	28 (15, 48)	15 (6.8, 26)
Meat, g/d	124 (93, 156)	86 (60, 110)	113 (80, 150)	96 (70, 125)	120 (87, 153)	90 (60, 125)

260 healthy U.S. women (5). A systematic review showed that a plant-based diet tended to be negatively associated with both FM and LM, but the results were inconclusive (22). In contrast to our study, previous studies have tended to find negative (22, 23, 31) or null associations (7, 32–35) between LM and a plant-based diet in adults and children (15–17). Possible reasons for these conflicting results are that the previous studies (1) had relatively small sample sizes, (2) did not adjust for covariates, (3) measured whole body composition rather than the composition at specific sites in the body, and (4) different measurements of diet. Additionally, the participants in our study were not strictly vegan; thus, we were unable to observe any potential negative association between a vegan diet and FM and any potential negative associations between a vegan diet and LM. We also distinguished between healthy and unhealthy food groups in our study, which was not done in the above-mentioned studies. This partitioning might have increased our ability to identify different direction of associations for the hPDI and uPDI. The need to distinguish between healthy and unhealthy plant foods has been indicated in previous studies in relation to multiple diseases (13, 36, 37). Taken together, the evidence indicates that a healthy plant-based diet, rather than an unhealthy plant-based diet, might be associated with better LM. Nevertheless, additional high-quality studies are needed to further explore this issue.

In our study, associations with higher significance for the android area were identified, and these results are supported by several previous studies. In a 14-week low-fat plant-based diet intervention in overweight postmenopausal women, the diet was associated with a smaller waist circumference but not associated with LM or FMP (34). In another study, a low-fat vegan diet intervention led to decreases in visceral fat volume (38). Compared with vegetarians, omnivores were found to have 50% greater tumor necrosis factor mRNA expression in abdominal fat, which increases adipose tissue inflammation (39). In our study, a negative association was found between a healthy plant-based diet and abdominal obesity in girls. Together, these findings emphasize the potential associations of a plant-based diet for lowering risk of abdominal obesity and the necessity for future studies to explore the detailed distribution of body composition.

Stronger hPDI adherence was associated with greater handgrip strength in boys. This result is supported by a systematic review that found that a plant-based diet was positively associated with muscle strength in middle-aged and older adults (22). Compared with an omnivore diet, a vegan diet was associated with better activity performance (higher estimated maximal oxygen consumption and submaximal endurance time to exhaustion) in physically active lean women in Canada (32). Conversely, in British Indians, those adhering

TABLE 3 Associations of plant-based diet index scores with body composition after adjusted for potential covariates.

Body composition	Per 10-score increment of plant-based diet index								
	PDI			hPDI			uPDI		
	β	*se*	*p*	*β*	*se*	*p*	*β*	*se*	*p*
Whole body									
FM, kg	−0.100	0.086	0.244	−0.155	0.097	0.113	0.052	0.087	0.551
LM, kg	0.098	0.084	0.246	0.155	0.095	0.103	−0.125	0.085	0.140
FMP, %	−0.408	0.309	0.188	−0.683	0.349	0.051	0.378	0.311	0.226
Trunk									
FM, kg	−0.009	0.043	0.830	−0.046	0.048	0.343	0.024	0.043	0.570
LM, kg	0.036	0.043	0.399	0.102	0.048	**0.035**	−0.091	0.043	**0.035**
FMP, %	−0.251	0.328	0.444	−0.672	0.370	0.070	0.495	0.330	0.134
Limbs									
FM, kg	−0.091	0.052	0.081	−0.102	0.059	0.085	0.024	0.053	0.654
LM, kg	0.064	0.049	0.185	0.076	0.055	0.171	−0.040	0.049	0.415
FMP, %	−0.670	0.424	0.115	−0.886	0.480	0.066	0.375	0.429	0.382
Android area									
FM, kg	−0.003	0.008	0.676	−0.007	0.009	0.446	0.005	0.008	0.545
LM, kg	0.007	0.010	0.436	0.038	0.011	**<0.001**	−0.023	0.010	**0.016**
FMP, %	−0.440	0.345	0.203	−1.183	0.388	**0.002**	0.742	0.347	**0.033**
Gynoid area									
FM, kg	−0.018	0.017	0.289	−0.018	0.019	0.364	0.016	0.017	0.343
LM, kg	0.019	0.019	0.317	0.048	0.021	**0.024**	−0.034	0.019	0.075
FMP, %	−0.590	0.382	0.123	−0.827	0.432	0.056	0.628	0.385	0.103

FM, fat mass; LM, lean mass; FMP, fat mass percentage.

Linear regression analysis, adjusted for covariates including: age, sex, height, weight, delivery way, household income, parental education, physical activity, use of calcium and multi-vitamin supplements, dietary intake of energy. The bold values indicates the statistical significance ($p < 0.05$).

to a vegetarian diet had lower handgrip strength than those adhering to an omnivore diet (23). Thus, firm conclusions cannot be made, and the effects of a healthy plant-based diet on handgrip strength require further investigation.

Subjects with higher hPDI scores tended to be with better maternal and paternal education, and follow a healthier lifestyle, like more physical activity, more use of calcium supplements. These factors might partly help to explain the positive associations of hPDI and LM and negative associations of hPDI and FMP. Although we tried to control these covariates in our analyses, the possible influence of these factors might could not be totally eliminated and still existed. Besides, several biological mechanisms might be involved for further explanations of the associations between hPDI and body composition. In children, a vegetarian diet was related to a higher ratio of anti-inflammatory to pro-inflammatory adipokines (15). Stronger hPDI adherence was associated with lower leptin levels, whereas weaker adherence was associated with high levels of high-sensitivity C reactive protein (40). A low-fat vegan diet intervention led to lower intramyocellular and hepatocellular lipid levels and improved insulin resistance (38). Transitioning to a vegan diet supplemented with fish lowered the plasma levels of branched-chain amino acids, which contribute to obesity and insulin resistance (41). Finally, a plant-based diet might be related to improved gut microbiota symbiosis and increased beneficial metabolites (e.g., short-chain fatty acids and trimethylamine N-oxide) (42).

Few studies have investigated the associations between a plant-based diet and body composition in children. A strength of our study was that we distinguished between different plant-based diet patterns (an overall, healthy, and unhealthy plant-based diet). The findings reveal that choosing healthy plant foods and avoiding unhealthy plant foods were associated with better body composition in Chinese omnivore children aged 6–9 years old. The use of gold-standard body composition measurement at multiple sites, along with measuring abdominal obesity and handgrip strength, provided comprehensive outcome information, enabling us to better understand the potential relationships between body composition and a plant-based diet. Finally, we controlled for several potential covariates in the analyses to avoid potential confounding. However, our study had several limitations. First, owing to the cross-sectional study

TABLE 4 Comparison of body composition between top tertile groups of hPDI and uPDI scores.

Body composition	Top tertile of hPDI ($N = 134$)		Top tertile of uPDI ($N = 142$)		Difference[a]	*P*-value of difference
	Mean	*Se*	*Mean*	*Se*		
Whole body						
FM, kg	7.427	0.105	7.555	0.102	−0.128	0.388
LM, kg	19.036	0.153	18.652	0.149	0.384	0.076
FMP, %	26.901	0.301	27.890	0.292	**−0.989**	**0.021**
Trunk						
FM, kg	2.795	0.054	2.855	0.052	−0.060	0.434
LM, kg	8.432	0.076	8.204	0.074	**0.228**	**0.034**
FMP, %	23.503	0.330	24.651	0.320	**−1.148**	**0.014**
Limbs						
FM, kg	3.809	0.059	3.878	0.057	−0.070	0.183
LM, kg	7.844	0.077	7.698	0.075	0.146	0.401
FMP, %	31.222	0.419	32.356	0.407	−1.134	0.056
Android area						
FM, kg	0.413	0.009	0.419	0.009	−0.005	0.696
LM, kg	1.218	0.014	1.167	0.013	**0.050**	**0.010**
FMP, %	23.509	0.342	24.886	0.332	**−1.377**	**0.005**
Gynoid area						
FM, kg	1.275	0.020	1.300	0.019	−0.025	0.369
LM, kg	2.563	0.029	2.486	0.029	0.077	0.065
FMP, %	32.155	0.381	33.537	0.370	**−1.381**	**0.011**

FM, fat mass; LM, lean mass; FMP, fat mass percentage.
ANCOVA analyses, adjusted for covariates including: age, sex, height, weight, delivery way, household income, parental education, physical activity, use of calcium and multi-vitamin supplements, dietary intake of energy.
[a]Difference = Mean $_{\text{(Top tertile of hPDI)}}$ − Mean $_{\text{(Top tertile of uPDI)}}$. The bold values indicates the statistical significance ($p < 0.05$).

TABLE 5 Associations of plant-based diet index scores with abdominal obesity.

Abdominal obesity	Plant-based diet index									
	T1	*T2*			*T3*			*Per 10 increment*		
	Reference	*OR*	*95%CI*	*p*	*OR*	*95%CI*	*p*	*OR*	*95%CI*	*p*
PDI										
Model 1	1.00	1.16	(0.65, 2.09)	0.616	1.23	(0.68, 2.21)	0.490	1.12	(0.75, 1.68)	0.589
Model 2	1.00	0.84	(0.34, 2.05)	0.693	1.24	(0.51, 2.97)	0.637	1.27	(0.68, 2.37)	0.457
hPDI										
Model 1	1.00	1.34	(0.77, 2.33)	0.298	0.70	(0.38, 1.29)	0.251	0.76	(0.48, 1.21)	0.244
Model 2	1.00	0.97	(0.42, 2.22)	0.941	0.75	(0.30, 1.91)	0.548	0.70	(0.34, 1.43)	0.326
uPDI										
Model 1	1.00	0.93	(0.50, 1.72)	0.815	1.44	(0.82, 2.54)	0.209	1.17	(0.78, 1.75)	0.441
Model 2	1.00	1.80	(0.68, 4.77)	0.238	2.12	(0.86, 5.26)	0.105	1.52	(0.82, 2.84)	0.185

Logistic regression analysis, with Model 1 as univariate analysis without adjustment; and Model 2 adjusted for covariates including: age, sex, height, weight, delivery way, household income, parental education, physical activity, use of calcium and multi-vitamin supplements, dietary intake of energy.

design, we were able to identify associations but could not attribute causality. Second, few of the children in the healthy plant food group consumed tea/coffee, and sweets/desserts, animal fats, and miscellaneous animal-based foods in the unhealthy plant food group were excluded because they were not covered by our FFQ. These factors might have attenuated

TABLE 6 Associations of plant-based diet index scores with handgrip strength.

Handgrip strength, kg	Per 10-score increment of plant-based diet index								
	PDI			hPDI			uPDI		
	β	***se***	***p***	*β*	***se***	***p***	*β*	***se***	***p***
Total (*N* = 452)									
Model 1	0.34	0.23	0.143	0.16	0.26	0.540	−0.13	0.23	0.584
Model 2	0.08	0.16	0.627	0.18	0.18	0.310	−0.11	0.16	0.482
Girls (*N* = 197)									
Model 1	0.01	0.30	0.751	−0.06	0.31	0.843	−0.06	0.31	0.843
Model 2	−0.14	0.22	0.522	−0.14	0.23	0.538	−0.15	0.23	0.507
Boys (*N* = 255)									
Model 1	0.53	0.33	0.107	0.45	0.41	0.274	0.45	0.41	0.274
Model 2	0.25	0.22	0.260	0.61	0.27	**0.024**	−0.12	0.22	0.595

Logistic regression analysis, with Model 1 as univariate analysis without adjustment; Model 2 adjusted for covariates including: age, sex, height, weight, delivery way, household income, parental education, physical activity, use of calcium and multi-vitamin supplements, dietary intake of energy. The bold values indicates the statistical significance ($p < 0.05$).

our ability to identify significant associations for the hPDI and uPDI. Although the associations might be underestimated, we did find statistical associations between the hPDI or uPDI score and body composition. Third, the abdominal obesity defined by an abdominal FMP ≥85th percentiles of the population in our study is sample based. Not standard reference data of abdominal obesity based on abdominal FMP data from representative sample could be found in Chinese children yet. Further studies with more representative and large sample size using standard reference of abdominal FMP data were encouraged for further examination of our results. Finally, considering our results were based on a specific population and with a small sample size, it is unclear yet if these results would translate to other age groups during adolescents or other races, ethnicities, or countries. Therefore, our finding should be interpreted with caution. Further prospective studies with larger sample sizes should be conducted to verify our results.

Conclusion

In this cross-sectional study, stronger adherence to a healthy plant-based diet tended to be associated with a higher LM and a lower FMP in Chinese omnivorous children aged 6–9 years old, and it associated with lower risk of abdominal obesity in girls and higher handgrip strength in boys. In contrast, an unhealthy plant-based diet (higher uPDI score vs. lower uPDI score) was associated with a lower LM and a higher FMP, especially in the android area. These results highlight the need to distinguish between healthy and unhealthy plant foods to maintain a healthy body composition in young children. More prospective studies with larger sample sizes based on different populations were encouraged to be conducted to verify our results in the future.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Ethics Committee of the School of Public Health at Sun Yat-sen University (no. 201549). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

GC and MS analyzed the data and wrote the paper. XC, YW, SC, and YZ were parts of the data collection team. ZL and ZZ revised the manuscript. ZZ designed the project, supervised the study, and revised the manuscript. All authors contributed to the article and approved the submitted version.

Funding

This work was supported by National Natural Science Foundation of China (No. 81502798, ZZ), Natural Science Foundation of Guangdong Province, China (No. 2015A030310399, ZZ), the Maternal and Children

Nutrition and Care Fund of Biostime (No. BINCMYF15006, ZZ), and National Natural Science Foundation of China (No. 82103855, GC), Basic and Applied Basic Research Foundation of Guangdong Province (No. 2019A1515110163, GC), and the Foundation of Bureau of Science and Technology of Foshan City (No. 2220001004104, GC). The funding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

Acknowledgments

The authors would like to thank all research members involved in the data collection of the study.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fnut.2022.918944/full#supplementary-material

References

1. Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet.* (2014) 384:766–81. doi: 10.1016/S0140-6736(14)60460-8

2. Afshin A, Forouzanfar MH, Reitsma MB, Sur P, Estep K, Lee A, et al. Health effects of overweight and obesity in 195 countries over 25 years. *N Engl J Med.* (2017) 377:13–27. doi: 10.1056/NEJMoa1614362

3. Kelsey MM, Zaepfel A, Bjornstad P, Nadeau KJ. Age-related consequences of childhood obesity. *Gerontology.* (2014) 60:222–8. doi: 10.1159/000356023

4. Dangardt F, Charakida M, Georgiopoulos G, Chiesa ST, Rapala A, Wade KH, et al. Association between fat mass through adolescence and arterial stiffness: a population-based study from The Avon Longitudinal Study of Parents and Children. *Lancet Child Adolesc Health.* (2019) 3:474–81. doi: 10.1016/S2352-4642(19)30105-1

5. Zagarins SE, Ronnenberg AG, Bertone-Johnson ER. Established diet quality indices are not universally associated with body composition in young adult women. *Public Health Nutr.* (2021) 24:2465–72. doi: 10.1017/S1368980021001440

6. Chen Z, Schoufour JD, Rivadeneira F, Lamballais S, Ikram MA, Franco OH, et al. Plant-based diet and adiposity over time in a middle-aged and elderly population: the Rotterdam study. *Epidemiology.* (2019) 30:303–10. doi: 10.1097/EDE.0000000000000961

7. Jakše B, Pinter S, Jakše B, Bučar Pajek M, Pajek J. Effects of an *ad libitum* consumed low-fat plant-based diet supplemented with plant-based meal replacements on body composition indices. *Biomed Res Int.* (2017) 2017:9626390. doi: 10.1155/2017/9626390

8. Tian HY, Qiu R, Jing LP, Chen ZY, Chen GD, Chen YM. Alternate Mediterranean diet score is positively associated with skeletal muscle mass index in middle-aged adults. *Br J Nutr.* (2017) 117:1181–8. doi: 10.1017/S0007114517001118

9. Soltani S, Shirani F, Chitsazi MJ, Salehi-Abargouei A. The effect of dietary approaches to stop hypertension (DASH) diet on weight and body composition in adults: a systematic review and meta-analysis of randomized controlled clinical trials. *Obes Rev.* (2016) 17:442–54. doi: 10.1111/obr.12391

10. Rippe JM, Angelopoulos TJ. Sugars, obesity, and cardiovascular disease: results from recent randomized control trials. *Eur J Nutr.* (2016) 55(Suppl. 2):45–53. doi: 10.1007/s00394-016-1257-2

11. Sievenpiper JL. Low-carbohydrate diets and cardiometabolic health: the importance of carbohydrate quality over quantity. *Nutr Rev.* (2020) 78(Suppl. 1):69–77. doi: 10.1093/nutrit/nuz082

12. Satija A, Bhupathiraju SN, Rimm EB, Spiegelman D, Chiuve SE, Borgi L, et al. Plant-based dietary patterns and incidence of type 2 diabetes in us men and women: results from three prospective cohort studies. *PLoS Med.* (2016) 13:e1002039. doi: 10.1371/journal.pmed.1002039

13. Satija A, Bhupathiraju SN, Spiegelman D, Chiuve SE, Manson JE, Willett W, et al. Healthful and unhealthful plant-based diets and the risk of coronary heart disease in U.S. Adults. *J Am Coll Cardiol.* (2017) 70:411–22. doi: 10.1016/j.jacc.2017.05.047

14. Kim H, Lee K, Rebholz CM, Kim J. Plant-based diets and incident metabolic syndrome: results from a South Korean prospective cohort study. *PLoS Med.* (2020) 17:e1003371. doi: 10.1371/journal.pmed.1003371

15. Ambroszkiewicz J, Chełchowska M, Rowicka G, Klemarczyk W, Strucińska M, Gajewska J. Anti-Inflammatory and pro-inflammatory adipokine profiles in children on vegetarian and omnivorous diets. *Nutrients.* (2018) 10:1241. doi: 10.3390/nu10091241

16. Ambroszkiewicz J, Chełchowska M, Szamotulska K, Rowicka G, Klemarczyk W, Strucińska M, et al. Bone status and adipokine levels in children on vegetarian and omnivorous diets. *Clin Nutr.* (2019) 38:730–7. doi: 10.1016/j.clnu.2018.03.010

17. Desmond MA, Sobiecki JG, Jaworski M, Płudowski P, Antoniewicz J, Shirley MK, et al. Growth, body composition, and cardiovascular and nutritional risk of 5- to 10-y-old children consuming vegetarian, vegan, or omnivore diets. *Am J Clin Nutr.* (2021) 113:1565–77. doi: 10.1093/ajcn/nqaa445

18. Huang Y, Cao D, Chen Z, Chen B, Li J, Guo J, et al. Red and processed meat consumption and cancer outcomes: umbrella review. *Food Chem.* (2021) 356:129697. doi: 10.1016/j.foodchem.2021.129697

19. Miao P, Guan L. Association of dietary cholesterol intake with risk of gastric cancer: a systematic review and meta-analysis of observational studies. *Front Nutr.* (2021) 8:722450. doi: 10.3389/fnut.2021.722450

20. Willett WC. Dietary fats and coronary heart disease. *J Intern Med.* (2012) 272:13–24. doi: 10.1111/j.1365-2796.2012.02553.x

21. Li CY, Fang AP, Ma WJ, Wu SL, Li CL, Chen YM, et al. Amount rather than animal vs plant protein intake is associated with skeletal muscle mass in community-dwelling middle-aged and older chinese adults: results from the

Guangzhou nutrition and health study. *J Acad Nutr Diet.* (2019) 119:1501–10. doi: 10.1016/j.jand.2019.03.010

22. Chan H, Ribeiro RV, Haden S, Hirani V. Plant-based dietary patterns, body composition, muscle strength and function in middle and older age: a systematic review. *J Nutr Health Aging.* (2021) 25:1012–22. doi: 10.1007/s12603-021-1666-7

23. Tong TY, Key TJ, Sobiecki JG, Bradbury KE. Anthropometric and physiologic characteristics in white and British Indian vegetarians and nonvegetarians in the UK Biobank. *Am J Clin Nutr.* (2018) 107:909–20. doi: 10.1093/ajcn/nqy042

24. Chen G, Yan H, Hao Y, Shrestha S, Wang J, Li Y, et al. Comparison of various anthropometric indices in predicting abdominal obesity in Chinese children: a cross-sectional study. *BMC Pediatr.* (2019) 19:127. doi: 10.1186/s12887-019-1501-z

25. Jiang Z, Sun TY, He Y, Gou W, Zuo LS, Fu Y, et al. Dietary fruit and vegetable intake, gut microbiota, and type 2 diabetes: results from two large human cohort studies. *BMC Med.* (2020) 18:371. doi: 10.1186/s12916-020-01842-0

26. Chen G, Li Y, Liang S, Xiao J, Duan X, Zhou Y, et al. Associations of dietary anthocyanidins intake with body composition in Chinese children: a cross-sectional study. *Food Nutr Res.* (2021) 65:4428. doi: 10.29219/fnr.v65.4428

27. Yang YX, Wang GY, Pan XW. *China Food Composition Table*. Beijing: Peking University Medical Press (2009).

28. Pi-Sunyer X. Changes in body composition and metabolic disease risk. *Eur J Clin Nutr.* (2019) 73:231–5. doi: 10.1038/s41430-018-0320-x

29. Guglielmi V, Sbraccia P. Obesity phenotypes: depot-differences in adipose tissue and their clinical implications. *Eat Weight Disord.* (2018) 23:3–14. doi: 10.1007/s40519-017-0467-9

30. Min KB, Min JY. Android and gynoid fat percentages and serum lipid levels in United States adults. *Clin Endocrinol.* (2015) 82:377–87. doi: 10.1111/cen.12505

31. Vanacore D, Messina G, Lama S, Bitti G, Ambrosio P, Tenore G, et al. Effect of restriction vegan diet's on muscle mass, oxidative status, and myocytes differentiation: a pilot study. *J Cell Physiol.* (2018) 233:9345–53. doi: 10.1002/jcp.26427

32. Boutros GH, Landry-Duval MA, Garzon M, Karelis AD. Is a vegan diet detrimental to endurance and muscle strength? *Eur J Clin Nutr.* (2020) 74:1550–5. doi: 10.1038/s41430-020-0639-y

33. Siani V, Mohamed EI, Maiolo C, Di Daniele N, Ratiu A, Leonardi A, et al. Body composition analysis for healthy Italian vegetarians. *Acta Diabetol.* (2003) 40(Suppl. 1):S297–8. doi: 10.1007/s00592-003-0091-1

34. Barnard ND, Scialli AR, Turner-McGrievy G, Lanou AJ, Glass J. The effects of a low-fat, plant-based dietary intervention on body weight, metabolism, and insulin sensitivity. *Am J Med.* (2005) 118:991–7. doi: 10.1016/j.amjmed.2005.03.039

35. Ho-Pham LT, Nguyen PL, Le TT, Doan TA, Tran NT, Le TA, et al. Veganism, bone mineral density, and body composition: a study in Buddhist nuns. *Osteoporos Int.* (2009) 20:2087–93. doi: 10.1007/s00198-009-0916-z

36. Heianza Y, Zhou T, Sun D, Hu FB, Qi L. Healthful plant-based dietary patterns, genetic risk of obesity, and cardiovascular risk in the UK biobank study. *Clin Nutr.* (2021) 40:4694–701. doi: 10.1016/j.clnu.2021.06.018

37. Song S, Lee K, Park S, Shin N, Kim H, Kim J. Association between unhealthful plant-based diets and possible risk of dyslipidemia. *Nutrients.* (2021) 13:4334. doi: 10.3390/nu13124334

38. Kahleova H, Petersen KF, Shulman GI, Alwarith J, Rembert E, Tura A, et al. Effect of a low-fat vegan diet on body weight, insulin sensitivity, postprandial metabolism, and intramyocellular and hepatocellular lipid levels in overweight adults: a randomized clinical trial. *JAMA Netw Open.* (2020) 3:e2025454. doi: 10.1001/jamanetworkopen.2020.25454

39. Morgan-Bathke ME, Jensen MD. Preliminary evidence for reduced adipose tissue inflammation in vegetarians compared with omnivores. *Nutr J.* (2019) 18:45. doi: 10.1186/s12937-019-0470-2

40. Baden MY, Satija A, Hu FB, Huang T. Change in plant-based diet quality is associated with changes in plasma adiposity-associated biomarker concentrations in women. *J Nutr.* (2019) 149:676–86. doi: 10.1093/jn/nxy301

41. Elshorbagy A, Jernerén F, Basta M, Basta C, Turner C, Khaled M, et al. Amino acid changes during transition to a vegan diet supplemented with fish in healthy humans. *Eur J Nutr.* (2017) 56:1953–62. doi: 10.1007/s00394-016-1237-6

42. Najjar RS, Feresin RG. Plant-based diets in the reduction of body fat: physiological effects and biochemical insights. *Nutrients.* (2019) 11:2712. doi: 10.3390/nu11112712

frontiers | Frontiers in Nutrition

TYPE Original Research
PUBLISHED 02 September 2022
DOI 10.3389/fnut.2022.958248

OPEN ACCESS

EDITED BY
Jared Piazza,
Lancaster University, United Kingdom

REVIEWED BY
Christoph Klebl,
The University of Melbourne, Australia
Jeanine Ammann,
Agroscope, Switzerland

*CORRESPONDENCE
Elisa Becker
e.becker@exeter.ac.uk

SPECIALTY SECTION
This article was submitted to Nutrition and Sustainable Diets, a section of the journal Frontiers in Nutrition

RECEIVED 31 May 2022
ACCEPTED 15 August 2022
PUBLISHED 02 September 2022

CITATION
Becker E, Kozmér S, Aulbach MB and Lawrence NS (2022) The relationship between meat disgust and meat avoidance—A chicken-and-egg problem. *Front. Nutr.* 9:958248. doi: 10.3389/fnut.2022.958248

The relationship between meat disgust and meat avoidance—A chicken-and-egg problem

Elisa Becker[1]*, Stella Kozmér[1], Matthias B. Aulbach[2,3] and Natalia S. Lawrence[1]

[1]Psychology Department, University of Exeter, Exeter, United Kingdom, [2]Centre for Cognitive Neuroscience, Department of Psychology, University of Salzburg, Salzburg, Austria, [3]School of Science, Aalto University, Espoo, Finland

Feelings of disgust toward meat have been researched for at least 30 years, but so far the causal relationship that may link meat disgust and meat consumption has remained elusive. Two possible pathways have been proposed in previous literature: the more common pathway seems to be that meat disgust is developed after a transition to vegetarianism, potentially *via* the process of moralization and recruitment of (moral) disgust. Other accounts suggest the existence of a second pathway in which disgust initiates the avoidance of meat and this can be explained by existing theories of disgust functioning as a pathogen avoidance mechanism and meat serving as a pathogen cue. However, the evidence base for either relationship remains thin and to our knowledge no research has examined whether temporary meat abstention can lead to increases in meat disgust, as the first pathway suggests. We measured meat disgust and meat intake in $n = 40$ meat eaters before and after attempting a meat-free diet for 1 month (while taking part in the annual vegan campaign Veganuary). Although most participants lapsed to eating meat during this period, we found that reductions in meat intake during the month were predictive of increases in meat disgust afterwards. This supports the view that meat disgust is expressed as a result of meat avoidance in meat eaters. Implications for theoretical understanding of the relationship between meat disgust and meat avoidance, as well as the development of disgust based interventions are discussed.

KEYWORDS

meat disgust, meat avoidance, evolution, vegetarian diet, eating behavior

Introduction

Meat production is an inefficient and unsustainable way of feeding the world's population (1), and is the cause of animal suffering (2). Many UK consumers are aware of these negative impacts of meat production and up to a third contemplate reducing their meat intake (3, 4), but perceptions of meat being "normal," "necessary," "natural," and "nice" means many people find it hard to resist (5–7). On the other hand, feelings of disgust toward meat have been well-documented in those who do not consume it [i.e., vegetarians and vegans (8–10)]. We define as "meat disgust" only those disgust responses

toward meat that is cooked and/or ready for consumption, unspoilt, and culturally appropriate to eat. Not surprisingly, in vegetarians, feelings of meat disgust predict stricter adherence to a vegetarian diet and fewer lapses (11). However, meat disgust is not strictly a vegetarian phenomenon—disgust toward red meat in particular has been frequently reported among omnivores (10, 12, 13), and there is evidence that meat disgust is a good predictor of lower meat consumption in omnivores and flexitarians (14). It seems that meat disgust could be a powerful factor counteracting meat liking and temptation and could help people reduce their meat intake and transition to a meat-free diet. However, we still know very little about this relationship, including any causal mechanisms.

The present paper aims to address this gap by first reviewing existing evidence for different causal relationships between meat disgust and meat intake (or rather, avoidance), and secondly, presenting a study of meat eaters that reduced or eliminated their meat intake for one month while taking part in the Veganuary campaign—a pledge to follow a vegan diet for the duration of January (www.veganuary.com) (15)—allowing us to observe if any changes in meat disgust followed this diet change or whether baseline disgust prior to participation in Veganuary predicted successful meat avoidance. Establishing a temporal order will bring us one step closer to understanding the mechanism that links meat disgust and meat avoidance and could enable us to harness the power of disgust in interventions that initiate or maintain the practice of meat avoidance.

Literature review

The relationship between meat disgust and meat consumption is still not well understood. Most existing studies of meat disgust have thus far focused on vegetarians who were already meat disgusted (8, 9, 16, 17), and this makes it difficult to draw conclusions about any causal relationship between meat disgust and meat avoidance (i.e., whether meat disgust is present first and causes meat avoidance or whether people decide to become vegetarians and develop meat disgust later). However, there is some evidence on the temporal order and causal relationship between the two (mostly from the accounts that vegetarians have given on how the relationship had developed in themselves), which will be reviewed in this part of the paper. While the evidence discussed below has large gaps (for instance, there is no evidence on the role of meat disgust in starting a meat-reduced diet rather than a vegetarian diet) it is still helpful in testing the plausibility of the several possible temporal and causal relationships that could link meat disgust and meat avoidance.

One possible mechanism that may link meat disgust and meat intake is that meat disgust develops after people have stopped (or reduced) their meat intake. Evidence for this possibility comes from a study by Paul Rozin et al. (17) who asked vegetarians to indicate their agreement with 20 different reasons for following a vegetarian diet, including feelings of disgust toward meat. Additionally, they asked their participants to indicate whether each of those reasons had been a reason for transitioning to vegetarianism in the first place. It is interesting to see that although 53% of their 104 subjects agreed or strongly agreed that they currently avoid meat because they find it disgusting, only 14.4% said that feelings of disgust toward meat had been an initial reason that led them to start following a vegetarian diet. Rozin et al.'s (17) findings therefore suggest that in the majority of vegetarians who feel disgusted by meat, these feelings developed after the transition to vegetarianism. This order of events is also corroborated by a number of qualitative studies (8, 9, 17–19) in which vegetarians report that they chose to stop eating meat for various reasons but are now (at the point of interviewing, often years after the transition) so disgusted by meat that they cannot bring themselves to eat it, not even to avoid conflict or embarrassment when they are served meat in a social situation (19). This demonstrates how the expression of disgust after the transition to vegetarianism would serve to maintain the practice of meat avoidance without the need for self-control.

One mechanism that has been proposed for the recruitment of disgust after transitioning to vegetarianism is moralization (17). According to this theory, activities that were previously perceived as morally neutral can acquire moral significance which then enables the development of norms and values about that activity. Meat consumption, the authors claim, is such an activity and once transitioned to vegetarianism, some people start to moralize and condemn meat consumption which turns their preference for vegetarianism into a value and part of their identity (17). One part of the moralization process seems to be the recruitment of disgust, which can be a moral emotion (20). Many researchers have reported that feelings of disgust toward meat are more common among those who follow a vegetarian diet for moral reasons [and have possibly, according to Rozin et al. (17) gone through a process of moralization] than those who do so for health reasons (e.g., 11, 17, 21). However, a longitudinal study by Feinberg et al. (21) demonstrates that moralization of meat eating can occur in omnivores before (or indeed without) a transition to vegetarianism. These authors suggest that the experience of meat disgust serves as a conduit for moralization, thereby turning the causal relationship proposed by Rozin et al. (17) on its head, which is also supported by others (13). Therefore, the moralization process does not seem sufficient in explaining the temporal or causal order of meat disgust and meat avoidance. In any case, moralization can only explain some cases of meat disgust, namely those in which moral disgust toward meat is experienced, rather than other, more basic forms like core disgust (22, 23).

The same studies that show that meat disgust commonly follows meat avoidance also deliver evidence for the reverse pathway—meat disgust causing meat avoidance. For instance,

a minority (14.4%) of the vegetarians in Rozin et al.'s (17) study (described above) reported that meat disgust caused them to stop eating meat. Confirming this, other studies also cite vegetarians who give disgust as the reason for giving up meat, and then usually as the result of a single disturbing and often disgusting "conversion experience" (9) like this interviewee describes:

> "I was cooking breakfast which was a cup of tea and a bacon cob . . . And that morning the smell of bacon was quite off-putting... And then, I was eating the cob, and I'd just taken a bite of it... and then, the next bite, the rind wasn't cooked properly. And the rind stayed in my mouth, and came off the meat, and sort of dangled from—from the corner of my mouth. And I—heaved, and put the cob down, and that was the end." (9)

Similar accounts of emotionally upsetting experiences (often also combined with guilt and sadness, rather than pure disgust) leading people to spontaneously become meat-disgusted vegetarians can be found elsewhere [e.g., (8)].

Even without a moral component, meat seems to elicit feelings of disgust much more easily than any other food: for example, pairing meat images with disgust stimuli in an evaluative conditioning experiment reduced willingness to eat meat, while the same disgust conditioning was ineffective for vegetables and beverages (24). Similarly, presenting meat dishes with a label that makes them seem unfamiliar (e.g., presenting a beef steak as "langua steak"—a fictitious animal name) can elicit disgust in prospective eaters, whereas plant-based foods with the same treatment do not (25). Tybur et al. (26) propose a possible mechanism for this phenomenon. Based on the widely accepted theory that disgust has evolved as a behavioral pathogen avoidance system (27–30), these authors suggest that objects that pose pathogen risks (such as meat—in essence a corpse that will soon rot) serve as inputs or heuristic cues for a risk-benefit computation, one output of which is a disgust response (26). This "preparedness" (31) for meat to be perceived as disgusting could explain why some people suddenly get disgusted by meat, to the point where it leads them to stop eating it.

To further complicate things, it should be noted that neither meat disgust nor meat consumption are binary "on/off" concepts but both exist and affect each other along a continuum as we have shown in a previous study (14). We quantified levels of meat disgust in vegetarians, flexitarians, and omnivores using visual analog scale ratings of images of meat that had elsewhere been rated as highly palatable (32). While on average, levels of meat disgust were highest in the vegetarian sample, flexitarians and even some omnivores also expressed some levels of disgust toward meat which was consistently higher than disgust toward control images of carbohydrate-rich (plant-based) foods. Using individual levels of meat disgust to predict individual levels of meat intake in omnivores and flexitarians, we found meat disgust to be the strongest predictor of reduced meat intake in flexitarians (whereas surprisingly self-control was not predictive of meat intake) and omnivores (here only after controlling for participant age). Furthermore, we found that naturally occurring decreases in meat intake over 6 months (in the absence of interventions) were associated with increases in meat disgust in both of these diet groups (14). This demonstrates that people cannot be classed as either meat disgusted or not, but that instead, meat disgust is experienced by everyone to varying degrees and is associated with how much meat a person consumes. Seeing meat disgust (and meat intake) as continuous variables has important consequences for research questions about this relationship, and rather than asking "which came first?," it might be more appropriate to ask whether increases in meat disgust can result from decreases in meat intake. This is what the current study aims to test.

The present study

In summary, there is good theoretical grounding and evidence for both accounts of the meat-disgust-meat-avoidance relationship (i.e., meat disgust causing meat avoidance; or meat avoidance leading to increased meat disgust). Other studies have already delivered some evidence that increasing disgust to meat can lead to reduced consumption of or willingness to eat meat (24, 25, 33, 34) but the reverse pathway (meat avoidance leading to meat disgust) needs more quantitative evidence. This study aims to test one direction of the possible causal relationship and asks whether temporary decreases in meat intake can result in increases in meat disgust.

An ideal study design to test the effect of reduced meat intake on meat disgust would randomly assign participants to conditions in which they have to either avoid meat consumption or not. At the time of data collection, we assumed that this would be very hard to recruit for (other than with large participant payments) and even harder to affirm that any reductions in meat intake had actually taken place [although recent research has achieved this *via* the use of daily smartphone surveys (35)]. Instead, we propose that the annual health challenge of "Veganuary" (www.veganuary.com) presents an ideal opportunity for a field study on meat avoidance. We surveyed people that planned to take part in Veganuary of their own accord, and, at the time of the survey still ate at least some meat. Their meat disgust and meat intake levels were measured at baseline (pre-Veganuary), along with other factors that potentially affect goal-directed eating behavior and disgust. At follow-up (post-Veganuary), the participants were asked how much meat they had consumed during Veganuary and their meat disgust levels were measured again.

From our previous investigation of the link between meat disgust and meat intake (14), we know that even in omnivores

and flexitarians (who constituted the sample of the present study) meat disgust predicts some variance in meat intake. We expected this relationship to be replicated in the present study, at baseline, before people embarked on the Veganuary challenge. In line with the majority of evidence presented in the literature review, we further predicted that a 1 month period of meat avoidance would lead to increases in meat disgust. The present study therefore tested the following pre-registered hypotheses*:

H1: Meat consumption will be negatively associated with meat disgust at baseline.

H2: Any decreases in meat consumption during Veganuary will be associated with increases in meat disgust at follow-up.

Additionally, we also explored factors that may explain better adherence to a meat-free/meat-reduced diet during Veganuary using a measure of restrained eating in a quantitative analysis, as well as qualitatively analyzing participants' own comments. While this is not the focus of the current study it may add to the research on barriers to and facilitators of transitions to meat-free diets and should further help to embed the role of disgust within a wider range of factors at play.

*Note: Slightly different hypotheses were pre-registered at https://aspredicted.org/ZBK_Y37 for H1 and H2 but had to be amended because the original hypotheses had rested on the assumption that most or all of the participants would follow a meat-free diet during Veganuary (as that was their intention at the time of pre-screening). However, only 11 participants followed a completely meat-free diet during Veganuary. For this reason, two of the three pre-registered hypotheses (H1: "Eliminating meat consumption for one month will be associated with increases in meat disgust." and H3: "In people who did not stick to a meat-free diet, the change in meat intake from baseline to follow-up will be associated with changes in meat disgust over that time.") were merged into the new H2 presented here.

Methods

Participant recruitment and sample

Participant recruitment took place on Prolific (www.prolific.co) (36). In order to gain access to a sample of participants who intended to not eat meat for the duration of January (but still ate at least some meat at the time of baseline recruitment), we conducted a pre-screen survey. This survey was advertised as a survey about health campaigns in January and asked participants to indicate if they intended to take part in any health challenges in January (with options including "Veganuary," but also other, non-meat related options like "Dry January"). Participants were then asked to identify their current diet on a spectrum from omnivore to vegan and were thanked for their participation. From the responses to this pre-screen we selected only those participants who had reported an intention to take part in Veganuary and reported to be either omnivore or flexitarian.

The pre-screen survey was completed by 1,125 people on Prolific. Of those, 60 were eligible participants (who were either omnivores or flexitarians and intended to take part in Veganuary or a different meat-free January challenge) and were invited to the baseline survey. 48 participants completed this survey without failing more than one of three attention check questions. All of these were invited to the follow-up survey in February which was completed without more than one failed attention check by all of the 40 people who participated in it. Table 1 shows descriptive statistics of our sample.

TABLE 1 Sample characteristics at baseline.

	Minimum	Maximum	Mean	SD
Age	19.00	70.00	30.28	11.67
Female gender (%)			82.50	
Disgust sensitivity	0.84	3.68	2.49	0.70
TFEQ scores				
Cognitive restraint	1.17	3.67	2.20	0.61
Uncontrolled eating	1.11	3.67	2.38	0.58
Emotional eating	1.00	4.00	2.47	0.88
Meat intake	0.00	13.00	5.28	2.92
Explicit meat disgust	0.00	85.67	44.64	24.11
Implicit meat disgust	−0.85	1.13	0.27	0.47

Procedure

The main study was hosted on Qualtrics (37) in December 2020 (baseline) and February 2021 (follow-up). Baseline and follow-up survey both measured the same concepts in identical order: After participants gave informed consent to take part, they completed a short demographics questionnaire [age, gender, country of residence, and hunger level which has previously been shown to affect food disgust ratings (38)]. Participants were also asked to report any existing medical dietary restrictions they may have so that we could control for any added difficulty of restricting an already restricted diet but no participants reported any restrictions.

Following this, we measured meat disgust in two different ways: first, an Implicit Associations Test [IAT (34, 35)] was used to measure meat disgust indirectly in order to avoid self-report biases. Then, disgust to meat and to carbohydrates was measured explicitly using visual analog scales (see Measures section below for more details). The meat and carb images presented as stimuli in the IAT and the VAS were the same, and the IAT was always conducted first so that any anchoring effects from the rating task would be avoided. After the meat disgust measures, the Three Factor Eating Questionnaire (39) and the

Disgust Scale—Revised (40) were then used to measure other factors that may affect meat intake and/or disgust, followed by a food frequency questionnaire assessing meat intake.

Additionally, at follow-up, participants were further asked about their intended diet going forward as well as their reasons for taking part in Veganuary. They were given one open-ended question about factors helping them during Veganuary (if they had reported zero meat intake during Veganuary) or factors that made following a meat-free diet harder (if they had reported some meat intake during Veganuary).

Measures

Implicit meat disgust

To test the strength of implicit associations between "meat" and "disgusting"/"delicious" participants performed an implicit associations test (IAT) with the concepts "meat" and "carbs" represented by six images each of meat and carbohydrate-rich foods, respectively, and the attributes "disgusting" and "delicious" represented by synonyms of these words (Figure 1). The IAT was identical to the one used in our previous study (14), with a procedure as described in Greenwald et al. (41). IAT block order was counterbalanced across participants at baseline, and, to avoid order effects (42) that would make the comparison of baseline and follow-up results difficult, we gave each participant the same version of the IAT at follow-up (with the same block order) that they had completed at baseline. The resulting *d*-score from the IAT was reversed to make interpretation more intuitive (stronger positive values indicating stronger bias toward the concept-attribute pairing of "meat" and "disgusting") and this variable is called "implicit meat disgust."

Explicit meat and carb disgust and liking

Participants were asked to rate six meat and six carbohydrate images (the same ones they had seen in the IAT) on 100-point visual analog scales (VAS) in terms of the taste of the food (from very unpleasant to very pleasant), the likelihood that they would eat the food (from very unlikely to very likely, responses to this question were not analyzed in this study), and the disgustingness of the food (from very disgusting to not at all disgusting). Using images of cooked, unspoilt, and culturally familiar meat including red and white meat, this measure captures specific disgust to "normal" meat that many other people would find appetizing. As such it measures the conceptualization of "meat disgust" that is used in this study and should not be affected by disgust toward signs of spoilage or unusual and unpleasant aspects of meat, as measured by other validated scales such as the Food Disgust Scale (43). Participants were always asked to rate the taste first in an effort to (a) mask the study's focus on disgust and (b) get participants to think about distaste and disgust as two separate concepts (see Figure 1).

Eating patterns

In order to control for other factors that may affect how successful participants were at reducing/eliminating meat intake during Veganuary, the 18-item version of the TFEQ was used to assess three dimensions of eating behavior—cognitive restraint, uncontrolled eating, and emotional eating (39).

Disgust sensitivity

Participants also completed the Disgust Scale—Revised [DS-R (40)] to assess disgust sensitivity in order to control for any observed changes in meat disgust being driven by this trait. Note that there is also a more specific Food Disgust Scale available (43), however, we opted for a more general scale to measure disgust sensitivity in order to avoid any circularity in the interpretation of any effects of disgust sensitivity on meat disgust (especially since the Food Disgust Scale has a "meat" subscale and therefore correlating this measure with our measure of meat disgust would be somewhat circular).

Meat intake

This was assessed by a Food Frequency Questionnaire (FFQ) asking participants how often they consumed various meat items in a typical month (at baseline) or during Veganuary (at follow-up in February), with response options on a seven-point scale ranging from "twice a day or more" down to "1–3 times a month" and "less often or never" [adapted from Churchill and Jessop (44) and Lawrence et al. (45)]. We also assessed consumption of fish and seafood, dairy, and eggs but did not include these in the analysis because this study and our disgust measures focused on meat.

Stimuli

The stimuli used in this study were the same as in our previous study (14): Six images each of meats and carbs were used in both the implicit and explicit measures (IAT and VAS) and were taken from the *food-pics* database (32) with the exception of one picture of bacon which was not available in *food-pics* and was taken from the internet. The images (see Supplementary Figure S1) were chosen to represent a variety of meats (two each of pork, beef, and chicken) that are commonly eaten in the UK and had high palatability ratings [ratings are available in the *food-pics* database (32)]. The carb images similarly represented different types of carbohydrates (bread, potatoes, rice) and were chosen to visually match the fat content and portion size of the meat images. All images were of foods that were deemed culturally familiar to our UK participants, cooked, and unspoilt.

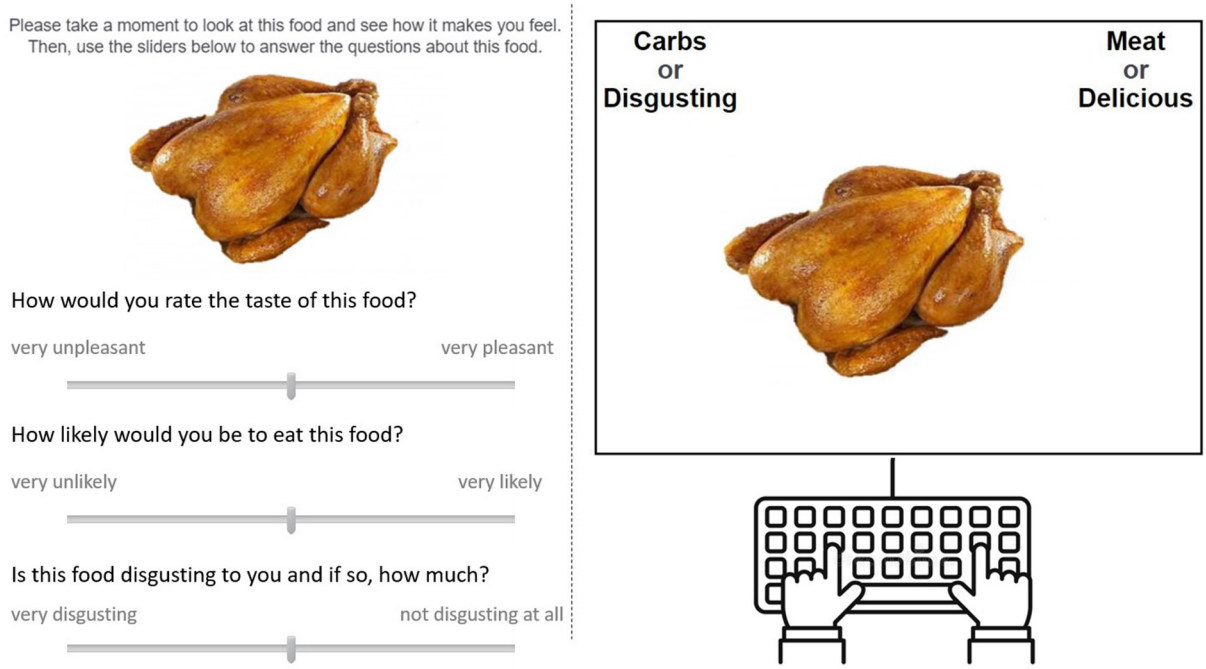


FIGURE 1
Example trials from the VAS meat/carb rating task (left) and the IAT (right). In both tasks, the same set of images was used (six of meat and six of carbohydrate rich foods).

Results

Hunger level did not correlate with explicit or implicit meat disgust and was therefore not controlled for in further analyses.

IAT scores may reflect/can be driven by any concept-attribute pairings that are presented within the IAT (in this case meat + disgusting/delicious, carbs + disgusting/delicious). To test that our implicit measure was a reflection of meat disgust and not the other concept associations that contributed to the IAT score, we correlated the IAT scores with the explicit measures of meat disgust, carb disgust, and carb liking. IAT scores showed a marginally significant weak correlation [$r(40) = 0.283$, $p = 0.077$, 95% CI $(-0.031, 0.547)$] with our explicit measure of meat disgust. None of the other explicit measures correlated significantly with the IAT scores, indicating that the IAT scores are most likely a reflection of meat disgust. However, the weak and not very significant correlation are cause for concern and readers should bear this in mind when interpreting the results presented below.

Hypothesis testing

We first analyzed the relationship of meat disgust and meat intake at baseline (H1: Meat consumption will be negatively associated with meat disgust at baseline) in a regression model. For this model, the six predictor variables age, gender, disgust sensitivity, cognitive restraint, implicit meat disgust and explicit meat disgust were pre-registered for purposes of comparability with Becker and Lawrence (14) where similar predictors were used to predict meat intake. However, because of the low sample size in this study ($n = 40$), the number of predictors should ideally not exceed four in order to still achieve sufficient power to detect at least large effect sizes (46). An alternative model with four predictors can be viewed in the Supplementary material, although there were no qualitative changes in the results other than the observed effect of implicit meat disgust decreasing in size and falling slightly below significance level.

The only significant predictors for meat intake were implicit and explicit meat disgust (Table 2). Interestingly, only explicit meat disgust predicted meat intake in the expected direction (the higher the level of meat disgust, the lower the meat intake). Implicit meat disgust on the other hand had a positive effect on meat intake (the higher the implicit meat disgust, the higher the meat intake at baseline).

To test H2 (any decreases in meat consumption during Veganuary will be associated with increases in meat disgust at follow-up), we tested whether changes in meat disgust from pre- to post-Veganuary were correlated with changes in meat intake in simple bivariate correlations. Change scores were calculated by subtracting the baseline score from the follow-up score, so

that a positive change score would indicate increases in meat disgust or meat intake and *vice versa*.

Changes in meat intake and changes in explicit meat disgust were negatively correlated in the expected direction [$r(40) = -0.44^{**}$, $p = 0.005$, 95% *CI* (−0.661, −0.148)]. For changes in implicit meat disgust there was no significant correlation with change in meat intake [$r(40) = -0.067$, $p = 0.683$, 95% *CI* (−0.37, 0.25)]. Figure 2 shows the relationship of these change scores.

Because changes in explicit meat disgust were associated with changes in meat intake in bivariate correlations, we chose to explore this relationship further by running a regression model to explain the changes in explicit meat disgust using additional predictors (Table 3). As mentioned above, because of the low sample size in this study ($n = 40$), the number of predictors was limited to no more than four in order to still achieve sufficient power to detect at least large effect sizes (46). We chose meat intake change, implicit meat disgust change, cognitive restraint [again, for comparability with our previous study (14) where self-control was included in the model predicting meat disgust], and disgust sensitivity (DS-R) as the most interesting predictors. Age and gender were not tested as predictors because although they might have an impact on the expression of meat disgust, this paper focuses more on psychological as opposed to demographic factors.

Changes in explicit meat disgust were significantly predicted by changes in meat intake during Veganuary in the expected direction: the more negative the change in meat intake (i.e., the larger the reduction) the larger the increase in meat disgust. The other significant predictor of changes in meat disgust was restrained eating, such that individuals with higher cognitive restraint (measured at baseline) showed larger increases in meat disgust during Veganuary.

TABLE 2 Coefficients from multiple regression on baseline meat intake with six predictors.

	β	95% *CI*		*p*
		Lower	Upper	
Age	−0.242	−0.513	0.029	0.078
Female gender	−0.046	−0.337	0.245	0.752
Disgust sensitivity	0.18	−0.103	0.463	0.205
Cognitive restraint	0	−0.266	0.266	0.997
Implicit meat disgust (T1)	**0.325**	0.047	0.603	0.023
Explicit meat disgust (T1)	**−0.773**	−1.09	−0.455	<0.001

n = 40, $R^2 = 0.481$, $R^2_{adj} = 0.387$. Bold value indicates significant coefficients at $p < 0.05$.

TABLE 3 Coefficients from multiple regression on changes in (explicit) meat disgust.

	β	95% *CI*		*p*
		Lower	Upper	
Change in meat intake	**−0.505**	−0.787	−0.223	0.001
Change in implicit meat disgust	0.178	−0.104	0.461	0.208
Cognitive restraint	**0.393**	0.103	0.684	0.009
Disgust sensitivity	−0.141	−0.433	0.150	0.332

$n = 40$, $R^2 = 0.365$, $R^2_{adj} = 0.293$. Bold value indicates significant coefficients at $p < 0.05$.

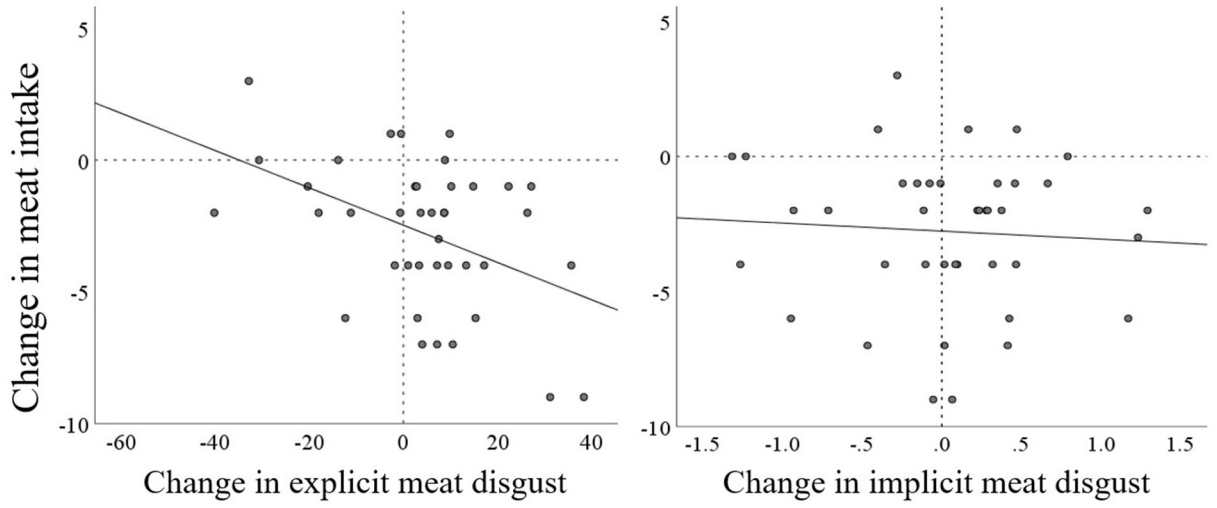


FIGURE 2
Scatterplot of changes in meat intake as a function of changes in explicit (left) and implicit (right) meat disgust.

TABLE 4 Coefficients from multiple regression on meat intake during Veganuary.

	β	95% *CI*		*p*
		Lower	Upper	
Meat intake (T1)	**0.579**	0.213	0.945	0.003
Explicit meat disgust (T1)	0.149	−0.235	0.533	0.436
Implicit meat disgust (T1)	0.038	−0.275	0.351	0.806
Cognitive restraint	0.225	−0.062	0.513	0.121

n = 40, $R^2 = 0.316$, $R^2_{adj} = 0.237$. Bold value indicates significant coefficients at $p < 0.05$.

In order to estimate the sensitivity of our regression models to detect different effect sizes, we conducted a *post-hoc* power analysis in G*Power (47), estimating the achieved power for single regression coefficients. For small effects (partial $R^2 = 0.02/f^2 \sim 0.02$), achieved power was 0.14; for medium effects (partial $R^2 = 0.13/f^2 \sim 0.15$) achieved power was 0.66; and for large effects (partial $R^2 = 0.26/f^2 \sim 0.35$) achieved power was 0.95.

Exploratory analyses of additional factors affecting reduced meat intake

Two separate analyses were used to explore the role of other factors in the adherence to a temporary meat-free diet. The first was a final regression model on meat intake during Veganuary, and the second was a thematic analysis of responses to an open question probing factors that affected successful meat avoidance during Veganuary.

The regression on meat intake during Veganuary was run using baseline meat intake, baseline explicit and implicit meat disgust, and cognitive restraint as predictors. After controlling for baseline meat intake, no significant predictors remained in the model (Table 4).

Because all factors of the TFEQ were administered in the survey, and not much is known about these factors and their link to reducing meat consumption, all three factors were in turn used as predictors in all of the above regression models (with emotional or uncontrolled eating replacing cognitive restraint). The results can be viewed in the Table S2, S3 in Supplementary material (only emotional eating was a positive predictor of meat intake during Veganuary).

All 40 participants responded to the open-ended question at the end of the survey asking them what they thought made it hard or easy to follow a meat-free diet during Veganuary. Thematic analysis of these responses resulted in three major themes (see Table 5): "psychological factors," "tools and resources," and "social influence." The former two themes were factors that were perceived as both helping to succeed or be unsupportive of the meat-free diet. For example, in the theme of "tools and resources," some participants mentioned good availability of vegan products in their local supermarkets as being a helping factor, while for others, a lack of vegan/vegetarian alternatives was the reason for lapsing during Veganuary. The third theme, "social influence," contained only quotes from participants who had eaten some meat during Veganuary. The prevailing motif here was that a vegan/vegetarian diet was too incompatible with the participant's household diet, so that separate meals would have to be prepared, which was often seen as too much effort or too time-consuming. No participants mentioned other people as a source of support or a helpful factor for sticking to a meat-free diet.

Findings from the "psychological factors" theme which contained quotes from 14 participants (Table 5), extended the quantitative results from this study. Craving or temptation was often mentioned by participants that had lapsed to eating meat, perhaps implying lack of self-control. Interestingly, none of the quotes from successfully meat-free participants in this theme directly mentioned strong self-control as a reason for their success, but they did mention a lack of temptation resulting from some sort of cognitive effort directed at pro-active strategies to avoid temptation, for example: *"I did not think about what I was missing out on"* (P33) or *"I think finding lots of different recipes and bulk buying vegetables and protein alternatives meant that I was not tempted to eat a meat based diet"* (P40). This suggests these people directed their thoughts and actions toward pursuing a vegetarian diet, rather than toward resisting the temptation of eating meat. Only one participant in this theme mentioned a disgust evoking experience: *"A video I watched where the muscles of a piece of meat contracted when cut into."* (P2).

All raw data are available at: https://osf.io/vkcef/?view_only=aea15b1ad2e44e899191e2699161894b.

Discussion

The present study aimed to investigate the causal mechanism that may link meat disgust and meat avoidance. We reviewed evidence for the different options of a causal link between the two variables and tested one of these by conducting a study that observed changes in meat disgust in meat eaters that attempted to eat a meat-free diet for 1 month. This approach can be understood as a "quasi-experiment" where participants self-selected the manipulation of a meat-free (or meat-reduced) diet but no manipulation of meat disgust other than this diet change took place.

In order to validate this study, we aimed to reproduce baseline findings from Becker and Lawrence (14) that found a negative association of meat disgust with meat intake in a much larger (combined omnivore and flexitarian $n = 605$) sample.

TABLE 5 Results from thematic analysis of challenging and helpful factors in maintaining a meat-free diet during Veganuary.

Theme		No of meat-free (MF) and lapsed (L) responses	Exemplar quotations from meat-free (MF) and lapsed (L) participants (typos corrected)
Psychological factors: Responses in this theme mention internal factors, such as self-control, motivation, and, in the case of lapsed respondents (not being able to overcome) habits.		MF: 3	*I did not think about what I was missing out on*
		L: 11	*I didnt have enough self-determination/perseverance to not eat meat*
Tools and resources: These were external factors of a very practical nature and were divided into two sub-themes:	**Vegan option availability:** Responses that mention availability of vegan options at home and in supermarkets.	MF: 8	*It was helpful that a lot of the supermarkets were doing new products and launches for veganuary, so there was more choice than usual, but being under lockdown I couldn't go to the ones out of my local area.*
		L: 4	*I went to the shops early January and there wasn't a lot of veg options—no fresh veg, I bought vegan food but decided easier to stick to meat and cheaper also*
	Information/knowledge: Having or lacking information on vegan recipes, meal planning or the benefits of a vegan diet.	MF: 3	*A really good vegetarian recipe book by Nigel Slater, being intrigued by different, appealing recipies encouraged me to enjoy eating vegetarian food and helped me stick to eating no meat*
		L: 5	*I wasn't getting enough protein and didn't know what to replace it with*
Social influence: Exclusively mentioned by lapsed participants, this theme focused on the influence of other people, usually in the household, including family or a partner, who made it impossible or inconvenient to follow a vegan diet		L: 12	*I ended up eating meat as my partner wasn't willing to give it up fully, most meals I cooked myself an alternative however for some meals it was a lot of effort and easier to cook one meal for us both*

Overall, H1 (meat consumption will be negatively associated with meat disgust at baseline) could partially be accepted as explicit meat disgust negatively predicted meat intake at baseline, before the Veganuary period. However, the effect was much larger here ($\beta = -0.773$, $p < 0.001$, $n = 40$), than the effects found in Becker and Lawrence (14) (in omnivores $\beta = -0.190$, $p < 0.001$, $n = 402$ and in flexitarians $\beta = -0.349$, $n = 203$, $p < 0.001$). One possible explanation for this is that the average baseline levels of explicit meat disgust were different in the two studies: in this sample of omnivores and flexitarians they were higher [$M(40) = 44.64$, $SD = 24.11$] than in Becker and Lawrence's (14) combined omnivore and flexitarian sample [$M_{(605)} = 24.99$, $SD = 19.06$]. This may simply highlight the fact that Veganuary participants are a selective sample with more flexitarian/vegetarian properties (e.g., increased meat disgust). We do not yet know whether or how the effect of meat disgust on meat intake changes at different levels of meat disgust. While this difference in effect size could point toward a non-linear relationship where the effect grows disproportionately to the level of meat disgust, drawing this conclusion from a comparison of two different samples (that are bound to be different in several other ways) would be premature. It does however highlight an interesting focus for further research.

The negative effect of implicit meat disgust on meat intake that Becker and Lawrence (14) found in their flexitarian sub-sample was not reproduced in this study. Instead, implicit meat disgust had an unexpected weakly *positive* effect on meat intake at baseline, whereas the explicit measure of meat disgust had a negative effect, as would be expected. This suggests that our two measures of meat disgust (explicit and implicit), which were not

significantly correlated with one another here, tap into different underlying mechanisms, as many others have suggested (48–50). Due to the current limited sample size and inconsistency with our previous findings, we are inclined to trust the result from our previous study with a much larger size. It would be important to replicate the positive association between implicit meat disgust and meat intake in larger samples, perhaps using other measures of implicit attitudes (such as affective priming) in addition to the IAT, before interpreting this effect.

For the main investigation of the causal relationship of meat disgust and meat avoidance, we hypothesized that any meat disgust increases at follow-up would be associated with meat reductions during Veganuary (H2). As before, this expectation was confirmed for explicit, but not for implicit meat disgust, from simple bivariate correlations of change scores. This may be because implicit attitudes tend to change on different time scales (51–54), or because our study was not powerful enough to detect a smaller effect, as our *post-hoc* power analysis suggests. The effect on explicit meat disgust was further confirmed in a regression model predicting changes in this variable: changes in meat intake during Veganuary were most predictive of changes in meat disgust in the expected direction—the more people reduced their meat intake relative to their baseline meat intake, the more their feelings of disgust toward meat grew. An additional predictor of increases in meat disgust was cognitive restraint. A link between heightened restraint and increased disgust toward food or dietary outcomes that people are trying to avoid has been shown by other researchers but so far only in weight loss/obesity-related studies where high cognitive restraint was linked with disgust toward high-calorie food and/or obese body shapes (55–57). Our finding of an association between restraint and disgust toward meat in a sample of people trying to avoid meat presents a novel and interesting expansion of these previous studies. However, the key finding of this study remains that short-term reductions in meat intake can have a powerful effect on increases in meat disgust.

A recent study by Piazza et al. (35) also followed participants during a 28-day meat-free pledge (compared to a non-pledging control group) and measured meat intake and several other factors before, during, and after the pledge period. While the focus of that study was not on disgust, they did measure the effect that attempting a meat-free diet had on meat cravings and found that participants who pledged to not eat meat experienced more meat cravings during the study period than participants in a control condition. Notably, in Piazza et al.'s study (35) participants were randomized to the pledge or control condition and did not self-select to attempt a meat-free diet as was the case in our study—this may limit our findings as the development of meat disgust after only 1 month of meat avoidance may only apply to people who are already motivated to reduce their meat intake. Interestingly, in Piazza et al.'s study (35), omnivores who expressed more "conflictedness" about meat consumption at baseline (e.g., agreeing that eating meat is unethical or unhealthy) were less likely to experience cravings during the period of meat avoidance. This finding may link to the study by Feinberg et al. (21) discussed in the literature review, as "conflictedness" could be seen as an early stage of moralization occurring before or in absence of a transition to vegetarianism. Perhaps our sample of self-selecting Veganuary participants is more akin to Piazza et al.'s (35) more conflicted omnivores which might also help explain the elevated levels of baseline meat disgust in this study as compared to our previous study (14). Additionally, and somewhat counterintuitively, meat cravings can co-occur with meat disgust as previous qualitative studies in vegetarians have reported (8, 9). Meat eaters' conflicted and ambivalent feelings about meat are well-documented, but this conflict usually focuses on the moral athletics that people have to engage in when they simultaneously love and eat animals, known as the meat paradox (58–61). Perhaps this inner conflict also expands to simultaneously experiencing meat cravings and meat disgust, which could be an interesting focus for future research.

The findings reported here (both our own and those of others) have some implications for our understanding of the development of meat disgust. Previous experimental research has shown that increasing disgust toward meat leads to reduced consumption, or willingness to eat meat (24, 25, 33, 34). This may seem obvious but some of this research (24, 25) suggests that only animal (and not plant) source foods can obtain a disgust status. Those findings cannot be explained by the moralization theory proposed by Rozin et al. (17) as discussed in the literature review. Tybur et al. (26) have theorized that because meat poses a greater pathogen threat than plants (24, 62), it may more readily be imbued with disgusting properties and can serve as a pathogen cue. Many other natural stimuli are "prepared" for disgust or fear responses (31, 63) through evolution and this theory can explain why a disgust response to meat (but not to plants) is so easily learned, as demonstrated in evaluative conditioning experiments (24). Our findings demonstrate that disgust to meat can be increased without a deliberately disgust-evoking intervention, simply by avoiding or reducing meat intake for only 1 month. It is still possible that disgust-learning has taken place during the month of meat avoidance/reduction, and one participant did mention a disgusting experience with meat that helped them avoid it, as mentioned above. However, other research demonstrates that people can express disgust to meat they have never had any experience with (25) which is not easily explained *via* preparedness of meat for disgust learning or by moralization.

Therefore, we would like to present a novel theory, building on Tybur et al.'s (26) idea that meat can serve as a pathogen cue. Rather than meat disgust being easily acquired through associative learning processes (perhaps due to preparedness of meat to be viewed as disgusting), we propose that humans may have evolved a blanket disgust response to all meat. This disgust may be the default response when novel meat is encountered

[or even when familiar meat is presented in an unfamiliar way (34)] but can easily be suppressed to certain meats, probably aided by social norms of what is culturally acceptable and as a result of positive experiences of eating meat. However, when meat consumption reduces or stops, suppression of meat disgust is no longer necessary, and therefore an increase is seen. A brief look into our evolutionary history could help explain why such a "default disgust" response to meat may have been adaptive to early humans: Compared to our primate ancestors, early humans distinguished themselves (among other things) by developing a much higher meat intake (64) shifting to routinely consuming meat, utilizing it as a major energy and protein source (65). This dietary shift, while beneficial in many ways (66) also exposed humans to an increased risk of pathogen contamination through meat and coincided with the evolution of a human-specific tape worm (67, 68). Early humans in turn needed a new strategy to navigate the pathogen threat of their new diet. Disgust may have evolved as an adaptation to counteract increased meat appetites [much like food neophobia and sensation seeking traits counteract each other in omnivorous animals to balance the threats and benefits that novel foods generally pose (69)]. This is particularly plausible when considering disgust's widely accepted function as a pathogen avoidance mechanism, which is why many of its elicitors (e.g., body fluids, cockroaches, rotten food, sick people, etc.) are pathogen vectors (27–30). Additionally, disgust is highly plastic and can be rapidly acquired, for instance after an episode of food poisoning (70, 71) and suppressed, for instance during sexual arousal (72, 73), or in times of food scarcity (38). A blanket disgust response to all meat that can be downregulated or suppressed for certain exceptions while they are safe to eat seems a tenable theory that is worthy of further investigation.

A secondary focus of this study lay on identifying factors that can act as barriers or facilitators of a meat-free diet. Our statistical analyses did not find any predictors of successful meat reduction during Veganuary (other than baseline meat intake which was controlled for rather than being a predictor of interest). The thematic analysis of participants' comments on what had made it hard or easy to stick to a meat-free diet during Veganuary confirmed that external factors (themes "tools and resources" and "social influence") seemed to have more of an impact (i.e., were more commonly mentioned) than psychological factors that were measured quantitatively in this study. These findings align well with previous research on barriers and facilitators of meat-free diets [see Graca et al. (74) for a review that places these factors within the COM-B model of behavior]. This suggests that the transition to a meat-free diet (or short-term reduction of meat consumption) can best be aided by removing practical barriers like low availability of plant-based products and lacking knowledge around vegan cooking and perhaps by involving significant others in the transition process. Only one participant mentioned a disgust eliciting video as helping them to avoid meat. This interesting case may be an example of how meat disgust may be expressed suddenly as a result of a disgusting experience rather than appearing more slowly after meat consumption has stopped.

Based on the key limitations of this study [as mentioned above, the low sample size, the special traits of this particular sample (high baseline meat disgust), and the difficulties interpreting the unexpected IAT results], we make the following recommendations for future studies in this area: (i) A larger sample more representative of the general population should be recruited and then randomly assigned (to avoid self-selection bias) to conditions, with meat avoidance as the intervention in the active condition [as in Piazza et al. (35)]; (ii) It would be interesting to measure both "true, underlying" (unsuppressed) disgust and more typical explicit disgust toward meat using comparable measures. For example, VAS ratings (like the ones used here for explicit meat disgust) could be used, with the meat stimuli being of unfamiliar and familiar meat. Pliner and Pelchat (25) have already shown that the simple labeling of meat as familiar or unfamiliar can differentiate between appetite and disgust. It seems logical that an individual's "true" basic level of meat disgust would be expressed to any unfamiliar meat stimulus where no suppression of meat disgust has occurred. Taking VAS ratings from familiar and unfamiliar meat might therefore be a simple, more valid and comparable method of measuring basic and suppressed (rather than implicit and explicit) meat disgust and would further our understanding of this dissociation.

Conclusion

Very few studies have directly observed attitudinal changes during transitions from an omnivorous to a meat-free or meat-reduced diet (35, 75), and this study adds novel insights to this field by focusing on the role of disgust toward meat. Our findings show that after avoiding or reducing meat intake for only 1 month participants showed an increase in explicit ratings of meat disgust. Further research will help to clarify the underlying mechanisms, e.g., moralization, preparedness for meat as disgust stimulus, or lack of suppression of feelings of disgust, which will contribute to theoretical accounts of meat-eating. Meat disgust may be seen as an interesting extension of the meat paradox, which is usually investigated as a moral dilemma of simultaneously caring for animals and eating them. It seems that in addition, people may also be simultaneously be disgusted by meat and enjoying meat. Both of these paradoxes can be resolved by psychological acrobatics (e.g., denying animal suffering for farm animals, but not for pets, or suppressing meat disgust to the meat of a cow but not to that of a horse) or simply by ceasing to eat meat. Future disgust-based interventions to reduce meat intake should also take into account that people might only need to be reminded of their disgust for meat, rather than having to learn to find meat disgusting.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: https://osf.io/vkcef/?view_only=aea15b1ad2e44e899191e2699161894b.

Ethics statement

The studies involving human participants were reviewed and approved by University of Exeter Psychology Ethics Committee. The patients/participants provided their written informed consent to participate in this study.

Author contributions

EB contributed to all aspects of this study and prepared the manuscript. SK contributed to participant recruitment, data processing, analysis, and wrote sections of the manuscript. MA contributed to data analysis and interpretation. NL contributed to design and conception of the study, data interpretation, and substantial revisions of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

Funding

This work was supported by a PhD grant to the EB from the University of Exeter Psychology Department.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fnut.2022.958248/full#supplementary-material

References

1. Godfray HCJ, Aveyard P, Garnett T, Hall JW, Key TJ, Lorimer J, et al. Meat consumption, health, and the environment. *Science.* (2018) 361:eaam5324. doi: 10.1126/science.aam5324

2. Grandin T. Animal welfare and society concerns finding the missing link. *Meat Sci.* (2014) 98:461–9. doi: 10.1016/j.meatsci.2014.05.011

3. Bryant CJ. We can't keep meating like this: attitudes toward vegetarian and vegan diets in the United Kingdom. *Sustainability.* (2019) 11:6844. doi: 10.3390/su11236844

4. Bryant CJ, Prosser AMB, Barnett J. Going veggie: identifying and overcoming the social and psychological barriers to veganism. *Appetite.* (2022) 169:105812. doi: 10.1016/j.appet.2021.105812

5. Lea EJ, Crawford D, Worsley A. Public views of the benefits and barriers to the consumption of a plant-based diet. *Eur J Clin Nutr.* (2006) 60:828–37. doi: 10.1038/sj.ejcn.1602387

6. Piazza J, Ruby MB, Loughnan S, Luong M, Kulik J, Watkins HM, et al. Rationalizing meat consumption. The 4Ns. *Appetite.* (2015) 91:114–28. doi: 10.1016/j.appet.2015.04.011

7. Ruby MB. Vegetarianism. A blossoming field of study. *Appetite.* (2012) 58:141–50. doi: 10.1016/j.appet.2011.09.019

8. Amato PR, Partridge SA. *The New Vegetarians: Promoting Health and Protecting Life*. New York, NY: Springer (2013). Available online at: https://public.ebookcentral.proquest.com/choice/publicfullrecord.aspx?p=5590512 (accessed July 21, 2020).

9. Beardsworth A, Keil T. The vegetarian option: varieties, conversions, motives and careers. *Sociol Rev.* (1992) 40:253–93. doi: 10.1111/j.1467-954X.1992.tb00889.x

10. Kenyon P, Barker M. Attitudes towards meat-eating in vegetarian and non-vegetarian teenage girls in England-an ethnographic approach. *Appetite.* (1998) 30:185–98. doi: 10.1006/appe.1997.0129

11. Rosenfeld DL. Why some choose the vegetarian option: are all ethical motivations the same? *Motiv Emot.* (2019) 43:400–11. doi: 10.1007/s11031-018-9747-6

12. Kubberød E, Ueland Ø, Risvik E, Henjesand IJ. A study on the mediating role of disgust with meat in the prediction of red meat consumption among young females. *J Consum Behav.* (2006) 5:281–91. doi: 10.1002/cb.180

13. Fessler DMT, Arguello AP, Mekdara JM, Macias R. Disgust sensitivity and meat consumption: a test of an emotivist account of moral vegetarianism. *Appetite.* (2003) 41:31–41. doi: 10.1016/S0195-6663(03)00037-0

14. Becker E, Lawrence NS. Meat disgust is negatively associated with meat intake—evidence from a cross-sectional and longitudinal study. *Appetite.* (2021) 164:105299. doi: 10.1016/j.appet.2021.105299

15. Veganuary. *Veganuary*. (2021). Available online at: https://uk.veganuary.com/ (accessed March 26, 2020).

16. Rothgerber H. A comparison of attitudes toward meat and animals among strict and semi-vegetarians. *Appetite.* (2014) 72:98–105. doi: 10.1016/j.appet.2013.10.002

17. Rozin P, Markwith M, Stoess C. Moralization and becoming a vegetarian: the transformation of preferences into values and the recruitment of disgust. *Psychol Sci.* (1997) 8:67–73. doi: 10.1111/j.1467-9280.1997.tb00685.x

18. Hamilton M. Disgust reactions to meat among ethically and health motivated vegetarians. *Ecol Food Nutr.* (2006) 45:125–58. doi: 10.1080/03670240500530691

19. Hamilton M. Eating death: vegetarians, meat and violence. *Food Cult Soc.* (2006) 9:155–77. doi: 10.2752/155280106778606053

20. Chapman HA, Kim DA, Susskind JM, Anderson AK. In bad taste: evidence for the oral origins of moral disgust. *Science.* (2009) 323:1222–6. doi: 10.1126/science.1165565

21. Feinberg M, Kovacheff C, Teper R, Inbar Y. Understanding the process of moralization: How eating meat becomes a moral issue. *J Pers Soc Psychol.* (2019) 117:50–72. doi: 10.1037/pspa0000149

22. Olatunji BO, Haidt J, McKay D, David B. Core, animal reminder, and contamination disgust: three kinds of disgust with distinct personality, behavioral, physiological, and clinical correlates. *J Res Personal.* (2008) 42:1243–59. doi: 10.1016/j.jrp.2008.03.009

23. Rozin P, Haidt J, McCauley C. Disgust. In: Lewis M, Haviland-Jones JM, Barrett LF, editors. *Handbook of Emotions.* 2nd ed. New York: Guilford Press (2000). p. 637–53.

24. Tybur JM, Laakasuo M, Ruff J, Klauke F. How pathogen cues shape impressions of foods: the omnivore's dilemma and functionally specialized conditioning. *Evol Hum Behav.* (2016) 37:376–86. doi: 10.1016/j.evolhumbehav.2016.03.002

25. Pliner P, Pelchat ML. Neophobia in humans and the special status of foods of animal origin. *Appetite.* (1991) 16:205–18. doi: 10.1016/0195-6663(91)90059-2

26. Tybur JM, Lieberman D, Kurzban R, DeScioli P. Disgust: evolved function and structure. *Psychol Rev.* (2013) 120:65–84. doi: 10.1037/a0030778

27. Al-Shawaf L, Lewis DMG, Alley TR, Buss DM. Mating strategy, disgust, and food neophobia. *Appetite.* (2015) 85:30–5. doi: 10.1016/j.appet.2014.10.029

28. Curtis V, Aunger R, Rabie T. Evidence that disgust evolved to protect from risk of disease. *Proc R Soc B-Biol Sci.* (2004) 271:S131–3. doi: 10.1098/rsbl.2003.0144

29. Curtis V, de Barra M. The structure and function of pathogen disgust. *Philos Trans R Soc B Biol Sci.* (2018) 373:20170208. doi: 10.1098/rstb.2017.0208

30. Thiebaut G, Méot A, Witt A, Prokop P, Bonin P. "Touch Me If You Can!": individual differences in disease avoidance and social touch. *Evol Psychol.* (2021) 19:147470492110561. doi: 10.1177/14747049211056159

31. Mineka S, Öhman A. Phobias and preparedness: the selective, automatic, and encapsulated nature of fear. *Biol Psychiatry.* (2002) 52:927–37. doi: 10.1016/S0006-3223(02)01669-4

32. Blechert J, Meule A, Busch NA, Ohla K. Food-pics: an image database for experimental research on eating and appetite. *Front Psychol.* (2014) 5:617. doi: 10.3389/fpsyg.2014.00617

33. Palomo-Vélez G, Tybur JM, van Vugt M. Unsustainable, unhealthy, or disgusting? Comparing different persuasive messages against meat consumption. *J Environ Psychol.* (2018) 58:63–71. doi: 10.1016/j.jenvp.2018.08.002

34. Kunst JR, Hohle SM. Meat eaters by dissociation: How we present, prepare and talk about meat increases willingness to eat meat by reducing empathy and disgust. *Appetite.* (2016) 105:758–74. doi: 10.1016/j.appet.2016.07.009

35. Piazza J, Gregson R, Kordoni A, Pfeiler TM, Ruby MB, Ellis DA, et al. Monitoring a meat-free pledge with smartphones: an experimental study. *Appetite.* (2022) 168:105726. doi: 10.1016/j.appet.2021.105726

36. Prolific. Oxford, UK: Prolific (2021). Available online at: www.prolific.co (accessed March 24, 2022).

37. Qualtrics. *Qualtrics.* Provo, Utah, USA: Qualtrics (2021). Available online at: www.qualtrics.com (accessed March 24, 2022).

38. Hoefling A, Likowski KU, Deutsch R, Häfner M, Seibt B, Mühlberger A, et al. When hunger finds no fault with moldy corn: Food deprivation reduces food-related disgust. *Emotion.* (2009) 9:50–8. doi: 10.1037/a0014449

39. Karlsson J, Persson LO, Sjöström L, Sullivan M. Psychometric properties and factor structure of the Three-Factor Eating Questionnaire (TFEQ) in obese men and women. Results from the Swedish Obese Subjects (SOS) study. *Int J Obes.* (2000) 24:1715–25. doi: 10.1038/sj.ijo.0801442

40. Olatunji BO, Williams NL, Tolin DF, Abramowitz JS, Sawchuk CN, Lohr JM, et al. The Disgust scale: item analysis, factor structure, and suggestions for refinement. *Psychol Assess.* (2007) 19:281–97. doi: 10.1037/1040-3590.19.3.281

41. Greenwald AG, Nosek BA, Banaji MR. Understanding and using the Implicit Association Test: I. An improved scoring algorithm. *J Pers Soc Psychol.* (2003) 85:197–216. doi: 10.1037/0022-3514.85.2.197

42. Messner C, Vosgerau J. Order effects in the IAT. In: McGill AL, Shavitt S, editors. Advances in consumer research. Duluth: Association for Consumer Research (2009). p. 38-40. Available online at: http://www.acrwebsite.org/search/view-conference-proceedings.aspx?Id=14261 (accessed August 21, 2020).

43. Hartmann C, Siegrist M. Development and validation of the Food Disgust Scale. *Food Qual Prefer.* (2018) 63:38–50. doi: 10.1016/j.foodqual.2017.07.013

44. Churchill S, Jessop DC. Reflective and non-reflective antecedents of health-related behaviour: exploring the relative contributions of impulsivity and implicit self-control to the prediction of dietary behaviour: Reflective and impulsive antecedents. *Br J Health Psychol.* (2011) 16:257–72. doi: 10.1348/135910710X498688

45. Lawrence NS, O'Sullivan J, Parslow D, Javaid M, Adams RC, Chambers CD, et al. Training response inhibition to food is associated with weight loss and reduced energy intake. *Appetite.* (2015) 95:17–28. doi: 10.1016/j.appet.2015.06.009

46. Miles J, Shevlin M. *Applying Regression and correlation: a guide for students and researchers.* London, Thousand Oaks, CA: Sage Publications (2001). p. 253.

47. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods.* (2007) 39:175–91. doi: 10.3758/BF03193146

48. Loonis RF, Brincat SL, Antzoulatos EG, Miller EK. A meta-analysis suggests different neural correlates for implicit and explicit learning. *Neuron.* (2017) 96:521–34.e7. doi: 10.1016/j.neuron.2017.09.032

49. Walla P, Rosser L, Scharfenberger J, Duregger C, Bosshard S. Emotion ownership: different effects on explicit ratings and implicit responses. *Psychology.* (2013) 04:213–6. doi: 10.4236/psych.2013.43A032

50. Woike B, Mcleod S, Goggin M. Implicit and explicit motives influence accessibility to different autobiographical knowledge. *Pers Soc Psychol Bull.* (2003) 29:1046–55. doi: 10.1177/0146167203254504

51. Aulbach MB, Knittle K, Haukkala A. Implicit process interventions in eating behaviour: a meta-analysis examining mediators and moderators. *Health Psychol Rev.* (2019) 13:179–208. doi: 10.1080/17437199.2019.1571933

52. Petty RE, Tormala ZL, Briñol P, Jarvis WBG. Implicit ambivalence from attitude change: an exploration of the PAST model. *J Pers Soc Psychol.* (2006) 90:21–41. doi: 10.1037/0022-3514.90.1.21

53. Rydell RJ, McConnell AR, Strain LM, Claypool HM, Hugenberg K. Implicit and explicit attitudes respond differently to increasing amounts of counterattitudinal information. *Eur J Soc Psychol.* (2007) 37:867–78. doi: 10.1002/ejsp.393

54. Yang Y, Qi L, Morys F, Wu Q, Chen H. Food-specific inhibition training for food devaluation: a meta-analysis. *Nutrients.* (2022) 14:1363. doi: 10.3390/nu14071363

55. Griffiths J, Troop NA. Disgust and fear ratings of eating disorder-relevant stimuli: associations with dieting concerns and fat intake. *Anxiety Stress Coping.* (2006) 19:421–33. doi: 10.1080/10615800601066771

56. Harvey T, Troop NA, Treasure JL, Murphy T. Fear, disgust, and abnormal eating attitudes: a preliminary study. *Int J Eat Disord.* (2002) 32:213–8. doi: 10.1002/eat.10069

57. Houben K, Havermans RC. A delicious fly in the soup. The relationship between disgust, obesity, and restraint. *Appetite.* (2012) 58:827–30. doi: 10.1016/j.appet.2012.01.018

58. Loughnan S, Haslam N, Bastian B. The role of meat consumption in the denial of moral status and mind to meat animals. *Appetite.* (2010) 55:156–9. doi: 10.1016/j.appet.2010.05.043

59. Buttlar B, Walther E. Measuring the meat paradox: how ambivalence towards meat influences moral disengagement. *Appetite.* (2018) 128:152–8. doi: 10.1016/j.appet.2018.06.011

60. Bastian B, Loughnan S. Resolving the meat-paradox: a motivational account of morally troublesome behavior and its maintenance. *Personal Soc Psychol Rev.* (2017) 21:278–99. doi: 10.1177/1088868316647562

61. Rothgerber H. Meat-related cognitive dissonance: a conceptual framework for understanding how meat eaters reduce negative arousal from eating animals. *Appetite.* (2020) 146:104511. doi: 10.1016/j.appet.2019.104511

62. Sherman PW, Hash GA. Why vegetable recipes are not very spicy. *Evol Hum Behav.* (2001) 22:147–63. doi: 10.1016/S1090-5138(00)00068-4

63. Seligman ME. On the generality of the laws of learning. *Psychol Rev.* (1970) 77:406–18. doi: 10.1037/h0029790

64. Kaplan H, Hill K, Lancaster J, Hurtado AM. A theory of human life history evolution: diet, intelligence, and longevity. *Evol Anthropol Issues News Rev.* (2000) 9:156–85. doi: 10.1002/1520-6505(2000)9:4<156::AID-EVAN5>3.0.CO;2-7

65. Milton K. A hypothesis to explain the role of meat-eating in human evolution. *Evol Anthropol Issues News Rev.* (1999) 8:11–21. doi: 10.1002/(SICI)1520-6505(1999)8:1<11::AID-EVAN6>3.0.CO;2-M

66. Baltic MZ, Boskovic M. When man met meat: meat in human nutrition from ancient times till today. *Proc Food Sci.* (2015) 5:6–9. doi: 10.1016/j.profoo.2015.09.002

67. Finch CE, Stanford CB. Meat-adaptive genes and the evolution of slower aging in humans. *Q Rev Biol.* (2004) 79:3–50. doi: 10.1086/381662

68. Perry GH. Parasites and human evolution. *Evol Anthropol Issues News Rev.* (2014) 23:218–28. doi: 10.1002/evan.21427

69. Rozin P. The selection of foods by rats, humans, and other animals. In: *Advances in the Study of Behavior*. New York, NY: Elsevier (1976). p. 21–76. doi: 10.1016/S0065-3454(08)60081-9

70. Rozin P, Wrzesniewski A, Byrnes D. The elusiveness of evaluative conditioning. *Learn Motiv.* (1998) 29:397–415. doi: 10.1006/lmot.1998.1012

71. Rozin P, Zellner D. The role of Pavlovian conditioning in the acquisition of food likes and dislikes. *Ann NY Acad Sci.* (1985) 443(1 Experimental):189–202. doi: 10.1111/j.1749-6632.1985.tb27073.x

72. de Jong PJ, van Overveld M, Borg C. Giving in to arousal or staying stuck in disgust? Disgust-based mechanisms in sex and sexual dysfunction. *J Sex Res.* (2013) 50:247–62. doi: 10.1080/00224499.2012.746280

73. Stevenson RJ, Case TI, Oaten MJ. Effect of self-reported sexual arousal on responses to sex-related and non-sex-related disgust cues. *Arch Sex Behav.* (2011) 40:79–85. doi: 10.1007/s10508-009-9529-z

74. Graça J, Godinho CA, Truninger M. Reducing meat consumption and following plant-based diets: current evidence and future directions to inform integrated transitions. *Trends Food Sci Technol.* (2019) 91:380–90. doi: 10.1016/j.tifs.2019.07.046

75. Amiot CE, El Hajj Boutros G, Sukhanova K, Karelis AD. Testing a novel multicomponent intervention to reduce meat consumption in young men. *PLoS ONE.* (2018) 13:e0204590. doi: 10.1371/journal.pone.0204590

frontiers | Frontiers in Nutrition

TYPE Original Research
PUBLISHED 08 September 2022
DOI 10.3389/fnut.2022.983856

OPEN ACCESS

EDITED BY
Jared Piazza,
Lancaster University, United Kingdom

REVIEWED BY
Susan M. Tosh,
University of Ottawa, Canada
Arkadiusz Szpicer,
Warsaw University of Life Sciences, Poland

*CORRESPONDENCE
Marija Banovic
maba@mgmt.au.dk

SPECIALTY SECTION
This article was submitted to Nutrition, Psychology and Brain Health,
a section of the journal Frontiers in Nutrition

RECEIVED 01 July 2022
ACCEPTED 15 August 2022
PUBLISHED 08 September 2022

CITATION
Banovic M, Arvola A, Pennanen K, Duta DE, Sveinsdóttir K, Sozer N and Grunert KG (2022) A taste of things to come: Effect of temporal order of information and product experience on evaluation of healthy and sustainable plant-based products. *Front. Nutr.* 9:983856. doi: 10.3389/fnut.2022.983856

A taste of things to come: Effect of temporal order of information and product experience on evaluation of healthy and sustainable plant-based products

Marija Banovic[1]*, Anne Arvola[2], Kyösti Pennanen[2,3], Denisa E. Duta[4], Kolbrún Sveinsdóttir[5,6], Nesli Sozer[2] and Klaus G. Grunert[1,3]

[1]MAPP Centre, Department of Management, Aarhus University, Aarhus, Denmark, [2]VTT Technical Research Centre of Finland Ltd., Espoo, Finland, [3]School of Marketing and Communication, University of Vaasa, Vaasa, Finland, [4]National Institute of Research and Development for Food Bioresources IBA Bucharest, Bucharest, Romania, [5]Matis Ltd., Reykjavík, Iceland, [6]Faculty of Food Science and Nutrition, University of Iceland, Reykjavík, Iceland

Current patterns of meat consumption are considered unsustainable. Plant-based products are presented as a solution. However, while some plant-based products thrive, others do not make the cut due to the information "framing" effect issues related to the way information is presented to the consumers. Information on the nutrition and health properties of food products are usually made available at the point of purchase, but their effect on consumer product evaluation and subsequent purchase intent can also occur later, during or after consumption. This research demonstrates that the effect of nutrition information on product evaluation and purchase intention depends on when such information is made available–before first tasting or after first tasting–and that the information interacts with the taste experience in its effect on product evaluation and subsequent purchase intent. Using three plant-based products as an example, we conducted a cross-cultural experimental sensory evaluation with temporal order of information as the main between-subject experimental condition (informed before taste vs. informed after taste vs. control condition), and product experience phase (expectation vs. experience vs. post-experience phase) and information content as within-subject conditions. Information content had two levels: lower vs. higher share of oat protein in the product (i.e., source of protein vs. high in protein). The results indicate that information generally increases consumers' purchase intentions with information before tasting having a higher weight when compared to the condition when information was presented after tasting. Presenting the information before tasting also mitigates a drop in the evaluation of taste after tasting, observed in the two other conditions. Further,

taste acts as a healthiness cue, but the direction of the inference depends on the availability of health-related information: tasting in the informed condition increased the healthiness perception, whereas tasting in the uninformed condition had the opposite effect. Giving the information before the first tasting also increased the weight of healthiness as compared to taste in the formation of purchase intentions. These findings contribute to a better understanding of the effect of temporal order of information and product tasting have on the consumers' product evaluations of plant-based products from theoretical and managerial perspectives.

KEYWORDS

temporal order of information, product experience, tasting, plant-based products, plant protein, sustainability, health information, nutritional labeling

Highlights

- Product evaluations depend on the temporal order in which information is presented.
- Information presented before product tasting results better subsequent taste perceptions.
- Information presented before product tasting changes the role of taste as a health cue.
- Information before (vs. after) tasting gives greater weight to health (vs. taste).

Introduction

The need for innovative products with plant-based proteins

Meat and dairy have been common and an important part of European diet over the past century mainly due to its nutritional quality (related to essential amino acids and its biological value) (1). Nevertheless, recent studies have supported the nutritional value of plant-forward diets arguing that vegetarian and vegan diets are in fact "balanced" and do meet the nutritional needs of humans when ensuring that an individual is eating a wide range of "green" plant products (such as vegetables, fruits, pulses, legumes, among others) (2–4). Further, a growing body of evidence demonstrates negative effects of meat and dairy production when compared to crop production in terms of surpassing safe limits for greenhouse gas emissions, nutrient flows, and biodiversity loss (5–7). This coupled with adverse impacts of overconsumption of meat on the environment (8, 9) and health-related risks pertaining to diabetes, cancer, blood pressure, and cardiac diseases (2, 10) brings forth the need for meat and dairy consumption to be scaled back.

To address these issues, a transition toward lower meat and dairy consumption and greater plant-based consumption is desirable (3, 11, 12). One of the routes to achieve a more sustainable and healthier diet is to provide partial meat and dairy replacement (13, 14) or complete substitution with alternative proteins from plant sources (12, 15). In this way, consumers could include several proteins in their diets by partially replacing meat and dairy with plant-based ingredients through hybrid products (11, 13) or by using alternative proteins from plants, in products such as meat analogs (16) or dairy alternatives (15).

Despite the substantial growth of meat and dairy alternatives between 2010 and 2020, doubling their market size, the market share of alternative proteins remains low in the European Union (EU), accounting for just 0.7% of the European meat market and 2.5% of the dairy market (17). To facilitate further growth of alternative proteins it is vital to improve the usage of the existing plant-based resources. Alternative plant-based proteins, such as proteins from pulses, oilseeds and cereals, are generally regarded as more environmentally friendly and healthier than conventional animal-derived proteins (9, 18, 19). However, most of the alternative plant-based proteins come from oilseeds and pulses, while cereals, such as oat, are often neglected, considered of low market relevance and mainly used for animal feed (20). This is despite the fact that cereals significantly contribute to the total EU's plant protein supply while EU's self-sufficiency rate is on the other hand low among oilseeds (e.g., for soya 5%) (20, 21).

Most of the companies offering substitute products containing plant proteins try to mimic meat and dairy by offering plant-based products, such as, plant-based burgers, sausages, and milk (22–24). However, they do not offer products that are not necessarily meat or dairy "look-alikes," but can offer the same amount of protein from a plant through another type of innovative product (17). By mimicking meat and dairy products another challenge arises, namely meeting the most important success criteria for consumers, product sensory

experience, and mainly flavor and texture [e.g., (25)]. If a new sustainable substitute product does not live up to consumer requirements for flavor and texture, this can lead to a market failure (6), and positioning products as substitutes encourages consumers to make comparisons of the sensory properties of the substitute with the original, which can lead to disappointment and a lack of repeat purchase (16). Finally, while some plant-based alternatives thrive, others do not make the cut due to the marketing and information "framing" effect issues related to the way that information is presented to the consumers [e.g., (26)].

Still, plant-based alternatives are the future and are already appealing to an increasing number of consumers, in addition to vegans and vegetarians (27–29). Furthermore, there is no sign that the growth of the market share of plant-based products is likely to stop (30). Therefore, it is of utmost importance to provide more alternatives and choices to consumers through products that are more sustainable, environmentally friendly, healthier, tastier, and which meet different demands, by making innovative use of existing resources, such as proteins from cereals. In developing such innovative products, it is important to integrate the development of marketing communication into the development process.

Temporal order of information effect

Consumers may see and process information about health and nutrition characteristics before their first purchase of the product. Alternatively, they may purchase the product without being aware of this information, but may see and process it later, after they have purchased and consumed the product. Whether consumers process this information before the first purchase or after the first consumption can affect consumers' product evaluations, which in turn will influence future purchases (31, 32). Two mechanisms can be at work here. First, when consumers are informed about health properties of the product in the pre-purchase phase, they may form expectancies not only about the healthiness of the product, but also about the sensory properties of the product, as consumers often make inferences from healthiness to taste and vice versa (33). Such expectations may in turn affect the actual perception of the sensory properties during consumption due to assimilation or contrast effects (34, 35). When consumers are exposed to such information only after the first consumption, they have already formed impressions about the sensory properties of the product that were not guided by health-related expectations. Since expectations about and perceptions of sensory properties impact purchase intention, these purchase intentions can hence be expected to differ depending on when the information is given (31) and how favorable product experience is (34). Second, the relative weight of sensory properties and information about the product in the formation of purchase intention can also differ depending the temporal order of information, which again would lead to differences in purchase intentions (36). At the first purchase, decision-making is based on expectations only, and providing health information can make the health motive more salient. After the first consumption, experience with the sensory properties of the product is available, which could make the taste motive more salient.

The question therefore is–does it make a difference when consumers get the health information and if the consumers' perceptions will be affected differently when learning health information before first product tasting compared to when this information is learned after first product tasting? The answer to this question has important practical implications for the marketing of products with nutrition and health benefits: should the information be made salient at the point of purchase, so that consumers become more likely to see and process it in the pre-purchase phase, or should it be conveyed in a way that encourages reading and processing it at home, after the first consumption experience?

It is well documented that information can affect consumers' food product evaluations not only before, but also after consumption (13, 26), and that information can lead to inferences across relevant product characteristics. For instance, learning that the product is locally produced before consuming it can appear to make it taste better (37). A food that is labeled as healthy may be expected and subsequently also experienced as being less tasty (33). Organic food is widely believed to taste better than conventional food and this expectations carries through to actual product experience [e.g., (38); for an overview of how extrinsic cues affect taste perception see (39)]. None of the above research, however, has investigated how temporal order of information affects consumers' product evaluations not only before first product experience (i.e., expectations) and after subsequent product tasting (i.e., experience), but also following the post-experience tasting phase. Information provided after tasting may still lead to taste inferences, but since taste experiences have already been made, they are likely to be much smaller, if they exist at all. In addition, information given after the first tasting may have a smaller impact on future purchase intentions, because the taste motive may have higher weight in the formation of purchase intentions than the health motive once taste perceptions already exist, as people tend to have limited willingness to compromise on taste for the sake of health (40). This is important to study as consumers often acquire product information after their initial product experience, and little is known about how learning product information after product is sampled for the first time affects its evaluations later during the second sampling in the post-experience phase. The product information learned after a first product experience may have effect on the evaluation of the subsequent product experience.

Based on the above, our main exploratory premise is that the effect of health and nutrition information on consumers' product evaluations will be contingent on the temporal order

in which the information is presented. The previous research indicated that assimilation and contrasting effects occur if the information about a product is presented before or after the product experience (35). When information is presented before product experience, it can affect opinions formed during product consumption when consumers try to assimilate received information with the formed experience (31, 37). On the other hand, research shows that contrasting effect occurs when consumers are presented with nutritional and health information only after the consumption, as opinions about the product sensory properties are not guided by information and sensory properties but are contrasted against received information (41). We expect that providing health and nutrition information will have a positive impact on purchase intentions because it creates expectations about healthiness. Exposure to externally generated product frames has been shown to positively impact willingness to buy product due to the consumer trust in this information, which is considered to be reliable and thus indicative of the product utility (42). When the information precedes the first tasting, it may also lead to expectations about the taste of the product, and these expectations can be positive (or negative) depending if the taste of the product meets (or not) the formed expectation levels (37). Taste expectations may affect the actual taste experience, thus affecting also the purchase intention after the first tasting (32). On the other hand, when the product information is presented after the tasting, consumers have already formed impressions of the taste, and we would expect that the combined effect of the information and taste would increase subsequent purchase intention (31). As noted, presenting the information before or after first tasting can have an impact on the relative weight of the health and taste motives in the formation of purchase intent.

<CPS_H2 Sustainable, plant-based protein products

The evaluation of food products, and particularly new sustainable products, such as plant-based protein products, is dependent on both the information provided and consumer direct experience with the product (15, 16). The modification of the sensory properties of a product for health and sustainability reasons could produce differing effects on the product evaluations. For instance, it has been shown that products containing lower levels of plant protein compared to the ones with higher levels of plant-protein are preferred due to its lower bitterness and appealing texture (15). Further, evaluations of these sustainable products tend to be based on functional cues such as information about the product characteristics related to main ingredient (i.e., plant protein) and healthiness. However, there are only a few studies looking into the effect of this information on the subsequent cognitive and sensory evaluations of these sustainable products (41).

We investigate the abovementioned research gaps and contribute to the consumer behavior and marketing literature in the following ways. We extend previous studies by exploring temporal order of information and product experience including both before and after exposure to information, as well as the post-experience phase, which is scarcely researched, but is present in real-life and important for everyday marketing practice. Food products are frequently bought, and the role that information plays in the formation of purchase intentions will change over time with repeated choices and product experiences. The effects of product information after first purchase and consumption have rarely been studied, but are of crucial importance if the aim is to encourage habits for choosing healthy and sustainable food products. Our study therefore makes a contribution to the learning that takes place over multiple purchases based on experience and information about healthy and sustainable food products. **Figure 1** summarizes our conceptual framework.

Materials and methods

Participants and recruitment

In total, six hundred and forty three subjects were recruited across selected countries (Denmark, Finland, Iceland, and Romania) with approximately 150 subjects per country (3 groups of 50 people per experimental condition in each country). Quotas for gender and age were used in each experimental condition (i.e., 50% male; 50%, 20–40 years of age, 50%, 41–65 years of age). Participants were recruited from the general population, were all responsible for food shopping, have consumed plant-based products at least once, and were assigned to the experimental conditions beforehand following the recruitment criteria. The participants were not informed on the actual purpose of the study, but instead they were told that the study focuses on tasting of plant protein based products with oat protein enrichment. Each participant signed informed consent where the participants were informed that they are free to withdraw at any time and that the results from the study would be treated anonymously. The ethical approval for the study has been obtained both from the university's ethical committee and the regional health institute. Sociodemographic characteristics of the participants are shown in **Table 1**.

We manipulated the order of information presentation to uncover how such information would affect subsequent product evaluations when information provided before vs. after tasting of the product, and compared to when there is no exposure to the information, only direct product experience, (i.e., control condition). We measured product evaluations three times: expectation (before tasting), experience (after 1st tasting), and post-experience (after 2nd tasting) phase. We did this for three different plant-based protein products. To ensure variation in the information provided and tasting experience, we used two versions of each of these products that were described as "source of protein" (SoP–at least 12% of the product's energy value is provided by oat protein) and "high

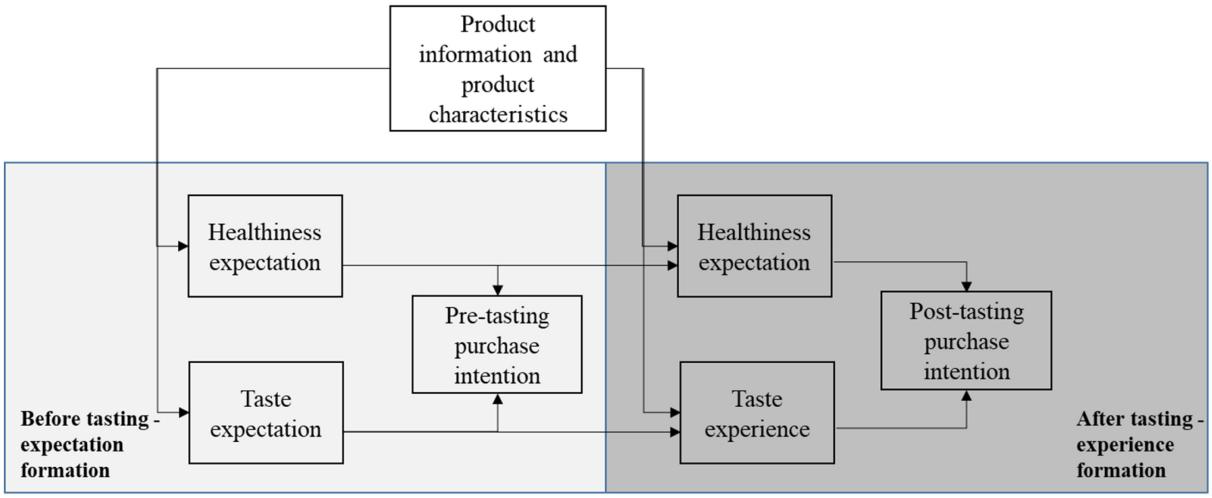


FIGURE 1
Conceptual framework.

TABLE 1 Sociodemographic characteristics of the participants.

Characteristics	Total *N* = 643	Denmark *N* = 190	Finland *N* = 150	Iceland *N* = 140	Romania *N* = 163
Age (mean) year	41.7	39.8	39.6	44.7	43.2
Gender (% female)	55.4	59.5	54.3	54.3	53.4
Marital status (%)					
- Married/co-habiting	63.0	68.4	63.3	70.7	49.4
- Single-living with parents	9.9	3.2	2.0	4.3	30.2
- Single-living independently	27.1	28.4	34.7	25.0	20.4
Children (yes, %)	49.9	47.9	50.7	48.6	52.5
Education (%)					
- Primary school	8.6	25.3	2.7	4.3	1.9
- Secondary school	13.1	11.0	20.0	20.0	1.2
- Higher education (not university)	21.0	25.3	15.3	15.7	27.8
- University (first degree, BSc)	18.8	14.7	19.3	29.3	11.7
- University (postgraduate, MSc, PhD)	38.6	23.7	42.7	30.7	57.4
Income level (%)					
- Less than average	20.7	24.7	24.7	17.9	15.4
- Average	53.0	37.9	54.6	61.4	58.0
- More than average	26.4	37.4	20.7	20.7	26.6
Consumption frequency (%)					
Plant-based products					
- Once a week and less	56.4	51.6	54.7	61.4	58.0
- 2 to 4 times a week	24.5	30.0	20.7	20.7	26.5
- 5 times a week and more	19.1	18.4	24.7	17.9	15.4

in protein" (HiP–at least 20% of the product's energy value is provided by oat protein) (EC regulation No 1047/2012). The three product categories were pasta, bread, and biscuits. This procedure allowed for assessing whether the product evaluations (i.e., purchase intentions, health and taste perceptions) are affected by the temporal order in which information is presented and direct experience with the product, accounting also for the influence of product experience when more favorable vs. less favorable product experience occurs. We expected from previous research that SoP products would be evaluated more favorably than HiP products (15). **Figure 2** depicts the research design of the study.

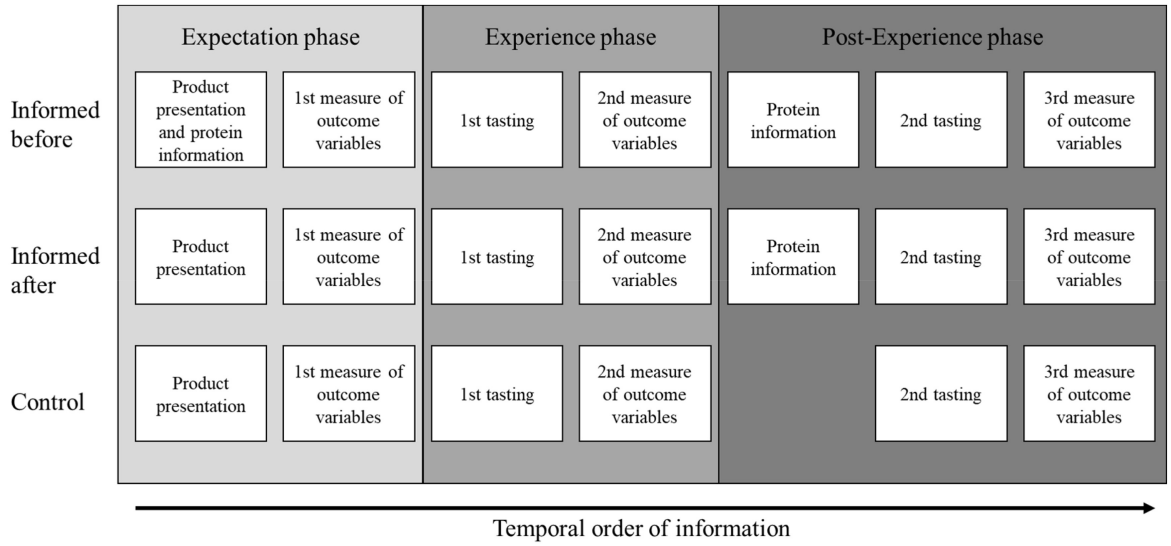


FIGURE 2
Research design.

Preparation of plant based protein-enriched products

Two different versions of protein-enriched products have been developed based on oat protein concentrate (OPC) and oat starch rich endosperm fraction (SRE) kindly provided by Fazer Mills Finland, Lahti, Finland. OPC had 28% protein, 45% starch, 5% fat and 4% dietary fiber (15) SRE had 12% protein, 60% starch, 2% fat and 8% dietary fiber. Three product categories: pasta, bread, and biscuits were produced in such a way that they could either bear the claim a "source of protein" (SoP) or the claim "high in protein" (HiP), Figure 3. We assumed that the sensory attributes of these two different product types (within each product category) would influence consumers' perceptions and subsequent purchase intentions, and that this effect would be modified with information disclosure on protein claims on SoP and HiP enrichments, depending on the temporal order of information.

The serving portion for all products was 50 gr (i.e., one slice of bread, 1 biscuit, ∼50 g cooked pasta) per person per enrichment (i.e., 50 gr of source of protein, and 50 gr of high in protein product), thus 100 gr in total per product category.

The protein-enriched pasta was developed at pilot scale using an automatic pasta production machine (La Monferrina, Italy). Two types of spiral short pasta were obtained: OPC oat pasta (with at least 20% protein from energy value-rich in protein) from: OPC fraction, wheat semolina, modified corn starch and water in the ratio: 5:5:1:1.9 and, respectively, SRE oat pasta (with at least 12% protein from energy value-source of protein) from: SRE fraction, wheat semolina, modified corn starch and water in the ratio: 10:1.25:1:5.7. Fresh extruded pasta in the shape of fusilli (spiral short pasta) were dried for 10 h in a discontinuous dryer (La Monferrina, Italy), operating with an air flow set at 23–27°C and 56–62% relative humidity up to the

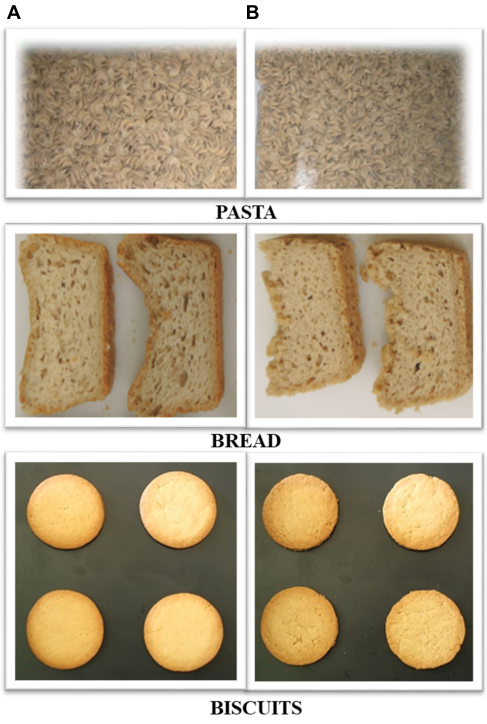


FIGURE 3
Plant-based protein enriched products: **(A)** low protein-enriched (source of protein–SoP) product, **(B)** high protein-enriched (high in protein–HiP) product.

final humidity around 11%. The preparation of pasta for product tasting involved cooking of pasta for 10 min in boiling water with salt (100 g dried pasta were boiled in 2.5 l water with 16 g salt), which was then rinsed with clean cold water before serving. Pasta was kept warm in covered Tupperware, which was only uncovered for the product trial.

Bread doughs were prepared by combining OPC and wheat flour. SoP bread dough had 20% OPC and 25% wheat flour whereas HiP bread dough had 38% OPC and 7% wheat flour. The ratio of remaining ingredients were the same in both bread doughs (oil 6%, sugar 1%, emulgator 0.3%, salt 0.8%, yeast 2.4% water 44%). The dry ingredients were first mixed together and then oil, yeast and water were added. The temperature of the water was adjusted so that the final dough temperature after mixing was 26 ± 1°C. Kneading was done for 120 s (slow speed) and 127 s (high speed) with a spiral mixer (Diosna SP12, Osnabrück, Germany). Baking tins were filled with 180 g of batter and then proofed for 45 min at 37°C and 70% relative humidity. The breads were baked in a rack oven (Sveba Dahlen, Fristad, Sweden) at 225°C for 20 min. One slice of bread from SoP and HiP enriched bread (about 50 gr each) was served to the participants.

Oat biscuits with SoP and HiP were prepared and provided by Fazer Bakeries (Vantaa, Finland). SoP biscuit dough had 29% OPC and 29% wheat flour whereas HiP biscuit dough had 54% OPC. The ratio of remaining ingredients were almost the same in both doughs with some small adjustments (oil 10%, sugar 9%, salt 0.5%, leavening agents 0.7%, water 24%).

All tasting sessions were held in individual sensory booths equipped with computers and online questionnaires under controlled environmental conditions with regards to light, temperature, and relative humidity. Each booth consisted of a counter top with walls that extend on three sides beyond the serving counter surface, so subjects could not view their neighbors. The subject was seated facing the computer and serving surface. Each participant was served with pair of product samples (SoP and HiP) from each of the above described product category. The two product samples were always served side by side following a Latin square or randomized order to avoid any bias in product testing. The order of two samples from each product category were also counterbalanced (43). Each sensory tasting trial was held with 10 participants.

Design, procedure, and measures

Between-subjects experimental study has been conducted where temporal order of information has been manipulated along three experimental conditions: (i) "informed before first tasting condition," (ii) "informed after first tasting condition," and (iii) "control condition," **Figures 2**, **5**. The study also included two within-subjects factors. The first within-subject factor was *product evaluation phase*: (i) "expectation" (before tasting), (ii) "experience" (after 1st tasting), and (iii) "post-experience" (after 2nd tasting) phase. The second within-subjects factor was related to level of product protein-enrichment, namely: (i) "low-enrichment" or "source of protein" claim (SoP) and (ii) high-enrichment or "high in protein" claim (HiP) (see section "Preparation of plant based protein-enriched products"). The same experimental design has been applied across four European countries, namely Denmark, Finland, Iceland, and Romania, as well as three product categories, that is, pasta, bread, and biscuits. As indicated in **Figure 5**, both country and product category have been used as control variables to be able to clearly identify the relationship between independent variables (temporal order of information, between-subjects variable; product experience phase, within-subjects variable; level of product protein enrichment, within-subjects variable), and dependent variable (product evaluations), and reduce the error term (44).

In each product evaluation phase, pair of protein-enriched products, SoP ("source of protein" for low-enrichment) and HiP ("high in protein" for high-enrichment), were randomly presented two at a time from each of three products categories (pasta, bread, and biscuits), once from the beginning of the product evaluations, as indicated in **Figure 2**. Thus, the pair of product samples have been in front of participants the whole time while forming the expectations, experience and post-experience evaluations and filling-in the questionnaire concerning 1st, 2nd, and 3rd measure of outcome variables. The 1st, 2nd, and 3rd outcome variables were same measuring how much participants like healthiness and taste of the product with each attribute measured on a 9-point hedonic scale ranging from 1–dislike extremely; 9–like extremely (43). We also assessed at each step participants' purchase intention on a 11-point probability scale ranging from 0–no chance, almost no chances (1 chance in 100) to certain, practically certain (99 chances in 100) (45).

As mentioned above, the order of receiving SoP and HiP product samples from three different product categories (pasta, bread, and biscuits) was counterbalanced (43). Participants filled-in separate evaluation online questionnaires for each pair of product samples from three product categories (pasta, bread and biscuits). As indicated in **Figure 2**, the time interval before first and the second tasting was interrupted by 2nd measure of outcome variables for all experimental groups and showing of the protein information for the informed before and informed after tasting experimental condition. In the control condition, after answering the 2nd measure of outcome variables participants were indicated to taste the two product samples again for the second time without presenting information. In the before tasting condition, each pair of products was again accompanied by their corresponding written descriptions, one saying "source of protein" (SoP for low-enrichment) and another saying "high in protein" (HiP for high-enrichment), (see example in **Figure 4**). In the informed after

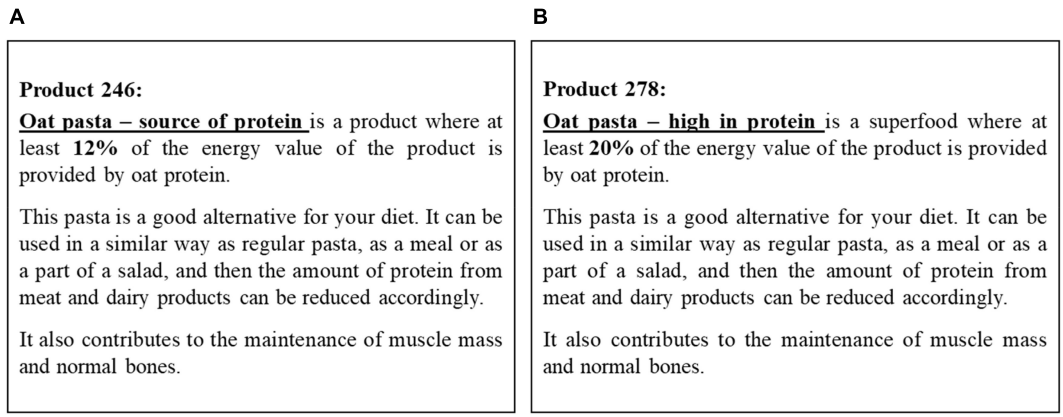


FIGURE 4
Example of information provided: Source of protein (SoP) **(A)** high inprotein (HiP) **(B)**.

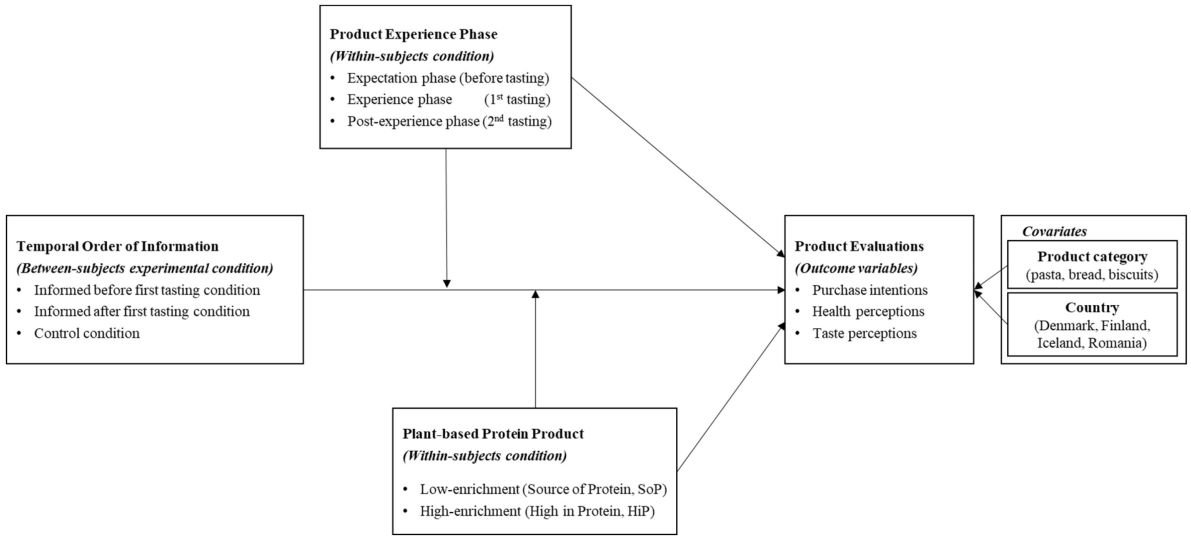


FIGURE 5
Design of repeated measures ANCOVA.

tasting condition, the participants received this information only during the post-experience phase (after second tasting).

Informed before tasting condition

In the informed before tasting condition, at each product evaluation phase (i.e., expectation, experience, and post-experience), each pair of product samples were shown side by side always with their corresponding information on the level of protein enrichment (i.e., SoP for low and HiP for high enrichment), Figure 2. In the *expectation phase*, participants' reported how much they like the healthiness and taste of the product (43), as well as their purchase intention (45). Subsequently, in the *experience phase*, participants repeated the same evaluations as above after having tasted each product with same information still available during tasting. Finally, in the *post-experience phase*, participants were asked to taste the products again presented along with information and evaluate them for the third time.

Informed after tasting condition

In the informed after tasting condition, all products were presented to the participants in the *expectation phase* without any information, only assigned numbers. The order was also randomized as mentioned above, followed by the same evaluations of measures as in the informed before tasting condition (i.e., expectations for health and taste, and purchase intention). This was followed by the *experience phase*, where blind tasting occurred, after which participants once more

evaluated the product characteristics and purchase intention. At the end of the tasting, in the *post-experience phase*, participants received the full-written description of each product. After reading the full description of the products, they evaluated each product for the third time, but this time with information, in the *post-experience phase* again on the same measures, **Figure 2**.

Control condition: Blind evaluation and tasting

This condition had the same three product evaluation phases: *expectation*, *experience*, and *post-experience*. However, the participants did not receive any information about the products, and thus all evaluations and tasting were blind, **Figure 2**. Participants were debriefed at the end of the study.

Data analysis

To analyze the influence of the experimental factors on the outcome variables, we ran repeated measures ANCOVA using the mixed method procedure in SPSS28, **Figure 5**. The analysis was performed first with purchase intention as a dependent variable, temporal order of information as main between-subjects experimental condition (i.e., informed before tasting vs. informed after tasting vs. control condition), and product evaluation phase (i.e., expectation, experience, and post-experience) and products' protein-enrichment (i.e., low–SoP–enrichment and high–HiP–enrichment) as the within-subjects factors. We included product category type (i.e., pasta, bread and biscuits) and country (i.e., Denmark, Finland, Iceland, and Romania) as covariates, to correct for initial non-equivalences and to increase the statistical power, thus reducing the error term. We further conducted the planned contrast analysis with the Bonferroni correction to focus on a few planned comparisons between the experimental conditions and product evaluation phases that allowed us to test for the statistical significance of expected differences (46). In particular, and in relation to our assumptions in section "Temporal order of information effect," we investigated if use of information claims on the level of protein content significantly affect product evaluations when compared to the control condition (where no information is presented), as well as if having information before product tasting vs. after product tasting significantly affects product evaluations. We repeated the above analysis by looking at the effect of temporal order of information and product experience on health and taste perceptions as outcome variables. Finally, we conducted regression analysis to explore if presenting information before vs. after first product have an impact on the relative weight of the health and taste perceptions in the formation of purchase intention (as assumed in section "Temporal order of information effect"). Therefore, we conducted separate regression analysis for each experimental condition as recommended by (47).

Results

The effect of temporal order of information and tasting on purchase intentions

The ANCOVA showed significant main effects for temporal order of information, evaluation phase and level of protein enrichment, as shown in **Table 2**. In addition, all interactions were significant, with the exception of the interaction of evaluation phase and level of protein enrichment.

Figure 6 shows purchase intention for the three experimental conditions and for the three evaluation phases. The planned contrast analysis revealed that the nutrition claims on the protein content significantly increased participants' purchase intention compared to the control condition ($t = 10.49$, $p < 0.001$), showing a medium effect ($d = 0.545$, 95% *CI* [0.443, 0.647]). These results thus endorse the fact that participants have higher purchase intentions of plant-based products when they are informed about the protein content. Further, having information before product tasting significantly increased participants' purchase intentions compared to having the same information presented after the product tasting ($t = 9.75$, $p < 0.001$, $d = 0.289$, 95% *CI* [0.231, 0.347]). This indicates that presenting information before tasting might have activated the health goal, giving higher weight to healthiness and lower weight to taste in the formation of purchase intention. In contrast, when participants taste first, it might give corresponding greater weight to the hedonic goal as opposed to the health goal. Alternatively, it is possible that when participants are exposed to the information first they make a cross-modal inference to a better taste and then experience it due to an assimilation effect, increasing subsequent purchase intention. We check for these assumptions in the subsequent section.

We also find that purchase intentions are significantly higher in the expectation phase than in the experience and post-experience phase, **Figure 6** (except for the informed after first taste condition). This suggests that the tasting experience disconfirms the taste expectations, or, in other words, that the actual taste was not as good as participants expected and that they hence adjusted their purchase intentions downward. Also this interpretation will be checked in the following section.

The main effect of level of product protein-enrichment on participants' purchase intentions was also significant ($F = 13.62$, $p < 0.001$, $\eta^2 = 0.014$, 95% *CI* [0.010, 0.049]). As expected, the purchase intention was greater for SoP products when compared to high HiP products ($M_{SoP} = 5.12$, $M_{HiP} = 4.47$, $p < 0.001$, $\eta^2 = 0.115$, 95% *CI* [0.080, 0.152]). We further found a significant interaction effect between temporal order of information (experimental conditions) and level of product protein-enrichment ($F = 3.60$, $p = 0.028$, $\eta^2 = 0.007$, 95% *CI* [0.000, 0.010]). Again, we find that giving the information before the first tasting raises the purchase intention, and this goes for

TABLE 2 Effect of temporal order of information (experimental conditions), product evaluation phase and level of product protein-enrichment on participants' purchase intentions, health perceptions, and taste perceptions.

Measures	Purchase intention					Health perceptions					Taste perceptions				
	F	*p*	η^2	*95% Confidence interval*		*F*	*p*	η^2	*95% Confidence interval*		*F*	*p*	η^2	*95% Confidence interval*	
				Lower	Upper				Lower	Upper				Lower	Upper
Between-subjects															
Temporal order of information (TOF) (experimental conditions)	22.30	<0.001	0.044	0.212	0.070	0.484	0.617	0.001	0.000	0.000	0.008	0.992	0.000	0.000	0.007
Within-subjects															
Product evaluation phase (PEP)	3.88	0.033	0.004	0.001	0.021	13.64	<0.001	0.014	0.010	0.048	5.24	0.013	0.005	0.001	0.025
Level of product protein-enrichment (LPPE)	13.62	<0.001	0.014	0.010	0.049	5.62	0.018	0.006	0.000	0.018	55.83	<0.001	0.054	0.029	0.082
PEP × LPPE	1.17	0.301	0.001	0.000	0.005	3.29	0.047	0.003	0.000	0.009	15.76	<0.001	0.016	0.006	0.027
TOF × PEP	16.14	<0.001	0.032	0.017	0.047	11.54	<0.001	0.023	0.010	0.035	3.15	0.014	0.006	0.000	0.013
TOF × LPPE	3.60	0.028	0.007	0.000	0.010	1.63	0.196	0.003	0.000	0.006	2.63	0.072	0.005	0.000	0.008
TOF × PEP × LPPE	3.59	0.012	0.007	0.001	0.014	0.724	0.548	0.001	0.000	0.005	0.54	0.668	0.001	0.000	0.004
Covariates															
Country (C)	137.70	<0.001	0.124	0.088	0.162	51.53	<0.001	0.050	0.027	0.079	76.76	<0.001	0.073	0.045	0.106
Product (P)	19.24	<0.001	0.019	0.006	0.039	31.31	<0.001	0.031	0.013	0.056	6.41	0.012	0.007	0.000	0.020
TOF × Country	2.33	0.098	0.005	0.000	0.019	65.18	<0.001	0.167	0.126	0.207	34.28	<0.001	0.096	0.062	0.130
TOF × Product	1.30	0.274	0.003	0.000	0.013	22.45	<0.001	0.065	0.036	0.094	6.74	<0.001	0.020	0.005	0.039
TOF × C × P	1.45	0.234	0.003	0.000	0.014	51.03	<0.001	0.136	0.097	0.174	15.61	<0.001	0.046	0.022	0.072

10.3389/fnut.2022.983856

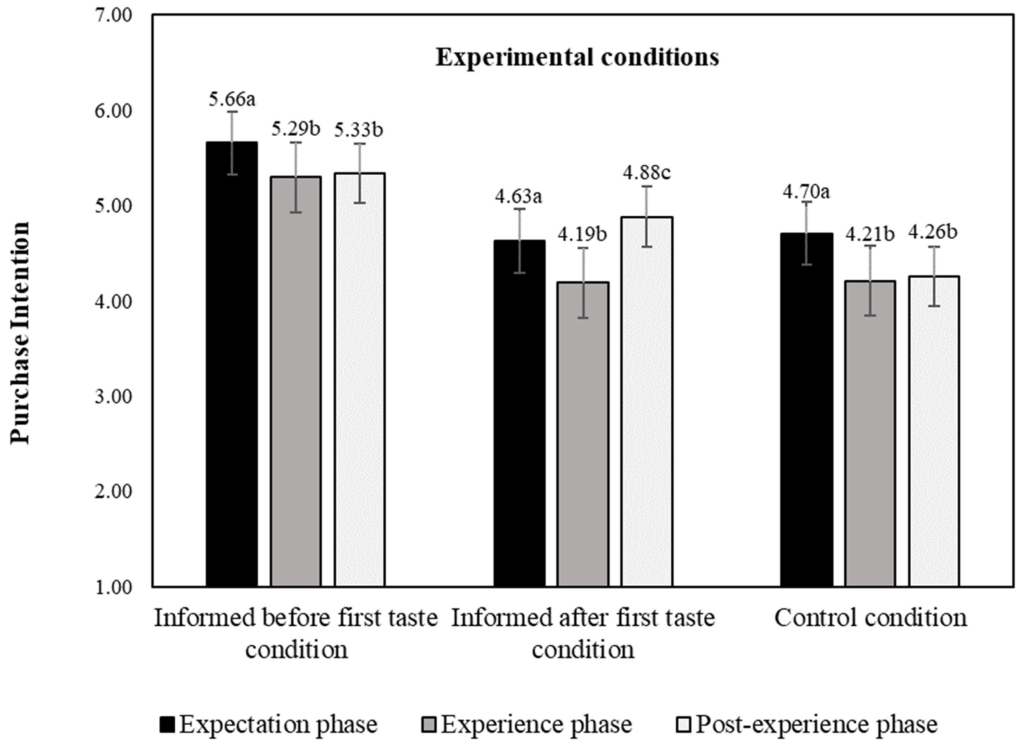


FIGURE 6
Purchase intention by product evaluation phase and experimental condition estimated, marginal means; a–c: means with different letters are significantly different at $p < 0.05$ level; purchase intention measured on a 11-point probability scale. The bars display standard errors.

both levels of protein enrichment, Figure 7. We do not find significant differences between the informed after tasting and control condition ($p_{SoP} = 1.00$; $p_{HiP} = 0.38$), as expected.

The effect of temporal order of information and tasting on health and taste perceptions

In order to shed more light on the mechanisms responsible for the effects on purchase intention found in the preceding section; we conducted additional repeated measures ANCOVAs, in which we replaced purchase intentions with health and taste perceptions as our focal outcome variables.

When considering health perceptions, we found that presenting information (either before or after tasting) when compared to the control condition does indeed significantly influence participants' health perceptions ($t = 4.48$, $p < 0.001$, $d = 0.233$, 95% CI [0.131, 0.334]). In fact, the interaction effect of the temporal order of information with product evaluation phase shows significance ($F = 11.54$, $p < 0.001$, $\eta^2 = 0.023$, 95% CI [0.010, 0.035]), Table 2 and Figure 8.

In the informed after tasting condition health perceptions decrease after first tasting ($M_{Exp.\_IAFT} = 5.05$, $M_{Exper.\_IAFT} = 4.71$, $p < 0.001$) but increase again after receiving information and second tasting (i.e., post-experience phase) ($M_{Post-Exper.\_IAFT} = 5.24$, $p < 0.001$). We thus find that health perceptions decrease after tasting when no information has been presented, but increase after tasting when information has been presented. Taste seems to work as a health cue, but the interpretation of this cue depends on the availability of the information. When there was no information on protein content, participants take the taste as an indication of a lower degree of healthiness. When, however, information about the protein content was available when tasting, the effect reverses and the taste is taken as an indicator of a higher degree of healthiness. Indeed, presenting the information alone without being able to taste does not seem to influence expectations about healthiness; it needs to be combined with the taste experience.

Furthermore, we find that SoP products are on average perceived as healthier than HiP products across all evaluation phases ($M_{SoP} = 5.06$, $M_{HiP} = 4.90$, $p < 0.001$), as we find significance main effect on health perceptions. However, we do not find significant interaction effect of level of product protein-enrichment with experimental conditions on health perceptions ($F = 1.63$, $p = 0.196$, $\eta^2 = 0.003$, 95% CI [0.000, 0.006]), Table 2.

For the taste perceptions, both the main effect of product evaluation phase ($F = 5.24$, $p = 0.013$, $\eta^2 = 0.005$, 95% CI [0.001, 0.025]) and its interaction effect with experimental conditions was significant ($F = 3.15$, $p = 0.014$, $\eta^2 = 0.006$,

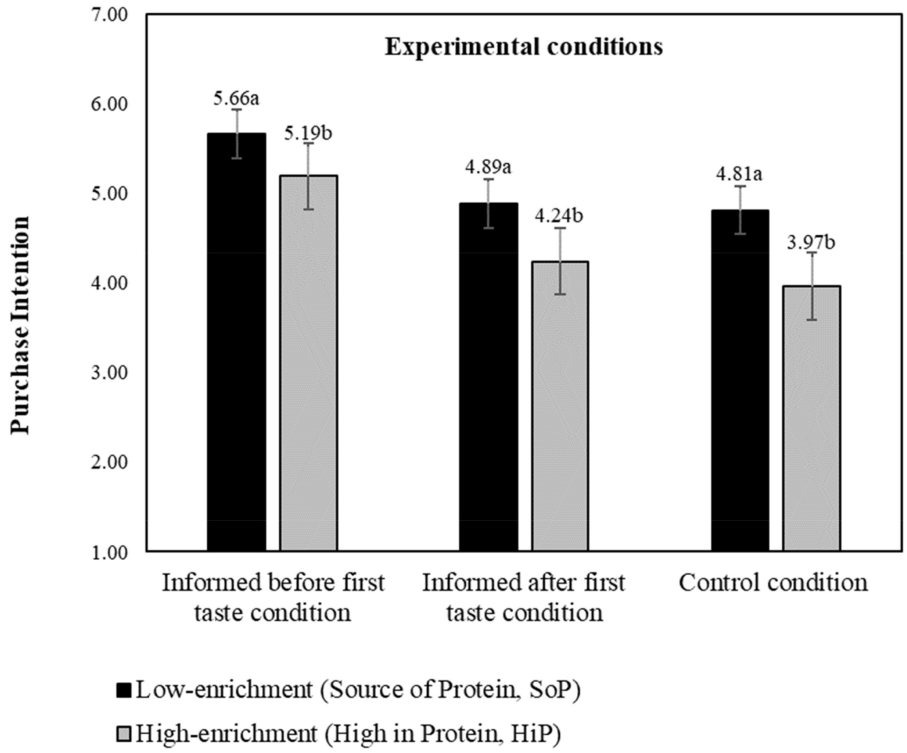


FIGURE 7
Interaction effect of experimental conditions and level of product protein-enrichment on purchase intention, estimated marginal means. a,b: means with different letters are significantly different at $p < 0.05$ level; purchase intention measured on a 11-point probability scale. The bars display standard errors.

95% *CI* [0.000, 0.013]), Table 2 and Figure 9 shows that taste perception slightly decreases after the first tasting when no information was available, indicating that the taste perception did not live up to the taste expectations. Giving information about the protein content, however, mitigates this effect. When information is presented first, so that both tasting occur with information available, the taste perceptions remains at the same level after first tasting ($M_{Exp.} = 4.81$, $M_{Exper.} = 4.87$, $p = 0.575$), and stays constant even in the post-experience phase ($M_{Post-Exper.} = 4.85$, $p = 0.759$). When information is given after the first tasting, the taste perception first decreases after the first tasting ($M_{Exp.} = 4.98$, $M_{Exper.} = 4.70$, $p = 0.009$), but then increases again after receiving the information from experience to post experience phase ($M_{Post-exper.} = 4.88$, $p = 0.001$).

The main effect of level of product protein enrichment was also significant ($F = 55.83$, $p < 0.001$, $\eta^2 = 0.054$, 95% *CI* [0.029, 0.082]). Generally, SoP products were preferred over HiP products in terms of taste ($M_{SoP} = 4.96$, $M_{HiP} = 4.74$, $p < 0.001$).

Finally, to check whether presenting information before (vs. after) tasting activates the health goal (vs. hedonic goal), and offers the higher weight to the healthiness perceptions (when compared to the taste perceptions) in its impact on purchase intentions, we conducted regression analysis separately for the before tasting, after tasting, and control experimental condition. In each of the three-conducted regression analysis, the purchase intention was dependent variable, while the health and taste perceptions acted as independent variables, we transformed variables and used their *Z*-scores in the analysis and bootstrapping procedure (47). When comparing results from three experimental conditions we found that presenting information before product tasting indeed increases the weight of health perceptions compared to the taste perceptions on purchase intentions ($exp(b)_{Health} = 1.821$, $p < 0.001$, 95% *CI* [1.623, 2.044]; $exp(b)_{Taste} = 1.131$, $p = 0.017$, 95% *CI* [1.023, 1.252]). In contrast, when presenting information after the tasting it gives the higher weight to the taste perceptions when compared to health perceptions ($exp(b)_{Taste} = 1.817$, $p < 0.001$, 95% *CI* [1.610, 2.040]; $exp(b)_{Health} = 1.149$, $p < 0.001$, 95% *CI* [1.322, 1.687]).

The main and interaction effect of country and product on product evaluations

The main between-subjects effect of country and product on participants' purchase intentions were both significant ($F = 137.70$, $p < 0.001$, $\eta^2 = 0.124$, 95% *CI* [0.088,

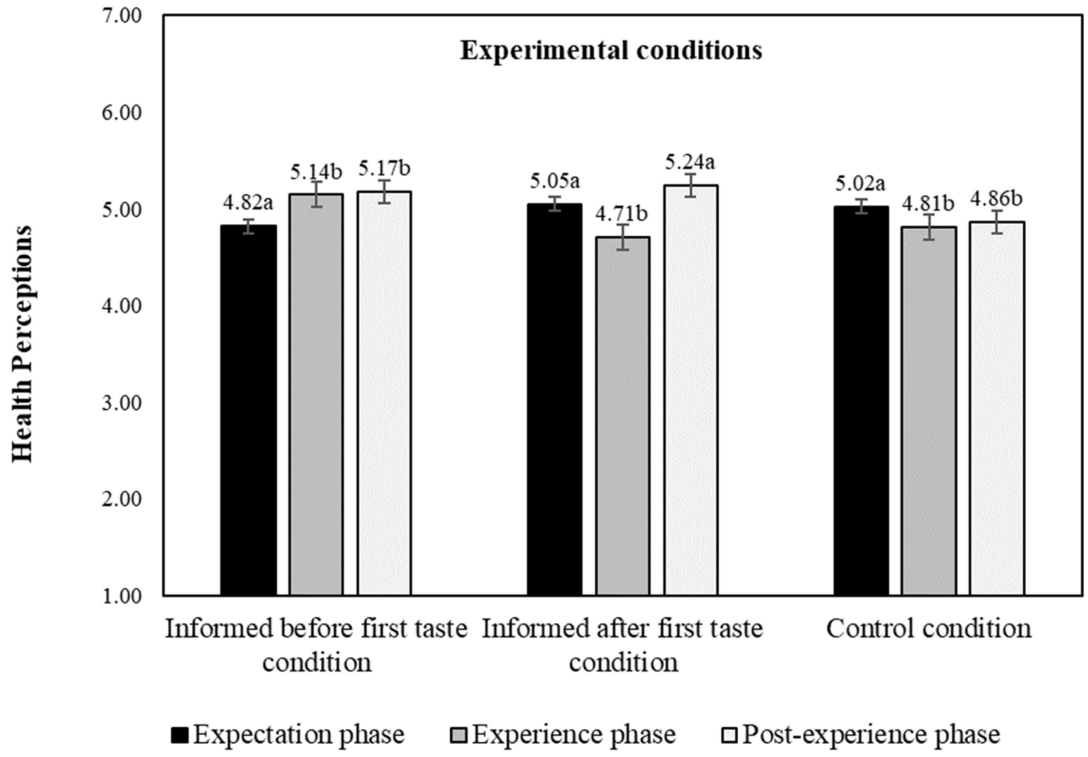


FIGURE 8
Interaction effect of experimental conditions and product evaluation phase on health perceptions, estimated marginal means. a–c: means with different letters are significantly different at $p < 0.05$ level; health perceptions measured on a 9-point hedonic scale. The bars display standard errors.

0.162]; $F = 19.24$, $p < 0.001$, $\eta^2 = 0.019$, 95% *CI* [0.006, 0.039], respectively), Table 2. The data show that on the average Romanian and Finish participants had slightly higher intention to buy plant protein enriched products ($M_{RO} = 5.97$; $M_{FI} = 4.77$) than Danish and Icelandic participants, ($M_{DK} = 4.11$; $M_{ICE} = 4.19$). With regard to the three product categories, on average participants expressed a higher intention to buy protein-enriched pasta and bread ($M_{Pasta} = 5.55$; $M_{Bread} = 5.22$) when compared to protein-enriched biscuits ($M_{Biscuits} = 4.20$). However, the interaction effect of country and experimental conditions, as well as product and experimental conditions, on purchase intention were both non-significant ($p = 0.098$, $p = 0.274$, respectively).

On the other hand, when looking at the health and taste perceptions, the interaction effect of country and experimental conditions was significant in both cases (all $ps < 0.001$), Table 2. Consistent with general findings data show across countries that for health perceptions and when comparing informed after and before tasting condition health perceptions decline when no information is presented, yet rise after tasting when information is presented. This effect seems to be significantly more pronounced (all $ps < 0.001$) among Romanian and German participants (after tasting condition: $M_{RO\_IAFT} = 6.81$; $M_{DK\_IAFT} = 6.26$; before tasting condition: $M_{RO\_IBFT} = 7.76$; $M_{DK\_IBFT} = 6.93$) than Danish and Icelandic participants, (after tasting condition: $M_{DK\_IAFT} = 5.06$; $M_{ICE\_IAFT} = 6.16$; before tasting condition: $M_{DK\_IBFT} = 4.92$; $M_{ICE\_IBFT} = 5.26$). This shows that there were some differences between the countries with regards to the influence of the information given, which was certainly more effective among Romanian participants. Nevertheless, same general effect was observed across countries.

For the taste perceptions, in the informed after the first tasting condition, across all countries taste perception slightly decreases when compared to informed before first tasting condition, indicating that the taste experience was not at the same level as taste expectations. This general effect was again similarly as above more evident (all $ps < 0.001$) among Romanian and German participants (after tasting condition: $M_{RO\_IAFT} = 6.39$; $M_{DK\_IAFT} = 5.19$; before tasting condition: $M_{RO\_IBFT} = 6.55$; $M_{DK\_IBFT} = 5.50$) than Danish and Icelandic participants, (after tasting condition: $M_{DK\_IAFT} = 4.34$; $M_{ICE\_IAFT} = 5.03$; before tasting condition: $M_{DK\_IBFT} = 4.66$; $M_{ICE\_IBFT} = 5.20$). This could be due to the fact that Scandinavian participants are more accustomed to the information on protein enrichment and plant-based products which are more available on their food market (48), and thus it might be that the presented information does not have the same first-impression impact.

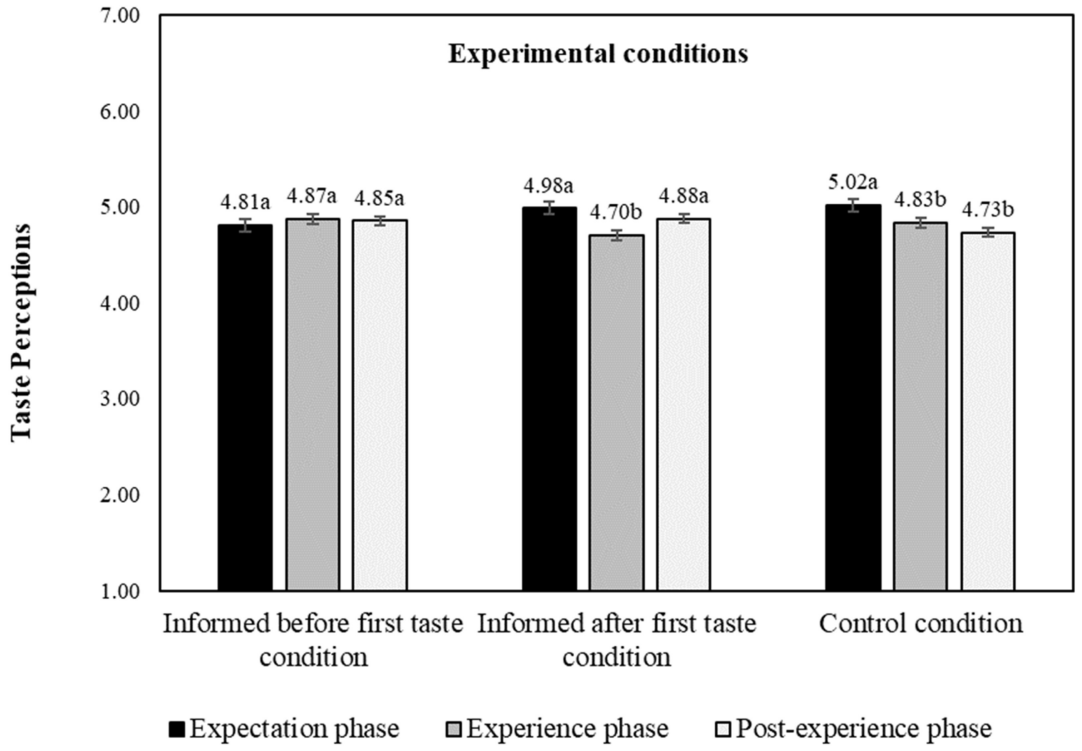


FIGURE 9
Interaction effect of experimental conditions and product evaluation phase on taste perceptions, estimated marginal means. a–c: means with different letters are significantly different at $p < 0.05$ level; taste perceptions measured on a 9-point hedonic scale. The bars display standard errors.

Discussion

Nutrition and health claims are major means of informing consumers about characteristics of food products and are also important regarding the promotion of healthy and sustainable plant-based products (49). Research has shown, though, that consumer attention to nutrition and health claims at the point of purchase is limited (50). However, nutrition and health information can have an effect on consumers also after the purchase (32). Consumers may be more at ease with reading this type of information at home, after they have purchased the product, and possibly after the first tasting experience, but not much is presently known about the temporal effect of nutrition and health information on consumers' product perceptions and intentions. Our study contributes to understanding how the effect of nutrition and health information on consumers' purchase intentions, taste evaluations and health perceptions of plant-based food products differs depending on when it is presented to consumers–before the first tasting or after the first tasting. Understanding such effects is important as food products are frequently bought and most purchase intentions and product perceptions are formed for products that have been previously bought and tasted.

The main results of our study show that it does indeed make a difference when the nutrition and health information is presented [cf. (31, 32)]. Starting with the purchase intentions, we found that the effect of information is highest when it is presented before the first tasting in expectation, experience, and post-experience phases. Further, our results show that the information before tasting increases the weight of health perceptions over the taste perceptions in explaining purchase intentions. The latter is most likely due to the fact that presenting the information increases the salience of health and consequently makes health having a larger impact on the formation of purchase intentions relative to taste [cf. (33)].

Interestingly, the same type of information effect was not detected in consumers' taste perceptions. The taste expectations before the actual tasting were similar regardless of the information presence. However, in the control condition without any information, the taste evaluations significantly dropped in contrast to the pre-tasting expectations and remained lower until the final post-experience phase evaluation. In the "informed after first tasting" condition, the taste perceptions dropped in the first blind tasting in contrast to the expectations, but bounced back in the final evaluation with the information. In the informed condition, the taste perceptions remained stable throughout all three evaluation phases. These results are aligned with the earlier findings that information

in general has influence on the taste perceptions (39) and relevant and value adding information tends to enhance the taste perceptions (37), demonstrated also in the context of information related to oat-enriched foods (15). However, what is interesting here is that the information had significant effect on the taste perceptions after the first blind exposure to the products' sensory qualities ('informed after first taste' condition). This might be because of the congruence between the product type and the health information. It has been found that the health information can have positive effect on the hedonic ratings especially in products (e.g., bread and pasta), which inherently carry health meanings to consumers (42, 51).

In addition, our study provides interesting new insights into how health and how nutrition and health information affects both health and taste perceptions, and on how this effect is dependent on actual taste experience. It is well-known that consumers can form subjective links between healthiness and taste, usually implying that healthy products are believed to be less tasty and vice-versa (33), even though this relationship seems to depend on a range of other factors such as the product type (42). Little is known, though, about how information and taste experience interact in the formation of health and taste experiences. Our study shows that the taste experience can indeed serve as a health cue, but that the type of inference made depends on the information provided. When no information was provided before tasting, the worse-than-expected taste was taken as a cue to indicate a worse-than-expected healthiness. However, when information about the protein content of the product was available, this effect reversed and participants increased their perception of healthiness because of the taste experience.

Our results, if corroborated by future studies, have interesting implications for the promotion of plant-based products. First, it is clear that making information available before the first tasting, i.e., at the point of purchase, is crucial. This makes the health aspect more salient in the formation of purchase intentions, raises purchase intentions, and also mitigates disappointment during the first tasting. However, the results also show that an important second effect of the information occurs during tasting. Tasting in an informed condition not only improves the taste experience, but also strengthens the health perception, by making the taste a positive health cue. This, in turn can to some extent counteract the lesser weight of healthiness as compared to taste in the post-tasting formation of purchase intentions. The boundary conditions for this to occur still need to be investigated, but a better understanding of these processes is crucial for the formation of habits in the purchase of healthy and sustainable food products.

Further, our results indicate that consumers evaluated the products with lower level of protein enrichment (i.e., SoP) tastier and healthier in comparison to the products with higher level of protein enrichment (i.e., HiP). In addition, consumers showed higher purchase intentions toward the products with less protein. There might be several reasons for this. First of all, the higher perceptions and intentions toward SoP products might be explained by the target products. Previous research indicates the importance of the fit between the carrier product and the added ingredient (52), also in the added protein domain (53). It might be that bread, pasta and biscuits were considered suitable carrier products for lower amount of protein (SoP), but not for the high amount (HiP) making the lower level of protein more favorable. Another potential explanation might be related to the protein source. Familiarity with the oat as ingredient in food has been found to influence consumers' responses toward the products (54). As oat is not a widely known cereal for human consumption in many countries except for the Northern Europe, the stated high level of an unknown ingredient in a food might have reduced the consumers' intentions on the products.

When it comes to the higher hedonic experience with the SoP products in contrast to HiP, the product features have a role to play. For instance, good quality pasta is defined as having high degree of firmness and elasticity (55). Proper evaluation of pasta cooking quality requires consideration of a number of factors including elasticity, firmness, surface stickiness, cooking tolerance, water absorption, and loss of solids to cooking water but also attributes related with the consumers' acceptance: color, flavor (unusual flavor or off-flavor), palatability. Short spiral pasta obtained from SRE (SoP) had a protein content around 12%, lower than short spiral pasta obtained from OPC (HiP) with 22% protein content. The fat content of the pasta samples was in the range between 0.8 and 3%, with a higher content for HiP. HiP dried sample was darker than SoP. The addition of oat protein concentrate produced an increase in hardness and chewiness of pasta in HiP sample. Addition of protein concentrates from oat had a great impact on the pasta color, increased hardness and decreased elasticity. Chewiness and sourness increased slightly [all results on product qualities are reported in Duta et al. (55)]. Taking together, the sensory properties of the HiP products have been inferior in comparison to the SoP products potentially contributing to the respective taste evaluations.

Limitations

Our study is based on three plant-based products (i.e., pasta, bread, and biscuits) and conducted in four European countries (Denmark, Finland, Iceland, and Romania), which strengthens the generalizability of the results. Still, the results are obviously specific to the three products investigated, the specific type of claim studied, namely a nutrition claims regarding the protein content, i.e., SoP and HiP, and oat as an protein ingredient. Further, there was no actual purchase involved and the two tastings were condensed in a short time span in a controlled lab condition. In this way, the study context is removed from the daily situation where people shop, eat, shop again, and eat again. Future studies, could investigate effect of nutrition claims in a real-life context to confirm the influence of temporal order of

information and product experience on consumers' evaluation of plant-based products and thus supplement the present study allowing for nutrition and health regulations to further evolve. In addition, since the products tested were all cereals, it would be valuable to investigate temporal-order effects using other plant-based products (e.g., meat or dairy substitutes). Grasso et al. (41) and (15) found an increase in overall liking for plant-based burgers and yogurts within informed-tasting conditions, relative to blind-tasting conditions. Thus, temporal order effects may likely extend beyond the plant-based substitutes examined here. Future research could also extend the investigation to other sensory features, such as a product's visual appearance, texture, and bitterness.

Practical implications

In terms of promoting the purchase and consumption of plant-based products marketed considering their content or ingredients (e.g., protein content), our results clearly emphasize the need to make the information about the nutritional properties of these products available both at the point of purchase and during consumption. While making the information available at the point of purchase has received plenty of attention and labeling mechanisms have been widely discussed, much less is known about how to make the information available again at the time of consumption. The packaging of the products is an obvious channel of communication also in the home, but other channels are conceivable, for example in the context of recipes and food blogs.

Conclusion

Overconsumption of meat is threatening both the environment and human health, which has led to development of healthy and sustainable plant-based products. Along with the product development, informing consumers about the products and their versatile benefits is of importance to facilitate transition from meat-based diets to plant-based ones. This study analyzed the effect of temporal order of information on consumers' purchase intentions, taste experiences and health perceptions toward oat-enriched pasta, bread, and biscuits. The results of the study showed that receiving health and nutrition related information about the products before the actual experience with the products increased all evaluations. However, the results indicate that informing consumers also after the first experience with the product leads to elevated consumers' evaluations and experiences with the products afterward. To conclude, the study provides understanding for food companies and marketers about the importance of informing consumers before the actual product experience but also afterward. Informing consumers after the first exposure, for example through a product label, can have significant effects on the subsequent purchase intentions and product evaluations.

Data availability statement

The datasets presented in this article are not readily available because of legal and privacy issues related to the confidentiality of the tested products, which impose limitations and impede the availability of the whole dataset. Requests to access the "minimal dataset" that is underlying the findings described and used to reach the conclusions of the manuscript are available to any qualified researchers and should be directed to MB, maba@mgmt.au.dk.

Ethics statement

The studies involving human participants were reviewed and approved by the Aarhus University, Cognition and Behavior Lab. The patients/participants provided their written informed consent to participate in this study. The research was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki.

Author contributions

MB: conceptualization, research design, methodology, investigation, experimental lab work, formal data analysis, and writing – review and editing. AA and KP: methodology, investigation, experimental lab work, and writing – review and editing. DD and KS: experimental lab work and writing – review and editing. NS: reviewing and editing and funding. KG: conceptualization, research design, methodology, and writing – review and editing. All authors contributed to the article and approved the submitted version.

Acknowledgments

We acknowledge European project ERA-NET SUSFOOD OATPRO-project which was supported by Ministry of Agriculture and Forestry (MMM, Finland), the Federal Ministry of Education and Research, (BMBF, Germany), Romanian National Authority for Scientific Research and Innovation, (CCCDI-UEFISCDI, Romania), and Danish Agency for Science, Technology and Innovation (DASTI, Denmark). Also, Nordic Innovation FUNPRO project under grant agreement no. P14046 is acknowledged, together with the Aarhus University Research Foundation project no. AUFF-E-201 9-9-15, ESTIMA–Estimating a meat demand system and "prices" of economic interventions to achieve environmental targets. We would like to also thank Fazer Mills (Lahti, Finland)

in providing oat protein concentrate and Fazer Bakeries (Vantaa, Finland) baking of SoP and HiP oat biscuits.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

1. FAO. *FAOSTAT Online Database*. (2022). Available online at: http://www.fao.org/faostat/en/#data (accessed on May 10, 2022).

2. Yip C, Lam W, Fielding R. A summary of meat intakes and health burdens. *Eur J Clin Nutr.* (2018) 72:18–29. doi: 10.1038/ejcn.2017.117

3. Vranken L, Avermaete T, Petalios D, Mathijs E. Curbing global meat consumption: emerging evidence of a second nutrition transition. *Environ Sci Policy.* (2014) 39:95–106. doi: 10.1016/j.envsci.2014.02.009

4. Reipurth MF, Hørby L, Gregersen CG, Bonke A, Cueto FJP. Barriers and facilitators towards adopting a more plant-based diet in a sample of Danish consumers. *Food Qual Prefer.* (2019) 73:288–92. doi: 10.1016/j.foodqual.2018.10.012

5. Allievi F, Vinnari M, Luukkanen J. Meat consumption and production–analysis of efficiency, sufficiency and consistency of global trends. *J Clean Prod.* (2015) 92:142–51. doi: 10.1016/j.jclepro.2014.12.075

6. Cheah I, Shimul AS, Liang J, Phau I. Drivers and barriers toward reducing meat consumption. *Appetite.* (2020) 149:104636. doi: 10.1016/j.appet.2020.104636

7. Swain M, Blomqvist L, Mcnamara J, Ripple WJ. Reducing the environmental impact of global diets. *Sci Total Environ.* (2018) 610:1207–9. doi: 10.1016/j.scitotenv.2017.08.125

8. Pais DF, Marques AC, Fuinhas JA. Reducing meat consumption to mitigate climate change and promote health: but is it good for the economy? *Environ Model Assess.* (2020) 25:793–807. doi: 10.1007/s10666-020-09710-0

9. Godfray HCJ, Aveyard P, Garnett T, Hall JW, Key TJ, Lorimer J, et al. Meat consumption, health, and the environment. *Science.* (2018) 361:eaam5324. doi: 10.1126/science.aam5324

10. Westhoek H, Lesschen JP, Rood T, Wagner S, De Marco A, Murphy-Bokern D, et al. Food choices, health and environment: effects of cutting Europe's meat and dairy intake. *Glob Environ Change.* (2014) 26:196–205. doi: 10.1016/j.gloenvcha.2014.02.004

11. Banovic M, Barone AM, Asioli D, Grasso S. Enabling sustainable plant-forward transition: European consumer attitudes and intention to buy hybrid products. *Food Qual Prefer.* (2022) 96:104440. doi: 10.1016/j.foodqual.2021.104440

12. Banovic M, Arvola A, Pennanen K, Duta DE, Brückner-Gühmann M, Lähteenmäki L, et al. Foods with increased protein content: a qualitative study on European consumer preferences and perceptions. *Appetite.* (2018) 125:233–43. doi: 10.1016/j.appet.2018.01.034

13. Banovic M, Barone AM. The hybrid enigma: the importance of self-construal for the effectiveness of communication messages promoting sustainable behaviour. *Food Qual Prefer.* (2021) 94:104334. doi: 10.1016/j.foodqual.2021.104334

14. Neville M, Tarrega A, Hewson L, Foster T. Consumer-orientated development of hybrid beef burger and sausage analogues. *Food Sci Nutr.* (2017) 5:852–64. doi: 10.1002/fsn3.466

15. Brückner-Gühmann M, Banovic M, Drusch S. Towards an increased plant protein intake: rheological properties, sensory perception and consumer acceptability of lactic acid fermented, oat-based gels. *Food Hydrocoll.* (2019) 96:201–8. doi: 10.1016/j.foodhyd.2019.05.016

16. Banovic M, Sveinsdóttir K. Importance of being analogue: female attitudes towards meat analogue containing rapeseed protein. *Food Control.* (2021) 123:107833. doi: 10.1016/j.foodcont.2020.107833

17. Snoeck J, Van Rompaey S. *The Future Of Food: A New Recipe for the Food Sector*. Belgium: Lannoo (2022).

18. de Boer J, Aiking H. Favoring plant instead of animal protein sources: legitimation by authority, morality, rationality and story logic. *Food Qual Prefer.* (2020) 88:104098. doi: 10.1016/j.foodqual.2020.104098

19. WHO. *Health, Environment And Climate Change, Seventy-Second World health Assembly*. Geneva: WHO (2019).

20. EC. *Report from the Commission to the Council and the European Parliament on the Development Of Plant Proteins in the European Union*. Belgium: European Comission (2018).

21. EC. *Balance Sheets By Sector*. Belgium: European Comission (2022).

22. Tarrega A, Rizo A, Murciano A, Laguna L, Fiszman S. Are mixed meat and vegetable protein products good alternatives for reducing meat consumption? A case study with burgers. *Curr Res Food Sci.* (2020) 3:30–40. doi: 10.1016/j.crfs.2020.02.003

23. Sogari G, Li J, Wang Q, Lefebvre M, Gómez MI, Mora C. Factors influencing the intention to purchase meat-mushroom blended burgers among college students. *Food Qual Prefer.* (2021) 90:104169. doi: 10.1016/j.foodqual.2020.104169

24. Watson E. Hybrid milk? DFA rolls out Dairy+ Milk Blends combining plant-based and Dairy Milk to Northeast. *Food-navigator.* (2020). https://www.foodnavigator-usa.com/Article/2020/10/31/Hybrid-milk-DFA-rolls-out-Dairy-Milk-Blends-combining-plant-based-and-dairy-milk-to-Northeast

25. Fiorentini M, Kinchla AJ, Nolden AA. Role of sensory evaluation in consumer acceptance of plant-based meat analogs and meat extenders: a scoping review. *Foods.* (2020) 9:1334. doi: 10.3390/foods9091334

26. Banovic M, Otterbring T. Athletic abs or big bellies: the impact of imagery, arousal levels, and health consciousness on consumers' attitudes towards plant-based protein products. *Food Qual Prefer.* (2021) 87:104067. doi: 10.1016/j.foodqual.2020.104067

27. Spencer M, Guinard JX. The flexitarian flip^{TM}: testing the modalities of flavor as sensory strategies to accomplish the shift from meat-centered to vegetable-forward mixed dishes. *J Food Sci.* (2018) 83:175–87. doi: 10.1111/1750-3841.13991

28. Kemper JA. Motivations, barriers, and strategies for meat reduction at different family lifecycle stages. *Appetite.* (2020) 150:104644. doi: 10.1016/j.appet.2020.104644

29. Lymbery P, Goodall J, Popkin B, Templer R, Kemp M, Phillips C, et al. Promote flexitarian diets worldwide: supplementary information to: governments should unite to curb meat consumption. *Nature.* (2018) 563:325–325. doi: 10.1038/d41586-018-07384-z

30. EC. *Farm to Fork Strategy: For a Fair, Healthy And Environmentally-Friendly Food System*. Belgium: European Comission (2020).

31. Levin IP, Gaeth GJ. How consumers are affected by the framing of attribute information before and after consuming the product. *J Consume Res.* (1988) 15:374–8. doi: 10.1086/209174

32. Banoviæ M, Grunert KG, Barreira MM, Fontes MA. Beef quality perception at the point of purchase: a study from Portugal. *Food Qual Prefer.* (2009) 20:335–42. doi: 10.1016/j.foodqual.2009.02.009

33. Raghunathan R, Naylor RW, Hoyer WD. The unhealthy= tasty intuition and its effects on taste inferences, enjoyment, and choice of food products. *J Market.* (2006) 70:170–84. doi: 10.1509/jmkg.70.4.170

34. Wilcox K, Roggeveen AL, Grewal D. Shall I tell you now or later? Assimilation and contrast in the evaluation of experiential products. *J Consume Res.* (2011) 38:763–73. doi: 10.1086/660702

35. Liu MT, Phau I, Teah M. "First in first out" or "last in first out": presentation of information order on evaluation of utilitarian products. *J Retail Consume Serv.* (2017) 36:148–55. doi: 10.1016/j.jretconser.2017.01.013

36. Biswas D, Grewal D, Roggeveen A. How the order of sampled experiential products affects choice. *J Market Res.* (2010) 47:508–19. doi: 10.1509/jmkr.47.3.508

37. Banoviæ M, Grunert KG, Barreira MM, Fontes MA. Consumers' quality perception of national branded, national store branded, and imported store branded beef. *Meat Sci.* (2010) 84:54–65. doi: 10.1016/j.meatsci.2009.08.037

38. Poelman A, Mojet J, Lyon D, Sefa-Dedeh S. The influence of information about organic production and fair trade on preferences for and perception of pineapple. *Food Qual Prefer.* (2008) 19:114–21. doi: 10.1016/j.foodqual.2007.07.005

39. Piqueras-Fiszman B, Spence C. Sensory expectations based on product-extrinsic food cues: an interdisciplinary review of the empirical evidence and theoretical accounts. *Food Qual Prefer.* (2015) 40:165–79. doi: 10.1016/j.foodqual.2014.09.013

40. Verbeke W. Functional foods: consumer willingness to compromise on taste for health? *Food Qual Prefer.* (2006) 17:126–31. doi: 10.1016/j.foodqual.2005.03.003

41. Grasso S, Rondoni A, Bari R, Smith R, Mansilla N. Effect of information on consumers' sensory evaluation of beef, plant-based and hybrid beef burgers. *Food Qual Prefer.* (2022) 96:104417. doi: 10.1016/j.foodqual.2021.104417

42. Siegrist M, Stampfli N, Kastenholz H, Keller C. Consumers' willingness to buy functional foods. The influence of carrier, benefit and trust. *Appetite.* (2008) 51:526–9. doi: 10.1016/j.appet.2008.04.003

43. Heymann H, Lawless HT. *Sensory Evaluation Of Food: Principles And Practices*. Berlin: Springer Science & Business Media (2013).

44. Meyvis T, Van Osselaer SM. Increasing the power of your study by increasing the effect size. *J Consume Res.* (2018) 44:1157–73. doi: 10.1093/jcr/ucx110

45. Juster FT. Consumer buying intentions and purchase probability: an experiment in survey design. *J Am Stat Assoc.* (1966) 61:658–96.

46. Field AP. *Discovering Statistics Using SPSS: (and Sex and Drugs and Rock 'n' Roll)*. London: SAGE (2013).

47. Cummings P. The stata journal. *Methods Estimat Adjust Risk Ratios.* (2009) 9:175–96. doi: 10.1177/1536867X0900900201

48. Mintel. *Mintel's Global New Products Database (GNPD)*. London: MINTEL (2022).

49. Lacy-Nichols J, Hattersley L, Scrinis G. Nutritional marketing of plant-based meat-analogue products: an exploratory study of front-of-pack and website claims in the USA. *Public Health Nutr.* (2021) 24:4430–41. doi: 10.1017/S1368980021002792

50. Volkova E, Ni Mhurchu C. The influence of nutrition labeling and point-of-purchase information on food behaviours. *Curr Obesity Rep.* (2015) 4:19–29. doi: 10.1007/s13679-014-0135-6

51. Van Kleef E, Van Trijp HC, Luning P. Consumer research in the early stages of new product development: a critical review of methods and techniques. *Food Qual Prefer.* (2005) 16:181–201. doi: 10.1016/j.foodqual.2004.05.012

52. Krutulyte R, Grunert KG, Scholderer J, Lähteenmäki L, Hagemann KS, Elgaard P, et al. Perceived fit of different combinations of carriers and functional ingredients and its effect on purchase intention. *Food Qual Prefer.* (2011) 22:11–6. doi: 10.1016/j.foodqual.2010.06.001

53. Song X, Pérez-Cueto FJ, Laugesen SMB, Van Der Zanden LD, Giacalone D. Older consumers' attitudes towards food carriers for protein-enrichment. *Appetite.* (2019) 135:10–9. doi: 10.1016/j.appet.2018.12.033

54. Wong CL, Mendoza J, Henson SJ, Qi Y, Lou W, L'abbé MR. Consumer attitudes and understanding of cholesterol-lowering claims on food: randomize mock-package experiments with plant sterol and oat fibre claims. *Eur J Clin Nutr.* (2014) 68:946–52. doi: 10.1038/ejcn.2014.107

55. Duta DE, Culetu A, Sozer N. Effect of dry fractionated hybrid protein ingredients on the structural, textural, thermal and sensory properties of gluten-free oat and faba pasta. *Int J Food Sci Technol.* (2019) 54:3205–15. doi: 10.1111/ijfs.14297

frontiers | Frontiers in Sustainable Food Systems

TYPE Original Research
PUBLISHED 28 September 2022
DOI 10.3389/fsufs.2022.997590

OPEN ACCESS

EDITED BY
Christopher John Bryant,
University of Bath, United Kingdom

REVIEWED BY
Giulio Gabrieli,
Italian Institute of Technology, Italy
Andreas Bschaden,
University of Hohenheim, Germany

*CORRESPONDENCE
Heidi Zamzow
h.zamzow@lse.ac.uk

SPECIALTY SECTION
This article was submitted to Nutrition and Sustainable Diets, a section of the journal Frontiers in Sustainable Food Systems

RECEIVED 19 July 2022
ACCEPTED 23 August 2022
PUBLISHED 28 September 2022

CITATION
Zamzow H and Basso F (2022) *'Say Cheese!'*: Humane halos from environmental practices in dairy production.
Front. Sustain. Food Syst. 6:997590.
doi: 10.3389/fsufs.2022.997590

'Say Cheese!': Humane halos from environmental practices in dairy production

Heidi Zamzow* and Frédéric Basso

Department of Psychological and Behavioural Science, London School of Economics and Political Science, London, United Kingdom

Awareness of the negative impacts of our food choices on planetary, human and animal health is growing. Research shows an increasing number of consumers consider ethical consequences when purchasing food. A new market sector has emerged which caters to the demands of these value-driven consumers. However, attempts to change the market through ethical purchases may be thwarted by advertising strategies which exploit the 'halo effect', a cognitive bias which manifests when first impressions of one attribute influence subsequent evaluations of unknown attributes. This research investigates how two ethical domains, environmentalism and animal welfare, interact to influence consumer choice. In an online experiment, we recruited 267 participants and randomly assigned them to read either a pro-environmental, anti-environmental, or ethically neutral vignette about a cheese company. After being asked to rate the dairy on how well it treats its cows—an issue on which no information had been provided—participants indicated how frequently they would recommend the cheese compared to other brands. Results confirm that information about the company's environmental practices influenced perceptions of its animal welfare practices: a 'humane halo' effect. Further, humane ratings predicted product consumption recommendations, indicating the humane halo acted as a mediator. Exploratory analyses suggest the strength of this mediated relationship depends on participants' environmental protection values, particularly if they received negative information. Our findings establish the existence of a cross-domain halo in food ethics and shed light on ways to increase the effectiveness of policies designed to shift consumers to more sustainable diets.

KEYWORDS

ethical consumption, animal products, dairy reduction, halo effect, animal welfare, environmental values, negativity bias

Introduction

Among animal products, cheese is the third largest emitter of greenhouse gases, after lamb and beef (Poore and Nemecek, 2018). In addition, dairy production is a major contributor to other environmental problems such as poor air quality (Domingo et al., 2021), water pollution (Joy et al., 2022), and excessive and inefficient use of natural resources (Shepon et al., 2018; Clark et al., 2019; Hayek et al., 2020). Animal agriculture is often discussed without differentiating between product types (e.g., Wellesley et al., 2015), making dairy's contribution to climate change and other environmental

impacts less salient in both the scientific and public spheres. As a result, researchers and policymakers concerned with sustainability have focused on meat consumption in their educational and behavioural interventions (see review in Kwasny et al., 2022). Whilst many industrialised countries may be reaching 'peak meat' (Carrington, 2021), both demand for cheese and emissions from dairy continue to rise (Sharma, 2020; USDA, 2021). More research is needed to understand perceptions of dairy production in order to identify opportunities for reducing consumption.

In the UK, food choices are primarily based on taste, cost, and convenience (Wellesley et al., 2015). Beyond self-interested drivers, however, there is evidence showing consumers can also be motivated by more altruistic concerns (Lusk and Briggeman, 2009), including human rights, the environment, and animal welfare (Hain, 2017). These 'ethical consumers' use their purchasing power to further ethical goals, considering both upstream (e.g., resource extraction and production methods) and downstream (e.g., pollution) consequences of their food choices.

Recent literature suggests that environmental concerns may be contributing to the observed decline in demand for meat (Sanchez-Sabate and Sabaté, 2019), and some studies indicate animal welfare also may be playing a role (Bertrandias et al., 2021; Mathur et al., 2021). Consumer research has consistently shown that the majority of people in Western cultures care about how food animals are treated (Bayvel and Cross, 2010; Ingenbleek et al., 2012; Estévez-Moreno et al., 2022), and many consumers are willing to pay more for humanely-sourced food (Lagerkvist and Hess, 2011; Spain et al., 2018; Thibault et al., 2022). This concern has created a new market sector which caters to the demands of these ethical consumers, such as 'cage-free' eggs and 'pasture-raised' beef.

However, questions remain as to whether such marketing practices effectively serve the intentions and expectations of value-driven consumers. Bray et al. (2011) conducted focus groups in the UK to better understand impediments to ethical consumption. Although lack of awareness about the ethical consequences of consumption choices was a significant barrier, the primary issue which kept consumers from translating their ethical preferences into purchasing behaviours was the quantity, variety, and ambiguous nature of value-based labels and advertisements which left consumers feeling confused and overwhelmed. Similarly, a recent survey of 1,000 US consumers found that 89% selected animal-sourced foods believing the labels signified better treatment of animals, yet some labels (e.g., 'humane,' 'farm-raised') lacked uniform standards, and others referred to production practices unrelated to animal welfare (Thibault et al., 2022). For example, the survey showed almost 70% of respondents purchased 'natural' dairy products because they associated the label with more humane practices, yet this appellation has no bearing on treatment of dairy cows (Dominick et al., 2018). Likewise, UK consumers motivated by animal welfare concerns may purchase organic foods because they conflate the term 'organic' with being 'animal-friendly' (Harper and Makatouni, 2002). Food manufacturers have a vested interest in highlighting only those product attributes which they believe will appeal to their customers. The obscurity and ambivalence which are often inherent in ethically-based food choices create an ideal scenario for the *halo effect* when marketing claims are salient in one ethical attribute yet silent on another.

The halo effect

The halo effect is a type of cognitive bias where known characteristics of a person or product influence expectations about unknown qualities. The term was first coined by Edward Thorndike (1920) who observed that, when asking someone to evaluate a colleague in one attribute, the rater's initial evaluation cast a 'halo' which predicted subsequent evaluations of other attributes. In daily life, choices are often based on information that is, at best, limited and ambiguous. The halo effect can facilitate more rapid and efficient decision-making by engaging heuristic processing mechanisms which selectively identify and interpret information to fit patterns. Because these inferences are not backed by evidence, the halo effect reinforces and propagates cognitive bias, creating a path dependency which can play a significant role in shaping not only perceptions but behaviours.

In recent years, ethical consumers have become a significant share of the market, with some surveys indicating upwards of 80% of respondents prioritise sustainability and brands which align with their social values (Kohan, 2021). Because consumers' beliefs about a company can have a strong influence on their purchasing behaviour, many firms are responding with marketing campaigns which signal corporate social responsibility (CSR) to enhance their image with stakeholders and promote brand loyalty (Jin and Lee, 2019). Such branding strategies often benefit from halo effects. For instance, Sheehan and Lee (2014) found that a 'cruelty-free' claim caused consumers to perceive a product as being safer and more socially responsible than other brands, and that this perception was intensified by values related to animal welfare.

Research shows that halo effects can occur within, as well as between, ethical domains. As an example of a within-domain effect, one study showed that when French university students read a brief description of a large European manufacturer of printers, those who went on to learn the company had a print cartridge recycling programme were more likely to believe the manufacturer also used eco-friendly production practices, compared to participants who did not read about the programme (Smith et al., 2010, Study 1). Smith et al. (2010, Study 2) also demonstrated a cross-domain halo effect: when participants learned a fast-food restaurant chain engaged in environmental initiatives (e.g., renewable energy and waste

reduction), they rated it higher on community-related CSR activities (e.g., blood donation and feeding the homeless) compared to those students who read only the generic description of the company. The same authors later ran a similar experiment online using US participants (Smith et al., 2018). Again testing the cross-domain halo effect, Smith et al. (2018, Study 1) showed that a fast-food company described as being at the forefront of environmentally friendly business practices (e.g., using solar panels and composting) was judged by participants to be more likely to ensure employee, customer and community well being, compared to a similar restaurant chain with more moderate pro-environmental initiatives (e.g., recycling and reducing water use). This effect held even when measuring participants' inferences about specific CSR initiatives, such as providing leadership opportunities for women employees (Smith et al., 2018, Study 2). The same study also demonstrated a within-domain environmental halo; for instance, the progressive company was perceived to be more likely than its more modest competitor to recycle cooking oil, even though this action was not listed among its pro-environmental activities.

Research on halo effects from ethical claims in the context of food has yielded mixed results. Most studies have looked at 'health' halos from environmental claims, such as organic (Schuldt and Schwarz, 2010; Lee et al., 2013; Richetin et al., 2022) or 'eco-friendly' (Sörqvist et al., 2015). For example, a sample of shoppers at a mall in the US perceived cookies, potato chips and yoghurt labelled 'organic' to be more nutritious and lower in calories compared to the same products when labelled 'regular' (Lee et al., 2013). Sörqvist et al. (2015) had Swedish students taste samples of fruit (grapes or raisins) described as either 'conventional' or 'eco-friendly' and then estimate which was healthier, higher in calories, or contained fewer vitamins and minerals. Despite the fact that the samples came from the same package (all conventionally produced), participants who tasted raisins rated the eco-labelled product more favourably on all three measures. Calorie estimates for the two samples did not differ for those who tasted grapes, however, even though the 'eco-friendly' version was perceived to be healthier and higher in vitamin and mineral content. Another study using German university students showed no difference in health perceptions of a spicy snack when it was promoted as 'sustainable' *versus* when no environmental information was provided (Bschaden et al., 2022).

The variation in sample pool, food product and research design makes it difficult to ascertain the source of the observed inconsistencies. Findings are also mixed with respect to how environmental ethics might influence consumer decisions in similar contexts. Some studies (Schuldt and Schwarz, 2010; Schuldt et al., 2012; Sörqvist et al., 2015) indicate effects are more pronounced in people with strong environmental values, whilst Lee et al. (2013) found just the opposite, i.e., a diminished halo effect in participants who scored higher on their pro-environmental index. Other studies (Bschaden et al., 2022) found no significant influence of environmental ethics on the halo effect.

In another ethical domain, Schuldt et al. (2012, Study 2) found that consumers perceived a chocolate bar's caloric content differently depending on how fairly the workers involved in its production were treated, and that this 'health halo' was moderated by participants' social ethics. However, we are aware of no studies which have explored whether ethical claims in one aspect of food production can lead to inferences about other ethical aspects of food production. Given that consumers may consider both the environment and animal welfare in their food purchases, in the present research we ask: *Can an environmental ethics claim cast a 'humane' halo?*

The bulk of food marketing research has logically focused on positive halos which can be used to help sell a company's products by creating a favourable impression in the minds of consumers. However, Schuldt et al. (2012, Study 2) also found evidence of an even stronger negative halo effect[1], in that consumers perceived calories to be higher if they felt the workers were being treated poorly and, in turn, were less likely to recommend the product. This finding is somewhat intriguing, given that it rarely appears in the food psychology literature. However, many studies have been done on positive-negative asymmetry, or 'negativity bias,' which could help shed light on their results. Baumeister et al. (2001) argue that, as a survival mechanism to avoid danger, 'we are psychologically designed to respond to bad more strongly than good' (p. 325). In a comprehensive review of the negativity bias phenomenon, the authors conclude that bad events produce more emotion and have stronger effects on adjustment than good events. Other researchers have found that consumers may be more confident in their evaluations when they are based on negative rather than positive information (Alves et al., 2019).

Negativity dominance, a related aspect of negativity bias (Rozin and Royzman, 2001), may also play a role. Put simply, all else being equal, when good and bad are combined, bad usually wins. People are more prone to notice—and act upon—negative information because it is counter-normative (Baumeister et al., 2001). When a negative behaviour is related to ethical issues (as opposed to, for instance, competence), the effect can be even stronger (Rozin and Royzman, 2001). The reasoning behind this assertion is that entities which violate the norm are resisting social pressure and risking social retribution, therefore their behaviour may be more revealing of their character in general; 'good' behaviour, on the other hand, is expected and hence may not be as demanding of either attention or action (Baumeister et al., 2001).

Aside from Schuldt and colleagues, there are few studies which explore the effect of negative halos resulting from a food company's ethical practices. Further, despite the growth

1 In other literature, a negative halo may be termed a 'reverse halo' or 'horn' effect.

in 'green' marketing (Babkin et al., 2021), we are aware of no studies which have looked at the influence of a food producer's environmental ethics on perceptions of its animal welfare practices. Our study builds upon the work of Schuldt et al. (2012, Study 2) by testing the halo effect in a cross-domain food ethics context and exploring the role of negative halos in perceptions of a dairy company. We formally hypothesise that:

- ***H1***: Participants will recommend eating a cheese more frequently when the cheese company producing it is described as engaging in pro-environmental practices.
- ***H2***: Participants will judge a dairy as *(a)* treating its cows better when they believe it engages in pro-environmental practices and *(b)* treating its cows worse when they believe it engages in anti-environmental practices.
- ***H3***: The relationship between a cheese company's environmental practices and consumption frequency recommendations of the cheese it produces will be mediated by participants' judgments of how the company treats its dairy cows.

Using a moderated mediation analysis, we also explore whether this relationship is influenced by the strength of participants' environmental protection values.

Materials and methods

This study was preregistered with the Wharton Credibility Lab, University of Pennsylvania (#23873). Please refer to the Supplementary material for survey design and analyses details not included in the text.

Research design

This replication is conceptual in that it applies the psychological phenomenon of the halo effect in a new context. Both the current work and Schuldt et al. (2012, Study 2) employ a between-subjects design using one independent variable and three conditions to investigate (1) whether claims regarding the ethics of how a food was produced could result in unwarranted inferences (a halo effect); (2) whether those inferences in turn would predict consumption recommendations; and (3) whether effects would be more pronounced among individuals who hold strong values about ethical consumption. To preserve the integrity of the replication, we attempted to match the survey design and stimuli as described in Schuldt et al. (2012, Study 2) in terms of the nature of the vignette and framing of the conditions (ethical *versus* unethical) as well as the outcome variable (consumption recommendation). However, whereas Schuldt and colleagues tested the effect of fair trade practices on health inferences in the context of social equity values, we test the effect of environmental practices on animal welfare inferences in the context of environmental protection values.

Data collection

Through Prolific Academic's crowdsourcing website, we recruited 292 UK participants to complete a brief survey on food consumption in exchange for £0.50. Of those, 25 were excluded for the following reasons: failed attention check (8), did not answer with care and diligence (2) or had dietary restrictions (15), leaving 267 participants ranging in age from 18 to 74 ($M_{age} = 37.40$, $SD_{age} = 12.02$; 196 female, 71 male). An *a priori* power analysis in G*Power 3.1 (Faul et al., 2007) indicated this was a sufficient sample size for a 95% probability of detecting a medium size effect ($d = 0.5$) given a conventional level of significance ($\alpha = 0.05$).

We took further precautions in designing and implementing the experiment to help ensure optimal quality. To ensure participants engaged sufficiently with the stimuli before answering questions, we set a 20-s timer on the treatment condition page, as pilot studies suggested this was the minimum time necessary to carefully read the vignette. We blocked access to mobile phone users because we observed during pilot studies that the Qualtrics survey was not always properly and consistently displayed on mobile devices. We also included questions to check attention (*'Please respond with "Strongly Agree" for this item'*), care and diligence, and comprehension as further quality control measures (e.g., excluding non-human participants or 'bots'). Finally, at the end of the survey we included a comment box for participants to provide feedback.

Procedure

After reading the instructions and giving informed consent, participants were randomly assigned by computer algorithm to one of three brief descriptions of a cheese made by a fictitious company called 'Delly's.' In all the conditions, they were presented with the same image of cheese and standard information about the product:

'Delly's has been making cheese for over 50 years. The company prides itself on quality control, with each batch of cheese thoroughly tested for texture and flavour. Delly's routinely wins awards from the National Cheese Society and other groups, and in 2012, the company received a gold medal in the World Championship Cheese Contest.'

Participants in the pro-environmental condition ($n = 90$) went on to read an additional paragraph which detailed the company's favourable environmental practices (e.g., effective waste management and support of environmental regulations). In the anti-environmental condition, participants ($n = 91$) instead read an additional paragraph with the wording

adjusted to reflect unfavourable practices (e.g., ineffective waste management and opposition of regulation). The control group ($n = 86$) received the standard description only.

Measures

After being presented with the vignettes, participants were then asked to respond to the following items.

Humane rating. To determine whether the environmental ethics frame would invite unwarranted inferences about animal welfare practices, participants were asked *'Compared to other cheese producers, how well do you think Delly's treats its dairy cows?'* (1 = *Far worse,* 4 = *About the same,* 7 = *Far better*).

Consumption recommendations. To determine whether the environmental ethics frame could influence downstream consumption decisions, participants were asked, '*Compared to other brands of cheese, how often do you think that Delly's cheese should be eaten?'* (1 = *Far less often,* 4 = *About the same amount,* 7 = *Far more often*).

Environmental protection values. Because our research question related to the potential role of ethical consumerism on food behaviour, we chose the six-item GREEN scale (Haws et al., 2014) to explore whether participants' responses to information about environmental aspects of cheese production could be a function of their values. The scale was designed specifically to capture 'the tendency to express the value of environmental protection through one's purchases and consumption behaviours' (Haws et al., 2014, p. 337), for example: *'My purchase habits are affected by my concern for our environment'* (1 = *Strongly disagree*, 4 = *Neither agree nor disagree*, 7 = *Strongly agree*).

Demographics. The survey concluded with questions regarding personal details. In addition to age, gender, level of education and political standing, we asked participants to describe their dietary identity (omnivore, vegetarian, etc.; Piazza and Loughnan, 2016) and disclose any dietary restrictions so that we could eliminate any respondents who limited or excluded dairy products.

Data analyses

We analysed the data with IBM SPSS Version 25 software and used an alpha level of 0.05 for all statistical tests. As the data set failed Levene's test for equal variance, we used a Welch's analysis of variance (ANOVA) with the Games-Howell pairwise multiple comparison test for *post hoc* analyses. Confidence intervals (*CI*) which do not contain zero indicate significant effects. For effect sizes of the experimental manipulation, Cohen's *d* with the Welch correction was calculated in Microsoft Excel Version 16.54 (Gaetano, 2019). All mediation and moderation analyses were performed with the PROCESS Version 3.3 macro for SPSS which uses an ordinary least squares regression with percentile bootstrap confidence intervals (Hayes, 2018).

We conducted the analyses in three steps. First, we tested the main effect (*H1*) and halo effect (*H2*) of the manipulation on the outcome variable of interest using a between-subjects one-way ANOVA with *post hoc* tests as described above. Second, we used PROCESS Model 4 to test for the mediation (*H3*). Third, we conducted exploratory analyses using PROCESS Model 1 and Model 8 to determine if the observed effects were influenced by environmental protection values.

Results

Sample characteristics

Descriptive statistics from SPSS were used to characterise participants' demographics. Approximately two-thirds of the participants reported eating mostly meat and vegetables, with the other third restricting or eliminating meat from their diets. The sample pool was diverse educationally (18% with secondary education, 21% with some college, 40% college graduates and 21% postgraduate) as well as politically, albeit with a tendency to lean liberal (46%) *versus* moderate (22%) or conservative (21%). Eleven percent of respondents expressed no political affiliation. A one-way ANOVA confirmed demographic characteristics did not differ between treatment conditions.

Main analyses

Main effect (H1). Analyses revealed a significant effect of the environmental framing on consumption recommendations across the three conditions [$F_{(2, 264)} = 128.94$, $p < 0.001$]. As predicted, participants who were told the company engaged in pro-environmental practices were more likely to recommend the cheese than participants who received no ethical information about the company [$M_{PRO} = 5.04$, $SD_{PRO} = 1.07$; $M_{CONTROL} = 4.64$, $SD_{CONTROL} = 0.97$; $M_{DIFF} = 0.41$, *95% CI*$_{DIFF}$ (0.04, 0.77), $p = 0.025$, $d = 0.40$]. In addition, we observed that the effect of the framing was even more pronounced for participants who were told the company engaged in harmful environmental practices [$M_{ANTI} = 2.37$, $SD_{ANTI} = 1.50$; $M_{DIFF} = -2.27$, *95% CI*$_{DIFF}$ (-2.71, -1.82), $p < 0.001$, $d = -1.79$].

Halo effect (H2). Consistent with our expectations, there were significant differences in participants' humane ratings between groups who received positive, negative or no information about Delly's environmental practices [$F_{(2, 264)} = 159.23$, $p < 0.001$]. Relative to the control condition, participants rated the dairy company as treating its cows better when it took measures to protect the environment [$M_{PRO} = 5.67$, $SD_{PRO} = 0.92$; $M_{CONTROL} = 4.88$, $SD_{CONTROL} = 0.95$; $M_{DIFF} =$

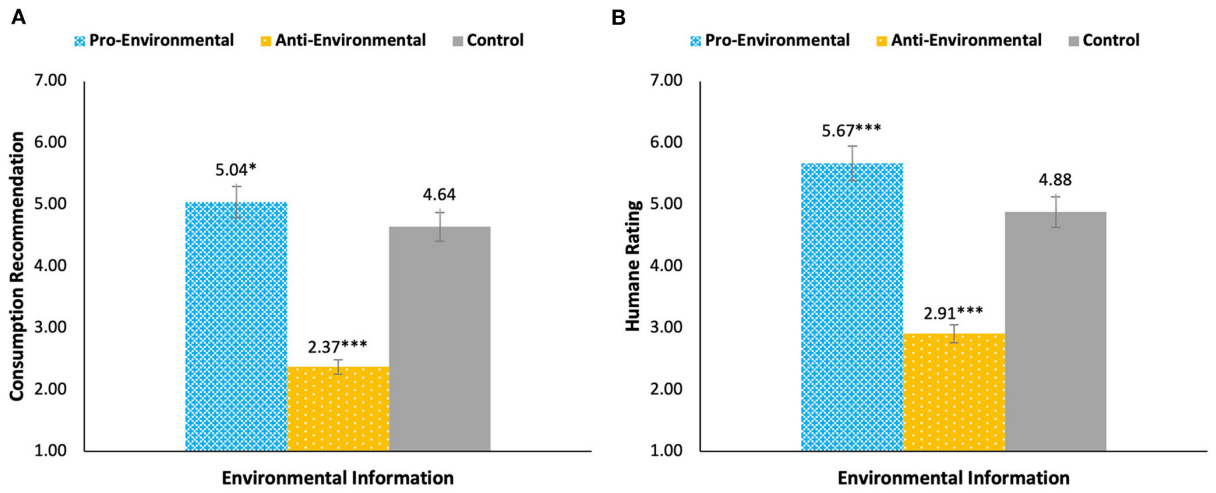


FIGURE 1
Mean scores for **(A)** cheese consumption recommendations and **(B)** judgment of dairy cow treatment, across the three conditions. Error bars correspond to 95% confidence intervals. Asterisks indicate significant differences *versus* the control condition, *$p < 0.05$ and ***$p < 0.001$.

0.78, *95% CI*$_{DIFF}$ (0.45, 1.12), $p < 0.001$, $d = 0.84$]. Again, a larger effect was observed in the anti-environmental condition, where participants judged the dairy cows to be treated far worse [$M_{ANTI} = 2.91$, $SD_{ANTI} = 1.29$; $M_{DIFF} = -1.97$, *95% CI*$_{DIFF}$ (-2.37, -1.57), $p < 0.001$, $d = -1.73$].

Results for testing our first and second hypotheses are depicted in Figures 1A,B, respectively. Taken together, the data suggest that, in considering how a cheese is produced, consumers will infer that a dairy treats its cows in a similar way it treats the environment; that is, the ethical claim regarding the environment projects a 'humane halo.' Further, negative information appears to have far more impact on judgments than does positive information.

Mediation (H3). Having established significant main effects on both the outcome variable and the proposed mediator, we proceeded to test our mediation hypothesis using PROCESS Model 4. We used indicator coding for the multi-categorical independent variable (Hayes and Preacher, 2014). Because we were interested in testing the effect of the treatment compared with the control, we coded the conditions as follows: 0 = Control, 1 = Pro-environmental, and 2 = Anti-environmental (PROCESS identifies 0 as the default reference group). We set humane ratings as the mediator in our model and consumption recommendations as the outcome variable. We report the unstandardized coefficients as generated by PROCESS for direct comparison with results from bootstrapping analyses (Hayes et al., 2017).

Results demonstrate that the information on environmental practices indirectly influenced consumption recommendations through its effect on perceptions of animal welfare. Bootstrap analysis with 5,000 resamples indicated that the indirect effect of pro-environmental information on consumption recommendations through humane ratings was slightly positive and significant [$b = 0.48$, $SE = 0.11$, *95% CI* (0.28, 0.71)]. Whilst the direct effect of the environmental ethics claim had been significant without the mediator [$b = 0.41$, $SE = 0.18$, $p = 0.027$, *95% CI* (0.047, 0.763)], it was no longer significant once the mediator was included in the model [$b = -0.07$, $SE = 0.16$, $p = 0.656$, *95% CI* (-0.386, 0.244)], indicating a full mediation[2]. Likewise, the indirect effect of anti-environmental information was strongly negative and significant [$b = -1.20$, $SE = 0.16$, *95% CI* (-1.51, -0.90)]. Here the direct effect on consumption recommendations was substantially weakened though remained significant [from $b = -2.27$, $SE = 0.18$, $p < 0.001$, *95% CI* (-2.623, -1.909) to $b = -1.07$, $SE = 0.19$, $p < 0.001$, *95% CI* (-1.444, -0.690)]. The model was significant [$F_{(3, 263)} = 157.01$, $p < 0.001$] and accounted for 49% of the variance in consumption recommendations ($R^2 = 0.49$); see Figure 2.

2 There is disagreement in the research community regarding what constitutes a 'true' test of mediation. Without entering into the debate, we report here results which meet Baron and Kenny (1986) causal steps criteria for mediation. Whilst our findings are consistent with their definition of 'full' mediation (in the pro-environmental treatment) and 'partial' mediation (for the anti-environmental treatment), we acknowledge the criticism that—in real life situations—the relationship between an independent and dependent variable is unlikely to be fully mediated. We also include significance tests for component paths (Yzerbyt et al., 2018) as well as the bootstrapping confidence intervals (Preacher and Hayes, 2004) generated by Model 4 to confirm the mediation.

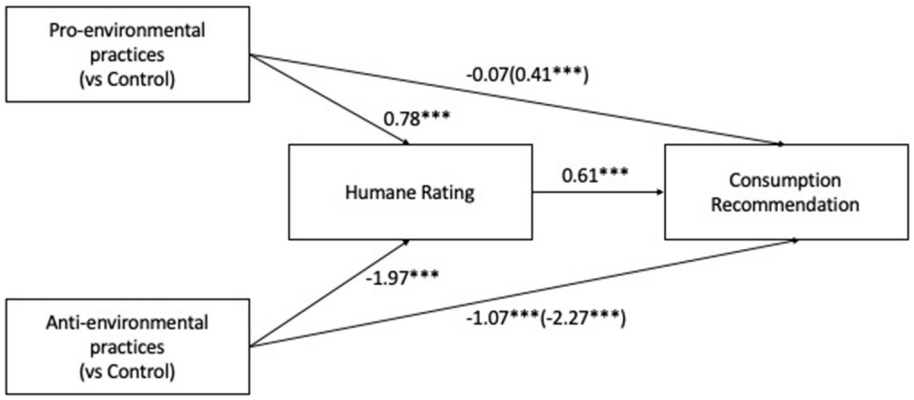


FIGURE 2
Model testing whether judgments about a dairy's treatment of its cows mediate the effect of environmental ethics information on consumption recommendations. The model accounted for 49% of the variance in consumption recommendations ($R^2 = 0.49$). Numbers in parentheses indicate direct effects without inclusion of the mediator in the model. Asterisks indicate significant differences *versus* the control condition, ***$p < 0.001$.

Moderated mediation analysis

For all our exploratory analyses, we used the same indicator coding as described in our mediation analysis and again report the unstandardised regression coefficients. The model parameters were as in Model 4, with the addition of environmental protection values as the moderator, mean-centred for ease of interpretation. Responses for the six items on the GREEN scale were highly correlated (Cronbach's $\alpha = 0.91$) and thus were averaged. A one-way between-subjects ANOVA showed no effect of the experimental manipulation on the scale, confirming its reliability as a moderator. Linear regression indicated GREEN scale scores alone did not predict either humane ratings ($p = 0.411$) or consumption recommendations ($p = 0.173$).

Moderated mediation occurs when the indirect effect of the independent variable on the outcome variable through the mediator changes across different levels of the moderator. Because our research focuses on the halo effect, we investigated a first stage moderated mediation (Edwards and Lambert, 2007), where the indirect effect is moderated through the influence of environmental protection values on the relationship between environmental information and perceptions of animal welfare. To better understand the nature of the conditional (moderated) indirect effect, we first conducted simple moderation analyses of both the main effect and the halo effect using PROCESS Model 1. Isolating the effect of environmental protection values on the relationship between environmental ethics information and consumption recommendations, without including humane ratings in the model, we found a significant interaction between framing and GREEN scale scores in the anti-environmental condition [$b = -0.50$, $SE = 0.21$, $p = 0.018$, *95% CI* (-0.912, -0.087)] but not in the pro-environmental treatment [$b = 0.284$, $SE = 0.20$, $p = 0.165$, *95% CI* (-0.118, 0.685)]. We then examined whether the halo effect varies as a function of how strongly people feel about environmentally ethical consumption by again using Model 1, this time with humane ratings as the outcome variable. As with consumption recommendations, the data suggest that the positive halo is not moderated by participants' environmental protection values [$b = 0.103$, $SE = 0.19$, $p = 0.577$, *95% CI* (-0.261, 0.467)] but the negative halo is [$b = -0.40$, $SE = 0.19$, $p = 0.035$, *95% CI* (-0.778, -0.029)].

By grouping GREEN scale scores as low (defined as one standard deviation below the mean), average, and high (one standard deviation above the mean), we can visualise the interactions using simple slopes (Figure 3). Consumption recommendations by participants who read the negative environmental framing fall rapidly moving up the scale but only gradually increase for participants in the positive framing (Figure 3A). The effect of anti-environmental information on product endorsement is sizeable and significant at all three levels of GREEN scale scores. Therefore, exploratory analysis suggests that consumers' environmental protection values could be an important factor influencing product recommendations when the dairy is shown to be environmentally irresponsible, but they are not likely to have a significant effect if the environmental information about the company is positive or ambiguous.

A similar pattern is seen for the effect of environmental protection values on perceptions of animal welfare (Figure 3B). The gap between humane ratings in the pro-environmental *versus* control conditions does not change significantly with increasing environmental values. However, the gap between the control and the anti-environmental condition gets wider moving along the scale. The perception that irresponsible environmental practices signify irresponsible animal treatment intensifies as the strength of participants' commitment to environmentally ethical consumption increases.

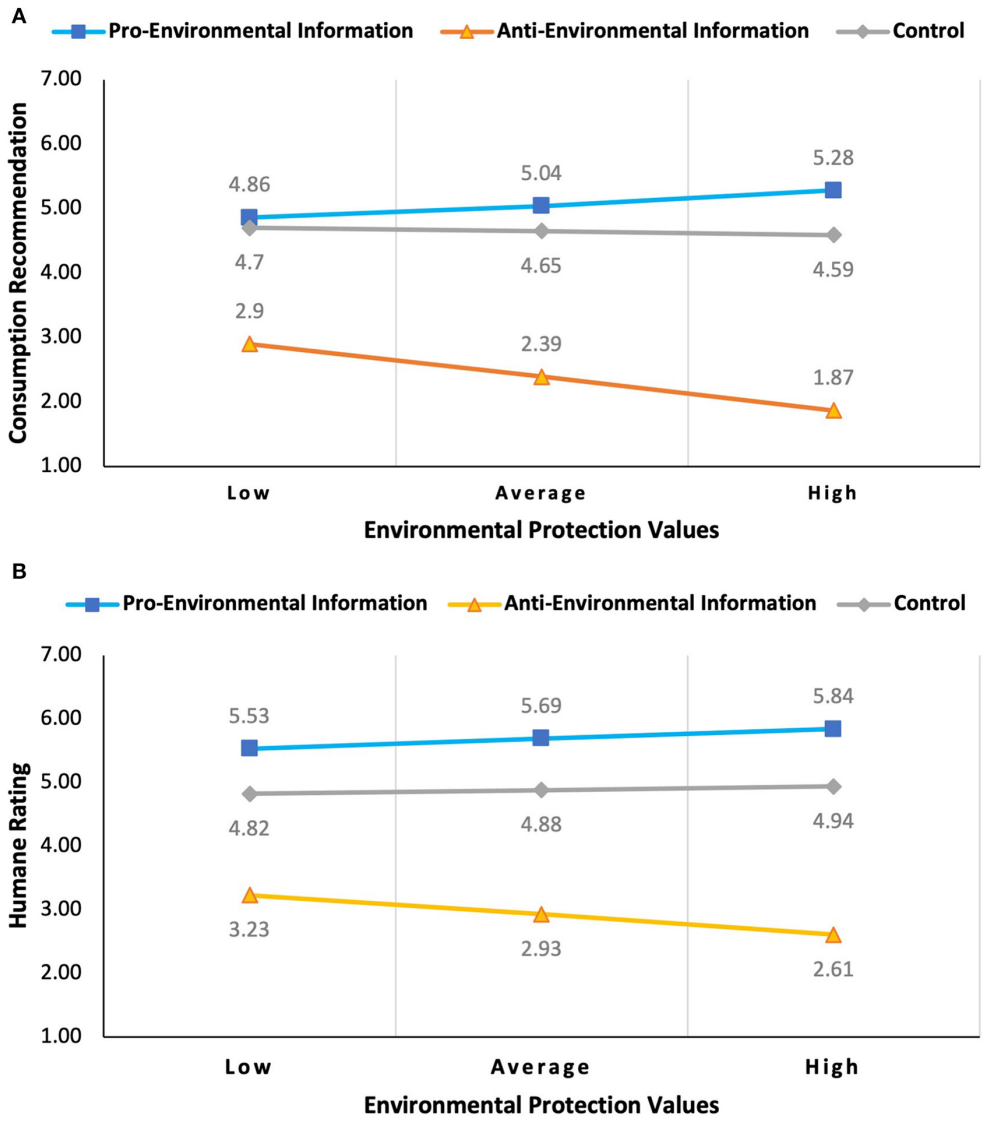


FIGURE 3
Simple slopes analysis showing the effect of participants' environmental protection values on **(A)** endorsement of the dairy's cheese (in terms of how frequently they would recommend it be eaten) and **(B)** how well they perceived the dairy's treatment of its cows, compared to other brands. Low and High values correspond to one standard deviation below and one standard deviation above the mean, respectively.

Having established evidence that the interaction between environmental information and environmental protection values significantly impacts both humane ratings and consumption recommendations, we tested moderation of the full mediation model using PROCESS Model 8, conceptually represented in Figure 4. The macro uses an index of moderated mediation with bootstrap confidence intervals to draw statistical inference. As opposed to the piecemeal approach described above, the index quantifies the relationship between the moderator and indirect effects (Hayes, 2018).

Treatment condition, GREEN scale scores, their interaction terms, and humane ratings were all included as predictors in the model. For the anti-environmental condition, the index of moderated mediation was significant [$index = -0.229$, $SE = 0.107$, $95\%\ CI\ (-0.454, -0.030)$]. Both direct and indirect effects were negative and significant at low, average and high levels of the moderator, with confidence intervals that did not contain 0. The index confidence interval did include 0 in the pro-environmental condition [$95\%\ CI\ (-0.127, 0.253)$]. The model was significant [$F_{(6, 260)} = 83.54$, $p < 0.001$] and accounted for 66% of the variance in consumption recommendations ($R^2 = 0.66$). Results strongly suggest that the mediation of the effect of negative information regarding a dairy's environmental practices on consumption recommendations of

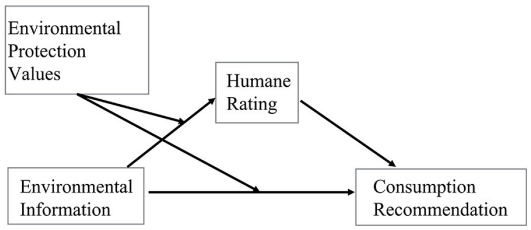


FIGURE 4
Conceptual model of the moderated mediation analysis used to explore the influence of the moderator (environmental protection values) on the relationship between the independent variable (environmental information) and the mediator (humane rating) as well as on the relationship between the independent variable and the outcome variable (consumption recommendation). Adapted from Hayes (2018).

its cheese through animal welfare perceptions is moderated by participants' environmental protection values.

Discussion

Conceptual replication is critical to advancing and improving theoretical development, as well as maintaining scientific integrity (Stroebe and Strack, 2014; Camerer et al., 2018; Baucal et al., 2020). In a well-powered, preregistered study using UK participants, we find evidence that an ethical claim in one domain can lead to unwarranted inferences in another ethical domain, confirming this halo effect as a robust phenomenon and extending the literature on its application in the context of food consumption. Schuldt et al. (2012) found that consumer judgments could be influenced by social ethics claims in chocolate production which provoke a 'health halo.' In like fashion, we demonstrated that consumers can be influenced by environmental practices in dairy production which cast a 'humane halo.' In so doing, we show that altruistic/ethical halo effects could be drivers of food consumption, in addition to self-interested ones. Of particular relevance to reducing consumption of animal products, we also found evidence to support the authors' finding of a pronounced negative halo from unethical food production which was conditional upon the strength of perceivers' values. Taken together, these results provide the first empirical evidence that ethics-related attributes can bias perceptions of animal welfare in dairy production as well as endorsement of the dairy product itself.

We find it interesting that the relationship between pro-environmental framing and consumption recommendations appears to be due to the indirect effect through perceptions of dairy cow treatment. This implies that, *when prompted* to consider the dairy cows—and when subsequently judging them to be treated well—consumers may indeed be more likely to recommend a cheese compared to other brands. Dairy advertisements frequently employ visual rhetoric of cows in nature, raising the possibility that the 'humane halo' may play a part in marketing strategy (Borkfelt et al., 2015; Shortall, 2019). It is worth noting that a dairy company's pro-environmental practices alone were not enough to cause participants to recommend its cheese over other brands about which they had no information. In contrast, both direct effects of unethical information and indirect effects through the negative halo were substantial and significant, with a roughly equivalent influence on consumption recommendations.

Our mediation analysis reveals that the path dependency of evaluations is not linear and depends on the valence of the information. Participants receiving information about ethical practices 'adjust down,' in that their humane ratings are higher than their consumption ratings (from $M_{HR} = 5.67$ to $M_{CR} = 5.04$). Conversely, participants receiving information about unethical practices 'adjust up'—that is, their negative evaluations become even stronger. As low as humane ratings were ($M_{HR} = 2.91$), average consumption ratings were even lower ($M_{CR} = 2.37$), reflecting participants' dissatisfaction with the dairy's treatment of the environment as well as their perceived treatment of the cows. As a result, the effect of positive *versus* negative information on consumption recommendations is highly asymmetrical (Figure 5).

The literature on negativity bias (Baumeister et al., 2001; Rozin and Royzman, 2001; Alves et al., 2019) lends itself well to interpretation of our results. Good behaviour is expected and therefore not likely to be rewarded; 'bad actors,' on the other hand, warrant punishment (Harth et al., 2013). Consistent with the theory of negativity dominance (Rozin and Royzman, 2001), a negative halo is likely to emerge if good information is immediately followed by bad (Kahneman, 2011). The positive tone of the control[3] (e.g., 'award-winning') may have set up a contrast which accentuated the counter-normativity of the anti-environmental behaviour, leading to stronger effects (Baumeister et al., 2001). By claiming a high-quality product, rather than 'buffering' against any subsequent negative publicity (Dawar and Pillutla, 2000; Cho and Kim,

3 A one-sample *t*-test indicated that humane ratings and consumption frequency recommendations for participants in the control group were significantly higher than 4 ($p < 0.001$), the mid-point of the response scale. The standard description read by participants in all groups was not entirely 'neutral' in the sense that it made reference to the quality of the cheese and the fact that the dairy had won awards. This language was crafted to closely reflect the wording in the original study, which also reported control means which were above the mid-point. Additionally, we felt this type of description was typical of what consumers confront in the marketplace, where companies often advertise their products as high quality and award-winning. The objective of the research is not to compare treatment results to a theoretical 'true' neutral condition which does not accurately reflect real-world conditions but rather to determine how participants deviate from the control as a result of the manipulation.

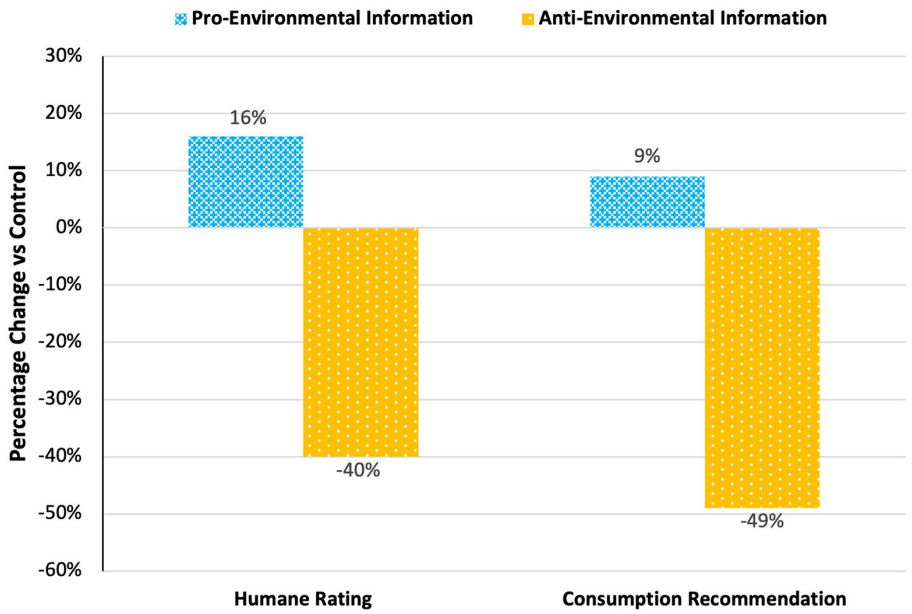


FIGURE 5
Asymmetrical effect of positive (pro-environmental production practices) *versus* negative (anti-environmental production practices) information on participants' perception of dairy cow treatment (humane rating) and their subsequent cheese consumption recommendation. The treatment effect of positive information (*versus* a neutral control) is significantly smaller than the effect of negative information. In addition, when moving from the humane rating to the consumption decision, the effect of positive information is attenuated whereas the effect of negative information increases.

2012), dairy promotions could possibly backfire if unethical issues are exposed.

Results of our moderation analyses support the conclusion of Schuldt et al. (2012) that ethical consumers process information more heuristically and are thus more susceptible to the halo effect and more vulnerable to marketing strategies which exploit it. However, in addition to the interaction, we also found significant main halo effects whereas the original study did not. Overall, our treatment effect sizes for both positive and negative halos, as well as consumption recommendations, were considerably larger and were statistically significant regardless of the strength of environmental values. This finding may be due in part to the sample being larger and/or drawn from a different population, however the nature of the halo itself may also have played a role. Concern for animal welfare can provoke strong emotions (Herzog and Golden, 2009), and research has shown this concern extends to farm animals, including dairy cows (Wolf et al., 2016; Busch et al., 2017). Whilst we did not directly measure emotional responses, they are known to have a powerful influence on attitude formation and subsequent decision-making (Slovic et al., 2007) and thus could help explain the strength of our effects.

Limitations and future directions

These findings should be interpreted with caution, as this experiment represents only one study of a UK sample. We recognise there can be vast cultural differences concerning animal welfare in food production (e.g., Fitzpatrick, 2009; Mazhary, 2021). Even within the UK there may be geographical differences, as perceptions of animals and the environment may differ between urban and rural populations (Vanhonacker et al., 2010). In addition to more studies using diverse populations, we recommend further research into ethical halos which combine different stimuli and measures. Our results are strongly indicative of a mediation *via* perceptions of animal welfare, however we did not attempt to measure the individual motivations behind whether participants recommended the cheese or not. Individuals will vary significantly in the degree to which self-interest *versus* more altruistic tendencies influence choice (Lusk and Briggeman, 2009). As discussed, consumers consistently express a desire for humane treatment of animals in food production. At the same time, some research has shown that consumers associate better taste with better treatment of the animal from whom the food was sourced

(Anderson and Barrett, 2016; Bray and Ankeny, 2017) as well as with sustainable production (Sörqvist et al., 2015). Our stimuli make specific reference to 'manure management' which may engender disgust, an emotion which has been implicated as a mediator of meat consumption (Ruby and Heine, 2012). In addition, both environmental and animal welfare practices in cheese production may be linked to perceptions of food safety (Harper and Makatouni, 2002; Demartini et al., 2018). Future studies could help parse out the relative contributions of these factors, for instance through a serial mediation model including taste as well as animal welfare.

The relationship between consumers' animal welfare values and their perception of dairy production should be further explored to generate additional insight into the psychological mechanisms underpinning our observations. A follow-up study could switch the stimuli and the mediator, such that information is provided regarding animal welfare, and participants are subsequently asked to evaluate environmental practices. Direct and indirect effects could again be compared, and animal welfare rather than environmental protection values could be explored as a moderator. There is also a gap in the literature regarding how consumers perceive the consumption of an animal 'product' (e.g., milk or eggs) as opposed to the animal itself (e.g., beef cattle or chicken), despite the fact that all animals used in food production are ultimately slaughtered. We focused on cheese in this study primarily because of its environmental consequences, but a conceptual replication using eggs rather than dairy products could improve our understanding of consumer psychology and ethical consumption as it relates to animal-based foods.

Our results are consistent with Schuldt et al. (2012, Study 2) who suggested that the observed halo effect on participants' product endorsement could impact downstream consumption. However, we also acknowledge that behaviour does not necessarily follow from intention. Participants may say they would or would not recommend a cheese but fail to do so in practice (Vigors, 2018). Eating behaviours are complex and contextual. Food choices are often strongly influenced by norms and other sociocultural factors which can be difficult to measure, and we do not attempt to do so here. Rather, we provide additional insight into drivers of dairy consumption by identifying a potential underlying mechanism which could be leveraged in behavioural interventions to change dietary practices.

Finally, whilst environmental and animal welfare ethics may contribute to consumer recommendations of one brand of dairy products over another, this does not in any way predict that these factors would deter consumers from eating less dairy overall, let alone eliminating it entirely. Self-interest is likely to dominate food behaviours, even amongst consumers who consider the ethical consequences of their diets (Lusk and Briggeman, 2009; Wellesley et al., 2015). Individual behaviours will change when norms change, but this will need the support of policy and regulation (Godfray et al., 2018). Complementary interventions will be required, to include incorporating externalised costs, incentivising innovation, and supporting businesses in bringing more sustainable and humane alternatives to market so that they are affordable and accessible. In addition, consumers need education not only on climate impacts but also how to easily and enjoyably incorporate non-dairy products into their diets. All of these strategies can be augmented by continuing to study food behaviours in order to understand the most effective means of shifting consumers to more sustainable lifestyles.

Implications

The halo effect can shape perceptions of not only people and objects, but producers of goods we consume every day. The danger is that it could be used to manipulate people into buying certain foods because they perceive production methods to be congruent with their values or standards. Our research shows that people can generalise from one kind of ethics claim to another ethical domain which may be a determining factor in dairy product choice. In light of the findings that negative information can have a strong influence on perceptions and possibly downstream consumption behaviours, the following considerations may be useful for policymakers and advocacy groups interested in reducing dairy consumption in the population:

Bring dairy to the climate change table. Concern for the environment, and climate change in particular, is at an all-time high in the UK (Steentjes, 2021). Encouragingly, this concern has translated into a significant reduction in meat consumption which is expected to continue (Stewart et al., 2021). Yet awareness of the connection between dairy and environmental impacts appears to be lagging. Our study shows that consumers are likely to develop negative attitudes towards a cheese when they learn its production has harmed the environment. In addition to raising awareness about water and air pollution associated with the industry, making the connection between climate change and dairy more salient could help motivate consumers to reduce their consumption.

Dismantle the humane halo. Our results suggest that if a dairy is environmentally responsible, it is not enough to get people to recommend its cheese over another brand. However, if consumers are primed into thinking about how the animals are treated and the halo effect leads them to associate environmental practices with humane practices, they may endorse the product. Yet in reality, regulations pertaining to treatment of animals in food production tend to be limited or inconsistent, and there may be little enforcement of voluntary humane certification (Borkfelt et al., 2015; Ballentine, 2016). Dairy production in Europe and the UK is increasingly moving away from pasturing cows to continuous indoor housing (March et al., 2014; Shortall, 2019), despite consumer preference for

more 'traditional' grazing systems which are perceived as better for animal welfare (Taverner, 2015). Practices such as dehorning calves without anaesthesia (Robbins et al., 2015) and immediate separation of calf from cow after birth (Busch et al., 2017) are also unpopular with consumers and incompatible with perceptions that dairy products are 'natural.' Efforts to reduce dairy consumption overall could focus on dismantling the humane halo by emphasising the downsides of animal welfare and dispelling some of the bucolic myths surrounding present-day dairy production.

Conclusion

As a conceptual replication of a study on the halo effect of a social ethics claim in food production (Schuldt et al., 2012, Study 2), this research investigated other ethical factors which could influence the consumption of dairy products in both direct and indirect ways. In producing evidence of a 'humane halo' emanating from information about a dairy's environmental practices, we introduce a novel application of the halo effect, showing that an ethical claim in the environmental domain can cause participants to infer an ethical attribute in the animal welfare domain. Further, our results demonstrate that inferences about dairy animal welfare can have a greater effect on cheese consumption recommendations than environmental information, suggesting new avenues for research regarding altruistic *versus* self-interested motivations for food behaviours. We hope these findings will provide a deeper understanding of the drivers of dairy consumption for policymakers as well as scientists as they chart a course to a more sustainable future.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by the Department of Psychological and Behavioural Science Ethics Committee of the London School of Economics and Political Science (LSE). The participants provided their written informed consent to participate in this study.

Author contributions

HZ: conceptualisation, methodology, formal analysis, investigation, writing—original draft, writing—review and editing, and visualisation. FB: conceptualisation, methodology, validation, resources, writing—review and editing, supervision, project administration, and funding acquisition. Both authors contributed to the paper and approved it for publication.

Funding

This research was funded by the London School of Economics and Political Science (LSE). We thank the LSE Open Access Publication Fund for generously supporting this research by covering the open access publication fees.

Acknowledgments

The authors thank Feiyang Wang and Dario Krpan for their help with methodology, and the editor and reviewers for their insightful comments and recommendations.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2022.997590/full#supplementary-material

References

Alves, H., Koch, A., and Unkelbach, C. (2019). The differential similarity of positive and negative information – an affect-induced processing outcome? *Cogn. Emot.* 33, 1224–1238. doi: 10.1080/02699931.2018.1549022

Anderson, E. C., and Barrett, L. F. (2016). Affective beliefs influence the experience of eating meat. *PLoS ONE* 11:e0160424. doi: 10.1371/journal.pone.0160424

Babkin, A., Malevskaia-Malevich, E., Kvasha, N., and Eliseev, E. (2021). The relationship between socially responsible investment and the market value of an enterprise. *E3S Web Conf.* 291:01002. doi: 10.1051/e3sconf/202129101002

Ballentine, L. (2016). What does "Humane Certified" really mean? 'Humane' or 'ethical' certification has a market value and as such may be driven by what consumers say they want rather than what is best for animals. *Ont. Farmer,* A.15. Retrieved from: https://www.proquest.com/magazines/what-does-humane-certified-really-mean-ethical/docview/2194547555/se-2 (accessed July 17, 2022).

Baron, R. M., and Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *J. Pers. Soc. Psychol.* 51, 1173–1182. doi: 10.1037/0022-3514.51.6.1173

Baucal, A., Gillespie, A., Krstić, K., and Zittoun, T. (2020). Reproducibility in psychology: theoretical distinction of different types of replications. *Integr. Psych. Behav.* 54, 152–157. doi: 10.1007/s12124-019-09499-y

Baumeister, R. F., Bratslavsky, E., Finkenauer, C., and Vohs, K. D. (2001). Bad is stronger than good. *Rev. Gen. Psychol.* 5, 323–370. doi: 10.1037/1089-2680.5.4.323

Bayvel, A. C. D., and Cross, N. (2010). Animal welfare: a complex domestic and international public-policy issue–who are the key players? *J. Vet. Med. Educ.* 37, 3–12. doi: 10.3138/jvme.37.1.3

Bertrandias, L., Cazes-Valette, G., and Gurviez, P. (2021). How concern for animal welfare impacts meat consumption. *Décis. Market*. 103, 229–250. Retrieved from: https://www.cairn-int.info/journal-decisions-marketing-2021-3-page-229.htm

Borkfelt, S., Kondrup, S., Röcklinsberg, H., Bjørkdahl, K., and Gjerris, M. (2015). Closer to nature? A critical discussion of the marketing of "ethical" animal products. *J. Agric. Environ. Ethics* 28, 1053–1073. doi: 10.1007/s10806-015-9577-4

Bray, H. J., and Ankeny, R. A. (2017). Happy chickens lay tastier eggs: motivations for buying free-range eggs in Australia. *Anthrozoös* 30, 213–226. doi: 10.1080/08927936.2017.1310986

Bray, J., Johns, N., and Kilburn, D. (2011). An exploratory study into the factors impeding ethical consumption. *J. Bus. Ethics* 98, 597–608. doi: 10.1007/s10551-010-0640-9

Bschaden, A., Schulz, J., and Stroebele-Benschop, N. (2022). The sustainability halo effect: does the provision of sustainability information of a snack affect sensory and health perception, and willingness to pay? *Future Foods* 5:100143. doi: 10.1016/j.fufo.2022.100143

Busch, G., Weary, D. M., Spiller, A., and von Keyserlingk, M. A. G. (2017). American and German attitudes towards cow-calf separation on dairy farms. *PLoS ONE* 12:e0174013. doi: 10.1371/journal.pone.0174013

Camerer, C. F., Dreber, A., Holzmeister, F., Ho, T.-H., Huber, J., Johannesson, M., et al. (2018). Evaluating the replicability of social science experiments in nature and science between 2010 and 2015. *Nat. Hum. Behav.* 2, 637–644. doi: 10.1038/s41562-018-0399-z

Carrington, D. (2021). *Europe and US Could Reach 'Peak Meat' in 2025 – Report. The Guardian*. Available online at: http://www.theguardian.com/environment/2021/mar/23/europe-and-us-could-reach-peak-meat-in-2025-report (accessed June 28, 2021).

Cho, S., and Kim, Y.-C. (2012). Corporate social responsibility (CSR) as a halo effect in issue management: public response to negative news about pro-social local private companies. *Asian J. Commun.* 22, 372–385. doi: 10.1080/01292986.2012.681666

Clark, M. A., Springmann, M., Hill, J., and Tilman, D. (2019). Multiple health and environmental impacts of foods. *Proc. Natl. Acad. Sci. U.S.A.* 116, 23357–23362. doi: 10.1073/pnas.1906908116

Dawar, N., and Pillutla, M. M. (2000). Impact of product-harm crises on brand equity: the moderating role of consumer expectations. *J. Mark. Res.* 37, 215–226. doi: 10.1509/jmkr.37.2.215.18729

Demartini, E., Ricci, E. C., Mattavelli, S., Stranieri, S., Gaviglio, A., Banterle, A., et al. (2018). Exploring consumer biased evaluations: halos effects of local food and of related attributes. *Int. J. Food Syst. Dyn.* 9, 375–389. doi: 10.18461/ijfsd.v9i4.947

Domingo, N. G. G., Balasubramanian, S., Thakrar, S. K., Clark, M. A., Adams, P. J., Marshall, J. D., et al. (2021). Air quality–related health damages of food. *PNAS* 118:e2013637118. doi: 10.1073/pnas.2013637118

Dominick, S. R., Fullerton, C., Widmar, N. J. O., and Wang, H. (2018). Consumer associations with the "all natural" food label. *J. Food Prod. Mar.* 24, 249–262. doi: 10.1080/10454446.2017.1285262

Edwards, J. R., and Lambert, L. S. (2007). Methods for integrating moderation and mediation: a general analytical framework using moderated path analysis. *Psychol. Methods* 12, 1–22. doi: 10.1037/1082-989X.12.1.1

Estévez-Moreno, L. X., Miranda-de la Lama, G. C., and Miguel-Pacheco, G. G. (2022). Consumer attitudes towards farm animal welfare in Argentina, Chile, Colombia, Ecuador, Peru and Bolivia: a segmentation-based study. *Meat Sci.* 187:108747. doi: 10.1016/j.meatsci.2022.108747

Faul, F., Erdfelder, E., Lang, A.-G., and Buchner, A. (2007). G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav. Res. Methods* 39, 175–191. doi: 10.3758/BF03193146

Fitzpatrick, M. (2009). "Seoul food." *The Guardian*. Available online at: https://www.theguardian.com/lifeandstyle/wordofmouth/2009/oct/23/korea-dog-meat-food-livestock (accessed July 1, 2022).

Gaetano, J. (2019). *Welch's t-test for comparing two independent groups: An Excel calculator (1.0.1). [Microsoft Excel workbook]*. doi: 10.13140/RG.2.2.14550.91209/2. Retrieved from: https://www.researchgate.net/publication/332217175_Welch's_t-test_for_comparing_two_independent_groups_An_Excel_calculator_101

Godfray, H. C. J., Aveyard, P., Garnett, T., Hall, J. W., Key, T. J., Lorimer, J., et al. (2018). Meat consumption, health, and the environment. *Science* 361:eaam5324. doi: 10.1126/science.aam5324

Hain, M. (2017). How good products make you feel: the underlying emotions of ethical consumerism. *Maastricht University Journal of Sustainability Studies 3*. Available online at: https://openjournals.maastrichtuniversity.nl/SustainabilityStudies'/article/view/509 (accessed July 5, 2022).

Harper, G. C., and Makatouni, A. (2002). Consumer perception of organic food production and farm animal welfare. *Br. Food J.* 104, 287–299. doi: 10.1108/00070700210425723

Harth, N. S., Leach, C. W., and Kessler, T. (2013). Guilt, anger, and pride about in-group environmental behaviour: different emotions predict distinct intentions. *J. Environ. Psychol.* 34, 18–26. doi: 10.1016/j.jenvp.2012.12.005

Haws, K. L., Winterich, K. P., and Naylor, R. W. (2014). Seeing the world through GREEN-tinted glasses: green consumption values and responses to environmentally friendly products. *J. Consum. Psychol.* 24, 336–354. doi: 10.1016/j.jcps.2013.11.002

Hayek, M. N., Harwatt, H., Ripple, W. J., and Mueller, N. D. (2020). The carbon opportunity cost of animal-sourced food production on land. *Nat. Sustain.* 4, 21–24. doi: 10.1038/s41893-020-00603-4

Hayes, A. F. (2018). *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*, *2nd Edn*. New York, NY: Guilford Press.

Hayes, A. F., Montoya, A. K., and Rockwood, N. J. (2017). The analysis of mechanisms and their contingencies: PROCESS *versus* structural equation modeling. *Australas. Mark. J.* 25, 76–81. doi: 10.1016/j.ausmj.2017.02.001

Hayes, A. F., and Preacher, K. J. (2014). Statistical mediation analysis with a multicategorical independent variable. *Br. J. Math. Stat. Psychol.* 67, 451–470. doi: 10.1111/bmsp.12028

Herzog, H. A., and Golden, L. L. (2009). Moral emotions and social activism: the case of animal rights. *J. Soc. Issues* 65, 485–498. doi: 10.1111/j.1540-4560.2009.01610.x

Ingenbleek, P. T. M., Immink, V. M., Spoolder, H. A. M., Bokma, M. H., and Keeling, L. J. (2012). EU animal welfare policy: developing a comprehensive policy framework. *Food Policy* 37, 690–699. doi: 10.1016/j.foodpol.2012.07.001

Jin, C.-H., and Lee, J.-Y. (2019). The halo effect of CSR activity: types of CSR activity and negative information effects. *Sustainability* 11:2067. doi: 10.3390/su11072067

Joy, M. K., Rankin, D. A., Wöhler, L., Boyce, P., Canning, A., Foote, K. J., et al. (2022). The grey water footprint of milk due to nitrate leaching from dairy farms in Canterbury, New Zealand. *Australas. J. Environ. Manage.* 29, 177–199. doi: 10.1080/14486563.2022.2068685

Kahneman, D. (2011). *Thinking, Fast and Slow*. London: Allen Lane.

Kohan, S. E. (2021). Customers seek purpose driven companies creating a rise in b corps. *Forbes*. Available online at: https://www.forbes.com/sites/shelleykohan/2021/03/28/customers-seek-purpose-driven-companies-creating-a-rise-in-b-corps/ (accessed July 18, 2022).

Kwasny, T., Dobernig, K., and Riefler, P. (2022). Towards reduced meat consumption: a systematic literature review of intervention effectiveness, 2001–2019. *Appetite* 168:105739. doi: 10.1016/j.appet.2021.105739

Lagerkvist, C. J., and Hess, S. (2011). A meta-analysis of consumer willingness to pay for farm animal welfare. *Eur. Rev. Agric. Econ.* 38, 55–78. doi: 10.1093/erae/jbq043

Lee, W. J., Shimizu, M., Kniffin, K. M., and Wansink, B. (2013). You taste what you see: do organic labels bias taste perceptions? *Food Qual. Prefer.* 29, 33–39. doi: 10.1016/j.foodqual.2013.01.010

Lusk, J. L., and Briggeman, B. C. (2009). Food Values. *Am. J. Agric. Econ.* 91, 184–196. doi: 10.1111/j.1467-8276.2008.01175.x

March, M. D., Haskell, M. J., Chagunda, M. G. G., Langford, F. M., and Roberts, D. J. (2014). Current trends in British dairy management regimens. *J. Dairy Sci.* 97, 7985–7994. doi: 10.3168/jds.2014-8265

Mathur, M. B., Peacock, J., Reichling, D. B., Nadler, J., Bain, P. A., Gardner, C. D., et al. (2021). Interventions to reduce meat consumption by appealing to animal welfare: meta-analysis and evidence-based recommendations. *Appetite* 164:105277. doi: 10.1016/j.appet.2021.105277

Mazhary, H. (2021). Distancing animal death: geographies of killing and making killable. *Geogr. Compass* 15:e12582. doi: 10.1111/gec3.12582

Piazza, J., and Loughnan, S. (2016). When meat gets personal, animals' minds matter less: motivated use of intelligence information in judgments of moral standing. *Soc. Psychol. Personal. Sci.* 7, 867–874. doi: 10.1177/1948550616660159

Poore, J., and Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science* 360, 987–992. doi: 10.1126/science.aaq0216

Preacher, K. J., and Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behav. Res. Methods Instrum. Comp.* 36, 717–731. doi: 10.3758/BF03206553

Richetin, J., Caputo, V., Demartini, E., Conner, M., and Perugini, M. (2022). Organic food labels bias food healthiness perceptions: estimating healthiness equivalence using a discrete choice experiment. *Appetite* 172:105970. doi: 10.1016/j.appet.2022.105970

Robbins, J., Weary, D., Schuppli, C., and von Keyserlingk, M. (2015). Stakeholder views on treating pain due to dehorning dairy calves. *Anim. Welf.* 24, 399–406. doi: 10.7120/09627286.24.4.399

Rozin, P., and Royzman, E. B. (2001). Negativity bias, negativity dominance, and contagion. *Pers. Soc. Psychol. Rev.* 5, 296–320. doi: 10.1207/S15327957PSPR0504_2

Ruby, M. B., and Heine, S. J. (2012). Too close to home. Factors predicting meat avoidance. *Appetite* 59, 47–52. doi: 10.1016/j.appet.2012.03.020

Sanchez-Sabate, R., and Sabaté, J. (2019). Consumer attitudes towards environmental concerns of meat consumption: a systematic review. *IJERPH* 16:1220. doi: 10.3390/ijerph16071220

Schuldt, J. P., Muller, D., and Schwarz, N. (2012). The "Fair Trade" effect: health halos from social ethics claims. *Soc. Psychol. Personal. Sci.* 3, 581–589. doi: 10.1177/1948550611431643

Schuldt, J. P., and Schwarz, N. (2010). The "organic" path to obesity? Organic claims influence calorie judgments and exercise recommendations. *Judgm. Decis. Mak.* 5, 144–150.

Sharma, S. (2020). *Milking the Planet. Institute for Agriculture and Trade Policy.* Available online at: https://www.iatp.org/milking-planet (accessed July 9, 2020).

Sheehan and Lee (2014). What's cruel about cruelty free: an exploration of consumers, moral heuristics, and public policy. *J. Anim. Ethics* 4, 1–15. doi: 10.5406/janimalethics.4.2.0001

Shepon, A., Eshel, G., Noor, E., and Milo, R. (2018). The opportunity cost of animal based diets exceeds all food losses. *Proc. Natl. Acad. Sci. U.S.A.* 115, 3804–3809. doi: 10.1073/pnas.1713820115

Shortall, O. (2019). Cows eat grass, don't they? Contrasting sociotechnical imaginaries of the role of grazing in the UK and Irish dairy sectors. *J. Rural Stud.* 72, 45–57. doi: 10.1016/j.jrurstud.2019.10.004

Slovic, P., Finucane, M. L., Peters, E., and MacGregor, D. G. (2007). The affect heuristic. *Eur. J. Oper. Res.* 177, 1333–1352. doi: 10.1016/j.ejor.2005.04.006

Smith, N. C., Read, D., and Lopez, S. (2018). CSR Halo: The gift that keeps on giving? (INSEAD Working Paper No. 2018/07/ATL/Social Innovation Centre). Available online at: https://ssrn.com/abstract=3135132

Smith, N. C., Read, D., and López-Rodríguez, S. (2010). *Consumer perceptions of corporate social responsibility: The CSR halo effect (INSEAD Working Paper No. 2010/16/INSEAD Social Innovation Centre).* Available online at: https://ssrn.com/abstract=1577000

Sörqvist, P., Haga, A., Langeborg, L., Holmgren, M., Wallinder, M., Nöstl, A., et al. (2015). The green halo: Mechanisms and limits of the eco-label effect. *Food Qual. Prefer.* 43, 1–9. doi: 10.1016/j.foodqual.2015.02.001

Spain, C. V., Freund, D., Mohan-Gibbons, H., Meadow, R. G., and Beacham, L. (2018). Are they buying it? United States consumers' changing attitudes toward more humanely raised meat, eggs, and dairy. *Animals* 8, 128. doi: 10.3390/ani8080128

Steentjes, K. (2021). *UK Public Concern Over Climate Crisis 'At All-Time High' as Crucial COP26 Summit Begins.* Cardiff University. Available online at: https://www.cardiff.ac.uk/news/view/2581272-uk-public-concern-over-climate-crisis-at-all-time-high-as-crucial-cop26-summit-begins (accessed July 17, 2022).

Stewart, C., Piernas, C., Cook, B., and Jebb, S. A. (2021). Trends in UK meat consumption: analysis of data from years 1–11 (2008–09 to 2018–19) of the National Diet and Nutrition Survey rolling programme. *Lancet Planet. Health* 5, e699–e708. doi: 10.1016/S2542-5196(21)00228-X

Stroebe, W., and Strack, F. (2014). The alleged crisis and the illusion of exact replication. *Perspect. Psychol. Sci.* 9, 59–71. doi: 10.1177/1745691613514450

Taverner, C. (2015). *British Public want Dairy Cows Grazing, Poll Shows. Farmers Weekly.* Available online at: https://www.fwi.co.uk/business/british-public-want-dairy-cows-grazing-poll-shows (accessed July 17, 2022).

Thibault, M., Pailler, S., and Freund, D. (2022). Why are they buying it?: United States consumers' intentions when purchasing meat, eggs, and dairy with welfare-related labels. *Food Ethics* 7:12. doi: 10.1007/s41055-022-00105-3

Thorndike, E. L. (1920). A constant error in psychological ratings. *J. Appl. Psychol.* 4, 25–29. doi: 10.1037/h0071663

USDA (2021). *Cheese Now Accounts for Largest Share of Dairy Cup-Equivalents in U.S. Diets.* US Department of Agriculture, Economic Research Service. Available online at: http://www.ers.usda.gov/data-products/chart-gallery/gallery/chart-detail/?chartId=58308 (accessed July 17, 2022).

Vanhonacker, F., Van Poucke, E., Tuyttens, F., and Verbeke, W. (2010). Citizens' views on farm animal welfare and related information provision: exploratory insights from Flanders, Belgium. *J. Agric. Environ. Ethics* 23, 551–569. doi: 10.1007/s10806-010-9235-9

Vigors, B. (2018). Reducing the consumer attitude–behaviour gap in animal welfare: the potential role of 'Nudges.' *Animals* 8:232. doi: 10.3390/ani8120232

Wellesley, L., Happer, C., and Froggatt, A. (2015). *Changing Climate, Changing Diets: Pathways to Lower Meat Consumption.* London: The Royal Institute of International Affairs, Chatham House.

Wolf, C. A., Tonsor, G. T., McKendree, M. G. S., Thomson, D. U., and Swanson, J. C. (2016). Public and farmer perceptions of dairy cattle welfare in the United States. *J. Dairy Sci.* 99, 5892–5903. doi: 10.3168/jds.2015-10619

Yzerbyt, V., Muller, D., Batailler, C., and Judd, C. M. (2018). New recommendations for testing indirect effects in mediational models: the need to report and test component paths. *J. Pers. Soc. Psychol. Attitudes Soc. Cogn.* 115, 929–943. doi: 10.1037/pspa0000132

frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 29 September 2022
DOI 10.3389/fpsyg.2022.935209

OPEN ACCESS

EDITED BY
Christopher John Bryant,
University of Bath, United Kingdom

REVIEWED BY
Kathryn T. Stevenson,
North Carolina State University, United States
Gemma Sharp,
Monash University, Australia
Gerhard Reese,
University of Koblenz and Landau, Germany

*CORRESPONDENCE
Rosie Harrington
rose.harrington@uca.fr
Armelle Nugier
armelle.nugier@uca.fr

SPECIALTY SECTION
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

RECEIVED 03 May 2022
ACCEPTED 26 August 2022
PUBLISHED 29 September 2022

CITATION
Harrington R, Nugier A, Khamzina K, Guimond S, Monceau S and Streith M (2022) Understanding individual and collective response to climate change: The role of a self-other mismatch.
Front. Psychol. 13:935209.
doi: 10.3389/fpsyg.2022.935209

Understanding individual and collective response to climate change: The role of a self-other mismatch

Rosie Harrington[1]*, Armelle Nugier[1]*, Kamilla Khamzina[2], Serge Guimond[1], Sophie Monceau[1] and Michel Streith[1]

[1]LAPSCO (Laboratoire de Psychologie Sociale et Cognitive), Université Clermont Auvergne et CNRS, Clermont-Ferrand, France, [2]PSITEC-ULR 4072, Psychologie: Interactions, Temps, Emotions, Cognition, Lille, France

Several scientists have shown the importance of mitigating global warming and have highlighted a need for major social change, particularly when it comes to meat consumption and collective engagement. In the present study (N = 486), we conducted a cross-sectional study to test the mismatch model, which aims at explaining what motivates individuals to participate in normative change. This model stipulates that perceiving a self—other difference in pro-environmental attitudes is the starting point and can motivate people to have high pro-environmental intentions. This mismatch effect is explained by participants' willingness to participate in normative and social change: people that perceive a gap between their personal attitude and the social norm should be more willing to participate in normative change. This should then motivate them to have high pro-environmental intentions on an individual and group level. The results confirm the hypothesized model on an individual and group level and explain how people can be motivated to participate in normative change. Implications of these findings and the need for further studies are discussed.

KEYWORDS

norms, mismatch, veganism, behavioral intentions, collective engagement

Introduction

The intergovernmental panel on climate change's (IPCC, 2021) sixth Assessment Report explains that "human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years" and that climate change has already had a visible impact on the average weather and climate conditions in every part of the world. For example, the number of heat waves, droughts, and tropical cyclones caused by human influence has increased since the fifth assessment report that was published only 7 years ago. In this report, IPCC also simulated different possibilities for what is to come and their results show that even if the optimistic option plays out (for which

we would have to drastically reduce our CO_2 and other greenhouse gas emissions), the global surface temperature will continue to rise until the mid-century mark. As the global temperature rises, these extreme meteorological conditions (heat waves, droughts, etc.) will occur more frequently and intensely.

Combined with other similar studies relating the negative impact of human-induced climate change on accessible resources (Watson et al., 1998; Christensen et al., 2004) and biodiversity (Willis and Bhagwat, 2009; Bellard et al., 2012), these results show how important it is to change how we interact with our environment. Indeed, mitigating the effects of climate change could somewhat help to avoid the disastrous effects of this phenomenon on our day-to-day lives. Different actions are possible to participate in the mitigation of climate change with some of them being more efficient and easily accessible than others. According to Wynes and Nicholas (2017), for example, following a plant-based diet (i.e., being vegetarian or vegan) is one of the most impactful individual behaviours in terms of climate change mitigation, with having one less child or using renewable energies (see also Barma et al., 2017), and public transport or walking (see also Fuglestvedt et al., 2008), compared to other repeated behaviours like recycling, washing clothes in cold water or even using led lightbulbs. Aside from acting on an individual level, people can also act on a societal level. Indeed, they can vote for green party politicians, organise, and/or participate in protests calling for more governmental action (see Aldy et al., 2001; Adger, 2003; Fritsche et al., 2011). Of importance, and according to Wullenkord and Hamann (2021), see also (Schulte et al., 2021), acting on an individual and group level is complementary and equally important for overcoming the effects of climate change.

Even if these different possibilities exist, and society acknowledges them (see Steg, 2018), a lot of people—including climate change deniers as well as those who are more aware of climate change—still do not necessarily behave pro-environmentally (Whitmarsh and Capstick, 2018). Thus, part of climate change mitigation has now started to include research on what motivates these behaviours and how social change can occur. In this article, we empirically test the mismatch model (Khamzina et al., 2021; Deffuant et al., 2022) to explain what can motivate individuals to act pro-environmentally on a group and individual level, and participate in normative change.

The mismatch effect on pro-environmental intentions

Social psychology is one of the many fields that offer explanations for why people act in various ways and throughout the different theories and studies, two behavioural predictors seem essential to understanding pro-environmental action: social norms and attitudes (Ajzen and Fishbein, 1977; Ajzen, 1991). Attitudes are generally considered to be an evaluation of a certain object, concept, or person, which ranges from extremely negative to extremely positive (Bohner and Dickel, 2011). Ajzen (1991) and Ajzen et al. (2018) then offers a more detailed definition with two main components: an affective dimension that focuses on what an individual personally believes about the behaviour, and a cognitive dimension that is more about what we think the consequences of said behaviour are. Researchers secondly define social norms as a 'collective awareness about the preferred, and appropriate behaviours among a certain group of people' (Chung and Rimal, 2016). Different theories then explain that different types of norms exist. For example, Cialdini et al. (1990) theory offer two types of norms: descriptive norms and injunctive norms. Descriptive norms represent how people in a specific group actually behave, and injunctive norms are standards that members of the group are expected to follow and expect others to follow in a given social situation. These norms indicate whether behaviour is approved of or frowned upon, whereas descriptive norms concern what people are actually doing.

Multiple studies have shown that attitudes and social norms play an important role in predicting intentions to act pro-environmentally (Fife-Schaw et al., 2007; Krispenz and Bertrams, 2020; Niemiec et al., 2020). Most of these studies and the underlying theories consider attitudes and social norms to be independent concepts, with independent effects on intentions and behaviour (Bagozzi and Schnedlitz, 1985; Ajzen, 1988, 1991). Nevertheless, the few studies that have tested the interaction effect of attitudes and norms found that it significantly affects the participants' intentions to engage in a particular behaviour (Grube and Morgan, 1990; Prentice and Miller, 1993; Fife-Schaw et al., 2007), notably when the two variables are mismatched—when one is in favour of the behaviour and the other one is against. Researchers first hypothesized that when an individual disagrees with public opinion, they would rather conform to what others believe rather than go against said social norm (Asch, 1951; Noelle-Neumann, 1974, 1993). Thus, people would tend to change their behaviour to fit with those of others (i.e., a normative influence hypothesis; Asch, 1951; Acock and DeFleur, 1972; Grube and Morgan, 1990). Studies testing Noelle-Neumann's spiral of silence theory have, however, mixed results and often find a weak correlation between majority support and the expression of personal opinions (Scheufele and Moy, 2000; Katz and Fialkoff, 2017). The mixed results could be due to the theory not applying to all situations. For example, it does not explain how and why societies evolve and change over time: normative change cannot happen if people always conform to the social norm. Therefore, some researchers have hypothesized that people sometimes share their dissident opinion and that minorities can significantly influence opinions (Moscovici et al., 1969; Moscovici, 1991). Others have also suggested that observing a difference between one's personal attitude and perceived social

norms is the starting point and can make us stand more strongly in our position and not conform to social norms (Khamzina et al., 2021; Deffuant et al., 2022).

Khamzina et al. (2021), see also Deffuant et al. (2022) call this interaction effect and its predictions "the mismatch hypothesis." The first central idea in this hypothesis is that the mismatch between perceived social norms and personal attitudes can be a source of motivation to have high intentions to act pro-environmentally—notably when the individual perceived their personal attitude to be in favour of the behaviour but not the social norm. In a series of studies, Khamzina et al. (2021) effectively confirm this hypothesis: intentions to convert to organic farming were significantly higher when the farmers' attitudes and perceived social norms were mismatched (with the personal attitude being in favour and perceived norms being against), compared to the other possibilities. This mismatch effect is not simply people ignoring the social norm because they do not identify with the social group: people who identify as a member of the said group can also be motivated to act against social norms (Packer, 2009; Packer and Chasteen, 2010). These studies stem from the normative conflict model that states that 'strongly identified members are attentive to group-related problems and perceptions that the status quo is harmful to the collective may trigger expression of dissenting opinions' (Packer, 2008, pp.1). On this basis, a second central part of this mismatch model theorised by Khamzina et al. (2021) is that the mismatch effect is rooted in wanting to change the group for the better and pushing for social change. Khamzina and collaborators, therefore, suggest, although do not test, that the mismatch effect on intentions can be explained by a willingness to change social norms. They suggest that when individuals perceive a mismatch between the social norm and their own personal attitude, they will want to change this social norm to make better the group, and this should result in more pro-environmental behaviours. This willingness to change norms would then push people to have a level of pro-environmental intentions that coincides with their own personal attitude.

Study overview

The main goal of this article is to investigate the theorized mismatch model and the key component of willingness to change social norms that, according to our knowledge, has yet to be empirically tested. We built our study on a specific environmental challenge: meat consumption. Given that meat consumption explains a significant part of greenhouse gas emissions due to human activity (Tukker and Jansen, 2006; Aubin, 2014), reducing our dietary intake of meat would contribute considerably to the fight against climate change (Salonen and Helne, 2012; Chai et al., 2019). In France and most western societies, however, diets with low or no meat intake are rare (Sanchez-Sabate and Sabaté, 2019) and there is often a strong national fightback when it is the case (Cholez, 2021; Schittly, 2021). People acting pro-environmentally, in this sense, are part of a minority in France. Hence, this is an area in which social change is crucial from a climate change mitigation perspective. As the mismatch model might explain individual behaviour in times of social change, vegetarians' behaviour could, therefore, be explained by the mismatch model. Indeed, previous literature shows that being part of a minority can make minority members feel different and distant from other members of the group (Hassouneh et al., 2014; Gutmann-Kahn and Lindstrom, 2015), whether it stems from having a different identity or even believing to have diverging opinions from majority members. Even if being vegetarian or vegan is not quite the same as other marginalized groups because they are a minority group based on choice not by biological trait, research shows that similar processes of distance and stigmatization still occur (Bresnahan et al., 2016; Markowski and Roxburgh, 2019). For example, vegetarianism is often treated as a deviant practice that requires explanation (Wilson et al., 2004; de Groeve et al., 2021). For these reasons, vegetarians could perceive a bigger self—other difference than non-vegetarians, and this could then activate the mismatch pattern. In the present study, we, therefore, compare vegetarians and vegans (i.e., veg*ns) to people who still eat meat to see if it is effectively the case.

We first hypothesized that veg*ns would feel more strongly in mismatch, with their personal attitude higher than the social norms, compared to participants who still eat meat regularly (H1). We also predict that veg*ns will have higher pro-environmental intentions than non-veg*ns, at an individual level (H2a). While studies on non-conformism have mainly looked at individual action, we also wanted to extend these results to group-level action: as vegetarians are more highly in mismatch, we predict veg*ns should also have higher group level intentions than non-veg*ns (H2b). Finally, to provide a test of the mechanism underlying the impact of mismatch on pro-environmental intentions, we hypothesized that the relation between mismatch and pro-environmental intentions will be mediated by the willingness of participants to change social norms. More precisely, we tested a serial mediation model in which veg*ns participants should be more highly in mismatch, which then heightens their willingness to change norms. The latter then increases intentions to behave pro-environmentally at an individual level (H3a) and group level (H3b).

Materials and methods

Participants

The final sample comprised 486 volunteers (97,3% French native; 78% women, 21 % men, 1% others) who ranged from 18 to 76 years (M_{age} = 34.84, SD = 12.80). Most of the participants had a university education (96,5%). Two hundred forty participants (49,4 %) declared themselves as vegetarian or vegan and 246 (50,6%) still eat meat (see **Supplementary materials** for

additional information). This online study was conducted from 26 July to 9 September 2021.

Procedure

We approached potential participants on a variety of social network groups and proceeded through snowball sampling. As the aim of the study was to compare two sub-groups of the French population that either act pro-environmentally (vegans) or do not (omnivores), we reached out to as many veg*n and non-veg*n groups as possible. Consequently, we had well-balanced groups, which was ideal for the planned statistical analysis. The study was presented as an online study on global warming and meat consumption. After briefing about the purpose of the study, participants answered the questionnaire and were then, debriefed and thanked.

Measures

All answers were given on 9-point Likert scales, ranging from (1) "*strongly disagree*" to (9) "*strongly agree*." Participants' composite scores for each measure were averaged.

Attitudes toward eating less meat in order to reduce global warming were measured using four statements inspired by Wan et al. (2017). We adapted their questions on attitudes toward recycling to our target behaviour (changed "recycling is rewarding" to "eating less meat is rewarding" for example), $\alpha = 0.88$, $M = 7.24$, $SD = 2.05$. Perceived *social norms* in France were measured using the Guimond et al. (2013, 2015) method where we replace "I think that" of each item that measured attitudes with "Most French people think that" (e.g., "Most French people think that eating less meat is a good idea in order to reduce global warming"), $\alpha = 0.90$, $M = 4.44$, $SD = 2.00$. The two measures were counterbalanced (see Guimond et al., 2013, 2015). A mismatch index was created by subtracting ratings of social norms from ratings of attitudes. A high score on this measure indicates a level of mismatch in favour of personal attitudes. Participants' *willingness to participate in normative change* was measured with one statement (e.g., "I would like to participate in the changing of the meat-consumption norm in France"), $M = 7.31$, $SD = 2.25$. *Individual-level intention* to act against global warming by eating less meat was assessed with four statements (e.g., "To fight against climate change, as an alternative to meat products, I intend to eat more legumes, cereals, or plant-based proteins) (e.g., tofu, red beans, lentils, chickpeas, etc."), $\alpha = 0.83$, $M = 7.43$, $SD = 1.92$. *Group-level intention* to act against global warming was assessed with two statements (e.g., "During the next presidential elections, I intend to vote for a political party, whose program would be very protective of the environment"; "I plan to participate in upcoming regional or national climate events"), $r = 0.41$, $p < 0.001$, $M = 5.33$, $SD = 2.25$. These two levels of intentions are positively correlated ($r = 0.47$, $p < 0.001$).

Demographic and dispositional variables

Participants answered socio-demographic questions relating to their gender, age, country of birth, country of residence, education level, diet (ie., veg*ns or not), political orientation [assessed by indicating their position on a scale ranging from (1) extreme left-wing to (9) extreme right-wing, $M = 3.94$, $SD = 1.59$], identification as a national (French) citizen [assessed by indicating their position on a scale ranging from (1) "*not at all*" to (9) "*extremely*", $M = 6.58$, $SD = 2.05$], and the perception of themselves as an environmental activist [assessed by indicating their position on a scale ranging from (1) "*not at all*" to (9) "*extremely*," $M = 4.38$, $SD = 1.67$]. Supplementary analyses controlling these factors were conducted and the results remained unchanged.

Results

Attitudes and perceived group norm: A significant mismatch

We conducted a 2 (Diet: veg*ns vs. non-veg*ns) * 2 (Type of measure: personal attitude vs. social norm) mixed ANOVA with the last variable as a within-participant factor. All reported effects are significant at $p < 0.001$ except where it is mentioned. We observed a main effect of type of measures [$F(1, 484) = 713.37$, $\eta^2_p = 0.59$], yielding a significant difference between personal attitudes and perceived social norms. Overall, participants had a more favourable attitude toward the reduction of meat consumption as a means to fight against global warming ($M = 7.24$, $SD = 2.05$) than what they perceived as the social norm in France ($M = 4.44$, $SD = 2.00$). As predicted, this main effect was qualified by a significant interaction with the participants diet [$F(1, 484) = 171.79$, $\eta^2_p = 0.26$, see **Figure 1**]. Veg*n participants were more positive toward the reduction of meat consumption as a mean to fight against global warming ($M = 8.35$, $SE = 0.11$) than non-veg*n participants [$M = 6.16$, $SE = 0.11$, $F(1, 484) = 194.90$, $\eta^2p = 0.29$]. They perceived slightly less ($M = 4.15$, $SE = 0.13$) than non-veg*n participants ($M = 4.73$, $SE = 0.12$) that French people are favourable toward the reduction of meat consumption as a mean to fight against global warming [$F(1, 484) = 10.36$, $\eta^2p = 0.02$]. Of interest, the perceived difference between attitude and social norms was greater for participants that follow a veg*n diet [mean difference = 4.21, $SE = 0.15$; $F(1, 484) = 782.99$, $\eta^2_p = 0.62$] compared with participants who still eat meat [mean difference = 1.44, $SE = 0.15$; $F(1, 484) = 93.66$, $\eta^2_p = 0.16$]. Thus, H1 was confirmed: veg*ns of our sample were more strongly in mismatch, with their attitude higher than the perceived social norms, compared to participants who still eat meat regularly.

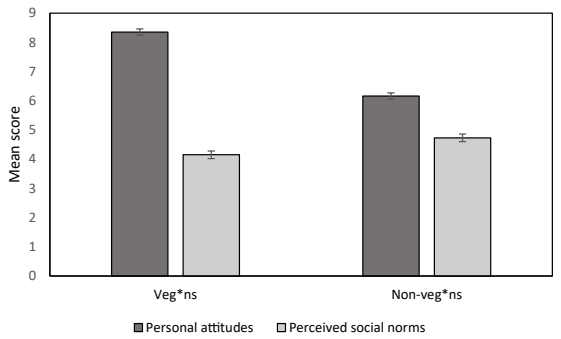


FIGURE 1
Veg*ns and non-veg*ns' mean scores of personal attitudes and perceived norms toward the reduction of meat consumption as a mean to reduce global warming. The bars are standard error bars.

Testing our model: Mediations on individual and group pro-environmental intentions

To test whether participants' diet indirectly influenced their tendencies to act pro-environmentally at an individual (Model A) and group level (Model B) through causally linked multiple mediators of mismatch and willingness to participate in normative change, two serial mediation analyses (Model 6 in PROCESS, 5000 percentile bootstrap) were conducted with the bootstrap method (Hayes, 2014). The paths for the full process model are shown in **Figure 2** and their corresponding coefficients and 95% Cis are shown in **Tables 1**, **2** (see **Supplementary materials** for an extended description). **Figure 2** shows the serial mediations.

As predicted, it was found that participants' diet significantly predicted the mismatch perception (b = −2.77, 95%CI [−3.19; −2.36]). Participants' diet (b = −1.13, 95%CI [−1.50; −0.75]) and mismatch perception (b = 0.35, 95%CI [0.28; 0.42]) also significantly predicted the willingness to participate in normative change. For the Model A and Model B, both the total effect of diet on intention to act at an individual or a group level against climate change (Model A: b = −1.76, 95%CI [−2.07; −1.46]; R^2 = 0.21; Model B: b = −1.51, 95%CI [−1.89; −1.13], R^2 = 0.11) and the total direct effects when controlling for the mediators were significant (Model A: b = −0.34, 95%CI [−0.61; −0.08]; and Model B: b = −0.60, 95%CI [−1.03; −0.18][1]).

Of importance, H3a and H3b were supported. For both Model A and Model B, the total indirect effects were significant (Model A: *effect* = −1.42, 95%CI [−1.70; −1.14], and Model B: *effect* = −0.90, 95%CI [−1.17; −0.65]), with a significant serial mediation effect being observed from participant's diet *via* mismatch perception and willingness to participate in normative change in intention to act at an individual level (Model A: *effect* = −0.50, 95%CI [−0.67; −0.36]) and to intention to act against climate change at a group level (Model B: *effect* = −0.35, 95%CI [−0.49; −0.23]). The specific indirect effect through mismatch only was significant for Model A (*effect* = −0.32, 95%CI [−0.49; −0.17]) but not for Model B (*effect* = −0.14, 95%CI [−0.38;.10]) whereas the specific indirect effect through willingness to participate in normative change only was significant for both Model A (*effect* = −0.59, 95%CI [−0.80; −0.39]) and model B (*effect* = −0.41, 95%CI [−0.59; -0.26]).

Overall, these findings indicate that veg*n participants have a strong intention to behave pro-environmentally at both individual level (i.e., eating no meat, H3a) and group level (i.e., voting for a green political party or participating in climate events, H3b), because the perceived mismatch between their attitude and social norms is associated with their willingness to change social norms toward meat consumption.

Discussion

In this study, we investigated the mismatch model by applying it to a minority that already acts pro-environmentally (i.e., veg*ns). We compared vegetarians and vegans to omnivores to see if the mismatch between personal attitudes and perceived social norms can explain how a minority maintains its high pro-environmental intentions on an individual level. Our second goal was to see if this same model can also motivate other levels of pro-environmental intentions (i.e., on a group level). When testing the model on pro-environmental intentions on an individual and group level, each path of the mediation is significant and confirmed our expectations—even when controlling for demographic and dispositional variables. First, vegetarians and vegans are significantly more in mismatch with their personal attitudes higher than the perceived social norm, compared to non-veg*ns. These results reflect previous research on minorities and how they differ from other members of the group (Hassouneh et al., 2014; Gutmann-Kahn and Lindstrom, 2015): being part of a minority does, indeed, accentuate the belief that one's personal attitude is different from the social norm. It does so not only by polarizing minorities' attitudes (i.e., in our sample veg*ns have stronger attitudes than others) but also by changing group members' perception of social norms (i.e., veg*ns perceived the social norm to be less in favour of eating less meat than omnivores). This confirms the biased perception of the social norm found in previous studies: group members do not estimate accurately the actual social

1 This path became nonsignificant when we included covariates in the model: b = −0.13, SE = 0.19, t = −0.68, p = 0.49, 95%CI [−0.51; 0.25]). Other unstandardized Betas slightly changed due to the addition of parameters in the model, but no large fluctuation toward p-values was observed. In other words, with the exception of path c' in model B which became nonsignificant, all other paths, for both models A and B are broadly the same as those described here.

10.3389/fpsyg.2022.935209

TABLE 1 Direct, indirect, and total effects of the hypothesized model A.

Model pathways	*b*	SE	*t*	*p*	LL95%CI	UL95%CI
Direct and total effects						
Diet → Mismatch	−2.77	0.21	−13.10	0.001	−3.19	−2.36
Diet → Willingness	−1.13	0.19	−5.86	0.001	−1.50	−0.75
Mismatch → Willingness	0.35	0.03	9.81	0.001	0.28	0.42
Mismatch → Individual level intention	0.11	0.02	4.42	0.001	0.06	0.17
Willingness → Individual level intention	0.52	0.03	16.95	0.001	0.46	0.58
Total model effect	−1.76	0.15	−11.38	0.001	−2.07	−1.46
Direct effect	−0.34	0.13	−2.55	0.011	−0.61	−0.08
Indirect effects	**Effect**	**SE**			**LL95%CI**	**UL95%CI**
Total	−1.42	0.14			−1.70	−1.14
Diet → Mismatch → Individual level intention	−0.32	0.08			−0.49	−0.17
Diet → Willingness → Individual level intention	−0.59	0.10			−0.80	−0.39
Diet → Mismatch → Willingness → Individual level intention	−0.50	0.08			−0.67	−0.36

b = unstandardized coefficients.

TABLE 2 Direct, indirect, and total effects of the hypothesized model B.

Model pathways	*b*	SE	*t*	*p*	LL 95%CI	UL 95%CI
Direct and total effects						
Diet → Mismatch	−2.77	0.21	−13.10	0.001	−3.19	−2.36
Diet → Willingness	−1.13	0.19	−5.86	0.001	−1.50	−0.75
Mismatch → Willingness	0.35	0.03	9.81	0.001	0.28	0.42
Mismatch → Group level intention	0.05	0.04	1.22	0.224	−0.03	0.13
Willingness → Group level intention	0.36	0.05	7.41	0.001	0.26	0.46
Total model effect	−1.51	0.19	−7.80	0.001	−1.89	−1.13
Direct effect	−0.60	0.21	−2.81	0.005	−1.03	−0.18
Indirect effects	**Effect**	**SE**			**LL95%CI**	**UL95%CI**
Total	−0.90	0.13			−1.17	−0.65
Diet → Mismatch → Group level intention	−0.14	0.12			−0.38	0.10
Diet → Willingness → Group level intention	−0.41	0.08			−0.59	−0.26
Diet → Mismatch → Willingness → Group level intention	−0.35	0.06			−0.49	−0.23

b = unstandardized coefficients.

norm (Prentice and Miller, 1993; Guimond et al., 2015; Geiger and Swim, 2016). Our results, however, go one step further by showing that different group members do not necessarily misestimate the social norm in the same way.

The results also confirm the mismatch models' effect on individual and group level intentions: self-other mismatch significantly explains vegetarians' intentions to continue to act on an individual level and to participate in group actions. First, vegetarians continuing to have high individual intentions are, indeed, linked to the difference in personal opinion compared to other group members, and their higher levels of willingness to participate in normative change. These results are consistent with those found in previous studies (Falomir-Pichastor et al., 2008; Lalot et al., 2018) and can effectively explain how minorities fight the pressure to conform to social norms. Second, while the specific indirect effect "diet—mismatch—group level intentions" was nonsignificant, the total direct and indirect effects of the model were significant: being part of a minority accentuates intentions to act on a group-level (participating in demonstrations and voting for a green political party). This effect is significantly mediated by participants' mismatch perception and their willingness to participate in normative change. The model, therefore, does not only explain how minorities maintain their original pro-environmental

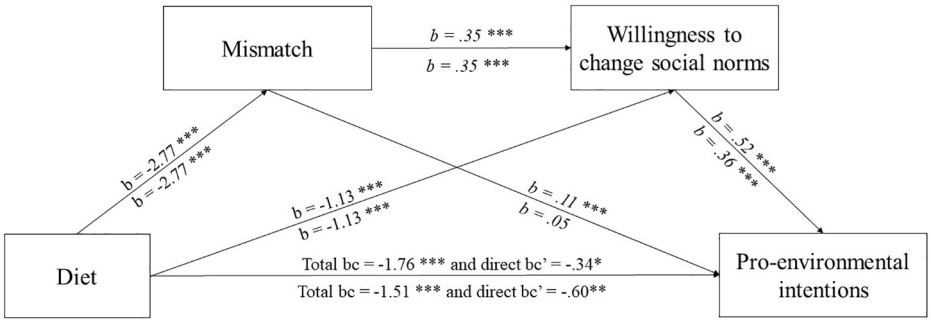


FIGURE 2
Mediation model A (above the arrows) and model B (under the arrows). They were assessed using Hayes process model 6, evaluating through mismatch perception and willingness to engage in normative change as mediators of the relationship between the diet that participants followed (coded: 0 = Veg*ns; 1 = non-veg*ns); and the intentions to act against the climate change at an individual-level and the diet that participants followed and the intentions to act against the climate change at a group-level, respectively. b = unstandardized coefficients. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

action: consistent with previous literature (Lalot et al., 2018) it can also motivate people to act pro-environmentally in ways they were not necessarily doing before.

Theoretical and applied implications

These results have multiple theoretical and applied implications. From a theoretical perspective, this study shows the need to refine certain theories in social psychology. Indeed, the present study can first be used to nuance the current literature on normative influence. Previously, deviance was originally considered as behaviour that negatively impacts the group and that should be avoided (Sherif, 1936; Asch, 1956). So, conformism was thought to be the be-all and end-all for group members, when they were faced with a social norm. It is not, however, necessarily the case: when group members are exposed to a social norm, they can also be part of an active minority that expresses a deviating opinion with the aim of changing and bettering the group. Indeed, a panel of previous real-life events and studies show that social change does not happen by conforming to social norms: social change is more often than not only possible with the efforts of minority groups and isolated individuals (Mugny et al., 1983; Lalot et al., 2018). For example, Moscovici et al. (1969), Moscovici and Lage (1976), and Moscovici (1991) shows that minorities drive social change by expressing their non-conformist opinions and that they have a latent influence on others. Unlike majorities that cause temporary public attitudinal and behavioural change (i.e., "manifest influence"), minorities influence others more slowly and privately. With this latent influence, minorities inspire and gradually motivate other group members to change by exposing them to opinions and behaviours that are different and non-conformist (Bolderdijk and Jans, 2021; Nardini et al., 2021). This dissident behaviour can, therefore, have a positive effect on society and is what some researchers call constructive deviance (Packer, 2008; Galperin, 2012; Vadera et al., 2013). This study contributes to this line of research firstly by confirming that certain group members do practice dissident behaviours, and secondly by showing that minorities actively participate in non-conformist actions in the specific aims to provoke social change. Social change is not an unwanted consequence of their actions but seems to actually be part of their motivation to act.

Of course, even if we cannot claim why people are vegetarian (indeed, multiple factors can be involved in eating preferences, see Symmank et al., 2017 for a review), our results suggest that vegetarians having high individual and group level intentions can be partly explained by their heightened "self-other" mismatch and their higher willingness to change the social norm. It seems like they manage to maintain their intentions because they perceive a bigger self-other gap and they want to change the social norm, compared to non-vegetarians. As a logical part of future research, motivation to be vegetarian and to encourage others to reduce their meat consumption should be examined more deeply. For example, future research could extend these results by seeing whether vegetarians continue their meat-free diet once the social change has been achieved: would they maintain their polarized, almost extreme level, of pro-environmental intentions once most group members are doing their part to help the planet? Or would they no longer feel the need to do so and shift to a less restrictive diet (i.e., eating meat at most once a day)?

Our results can secondly shed some light on limitations to the theory of planned behaviour that has been discussed in prior research. Recent studies show that attitudes do not have as much influence on intentions and behaviour as previously suggested and that a positive attitude does not always finish in actual behaviour. This is known as the attitude-behaviour gap (Aschemann-Witzel and Niebuhr Aagaard, 2014; Farjam et al., 2019). This can partly explain why a significant amount of

studies and interventions (notably communication campaigns) have solely relied on majority normative influence to motivate pro-environmental behaviours (Bergquist and Nilsson, 2016; Niemiec et al., 2020; Salazar et al., 2021). While this attitude-behaviour gap does effectively exist, it can be reduced by several means, notably by considering moderating variables (Conner et al., 2002; Farjam et al., 2019). For example, Conner et al. (2002) show that the attitude-behaviour gap is reduced when the individual's attitude is not ambivalent. On a similar note, our results also show that individuals' attitudes can have a more significant role in motivating pro-environmental behaviour when they do not match with the actual norm. These results, therefore, also join a second criticism brought forward concerning the theory of planned behaviour and the stipulated independence between personal attitudes and social norms. Indeed, models like the theory of reasoned action (Ajzen and Fishbein, 1977), further extended within the theory of planned behaviour (Ajzen, 1991), suggest that while social norms and personal attitudes can often predict intentions and behaviour, they always do so independently (Ajzen, 1988). The present study concludes, however, that considering the interactive effect between social norms and personal attitudes can improve the understanding of what motivates intentions and behaviours: if people's personal attitudes do not match social norms, then their intentions are affected differently, compared to when they are matched. Including the interaction between social norms and personal attitudes significantly predicts intentions and therefore improves the understanding of what motivates intentions and behaviours.

Another theoretical question emerges from our results: would we find the same 'attitude – social norms' mismatch effect on intentions when taking into account the perceived descriptive or prescriptive characteristics of norms rather than the perceived general attitude of the group (i.e., the social norm in general)? Would a disagreement with an injunctive norm (what others believe is right/wrong) have a different effect than a disagreement with a descriptive norm (what others do)? Previous studies (Khamzina et al., 2021) show that different types of norms can effectively interact differently with personal attitudes. They find that perceived group norms (PGNs, which focus on attitudes of others) interact more with participants' attitudes than subjective norms (norms that focus on 'important' others) do. This can be due to the fact that there is a bigger perception bias for perceived group norms than for subjective norms (Deffuant et al., 2022): people tend to perceive others' far attitudes (PGN) further than they actually are and close attitudes closer to theirs than they really are. This is less the case for subjective norms. As subjective norms are conceptually closer to injunctive norms (see Thøgersen, 2006 for a review), the mismatch effect could also have a bigger effect when considering descriptive norms, rather than injunctive norms. Further studies empirically testing these hypotheses are, however, still needed in this area.

Finally, our results could be used during the creation of behavioural change interventions. Indeed, many studies have found a positive impact of interventions aimed at either changing the TPB variables and thus indirectly changing intentions and behaviour, or using these variables to directly change intentions and behaviours (Steinmetz et al., 2016). Ajzen and Schmidt (2020), therefore, recommend designing interventions that influence these variables because they could produce substantial changes in behaviour. When creating and testing future interventions aiming for behavioural change, researchers could use our results to nuance and adapt these interventions to target a larger sample of individuals (i.e., by accentuating the idea that people can lead normative change by following their more favourable attitudes). For example, using informational strategies (see Steg and Vlek, 2009, for a review on informational strategies) that broadcast normative messages could remind individuals that the social norm is less favourable than they would like, and consequently activate their willingness to change social norms. This would push them to participate more in environmental action (i.e., eat less meat, or participate in collective action). This intervention would, however, only heighten environmental behaviours for participants that perceive a mismatch with their attitudes higher than the norm.

Limitations and future directions

Despite providing empirical support for the mismatch model and having important implications, this study presents some limitations—notably the experimental design. Since this study is cross-sectional, the pathways in the mediation analysis can only be considered correlational and not to be causal links. While this study is a first step toward explaining the mismatch effect on pro-environmental intentions and how minorities maintain their pro-environmental intentions, further studies need to be conducted with an experimental design capable of testing the causal pathways of this model (i.e., manipulating the self-other difference in pro-environmental attitudes). A second limitation concerns the sampling strategy. In this study, we aimed to test the mismatch model presented in the introduction by comparing people who already act pro-environmentally in real life (i.e., vegetarians and vegans by eating no meat) and those who do not yet (i.e., people who still eat meat). Comparing these two existing sub-groups in the French population offered initial evidence supporting the mismatch model as hypotheses are confirmed. Indeed, veg*ns had much higher scores on each mismatch variable. While we compare statistically balanced groups, our participants had to volunteer to take part in the research which may have been creating a self-selection sampling bias. Thus, one can argue that this could have led to participants with only certain

characteristics wanting to participate in the study, and therefore not providing a representative sample for the study (see Sharma, 2017). This is a common bias for all the studies that use, as we did, volunteer procedures of recruitment and snowball sampling for the study of 'hard-to-reach' populations such as veg*ns. This limit should be considered when interpreting the presented results.

A third limit is that we focused on only one of the various behaviours that can be used to mitigate climate change (see Wynes and Nicholas, 2017). Indeed, we generally wanted to study behaviour that contributes to the reduction of greenhouse gas emissions, and reducing one's meat consumption does so significantly (see Tukker and Jansen, 2006; Aubin, 2014). Further research could reinforce our results by conducting conceptual replications with other pro-environmental behaviours. If the mismatch model does effectively explain social change, a "self-other" difference should also explain people's behavioural intentions in others areas where social change is also needed (using eco-transports rather than a car alone, reducing energy and water consumption for example). Moreover, we did not consider other important factors that could intervene and extend the understanding of individual dynamics that are involved in the motivation to participate in social change. For example, it could be interesting to examine the role of people's perceptions of climate change because this could play an important role in whether they support climate policies, and act to mitigate and/or adapt to climate change. Indeed, people may hold different beliefs about the extent to which climate change is caused by humans and what consequences it will have, where, and when (Van Valkengoed et al., 2021). For example, believers should be more inclined to behave in a pro-environmental way, and even more so if they perceived that this is not the case for general others. Indeed, as they should perceive the highest urgency to react against climate change, they also should be more motivated to change social norms with regard to pro-environmental behaviours. Other variables could also moderate the mismatch model. For example, depending on the person's perceived behavioural control (PBC, Fife-Schaw et al., 2007; La Barbera and Ajzen, 2020) on the target behaviour, and the perceived electability of the political party (Abramowitz, 1989; Sandri and Seddone, 2015; Mildenberger and Tingley, 2017), their individual and group level intentions may not be the same. The classic hypothesis for PBC would be that perceiving low behavioural control would reduce the beneficial effect of a 'self-other' difference on individual pro-environmental intentions (see Ajzen and Schmidt, 2020 for a review). But a recent study conducted by Khamzina et al. (2021), see also Deffuant et al. (2022) shows that the mismatch effect only influences peoples' behaviour with low PBC—as if high PBC sufficed in motivating action but when perceived control is low, other factors need to come into play. These results concur with other studies (Guagnano et al., 1995) that show that attitudes predict behaviour less when behaviour is easily feasible. As for the perceived electability of the political party, perceiving a political party as unlikely to be elected could reduce the beneficial effects of the mismatch effect on voting for a said political party. It might not, however, have an effect on other group-level actions (i.e., participating in demonstrations and protests). So, while this study's main focus was the interactive effect between social norms and personal attitudes drawn from the theory of planned behaviour, future studies could include measures of perceived control and perceived electability to see how they specifically influence the mismatch model.

Finally, only pro-environmental intentions were measured and not actual pro-environmental behaviour. Despite their importance in predicting action (Armitage and Conner, 2001; Riebl et al., 2015), intentions cannot be fully equated with actual behaviour. Therefore, future research needs to assess the mismatch model by measuring, or even observing pro-environmental actions.

Conclusion

This research contributes to the literature on social change and provides a better understanding of how vegetarians maintain their pro-environmental intentions, despite the social pressure to do otherwise. Indeed, our findings suggest that they perceive a gap between their attitude and the social norms, and this motivates them to change the current social norm. This willingness to participate in normative change is what then leads to vegetarians maintaining their individual intentions, and even having higher levels of group-level pro-environmental intentions. Future behavioural change interventions should, therefore, consider these results to better support active minorities and to also lead others into participating in normative change.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation. Materials and data are available at OSF at: https://osf.io/unmc8.

Ethics statement

All procedures performed were in accordance with the ethical standards of the Clermont Université Auvergne Research Ethics Committee (IRB-UCA REC) and with the 1964 Helsinki Declaration and its later amendments or comparable ethical

standards. Ethical permission to conduct this research was granted by the IRB-UCA REC Protocol N° IRB00011540-2021-53. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

RH, AN, KK, SG, SM, and MS: conceptualization. RH and AN: material development, formal analysis, original draft, and writing – review and editing. RH and SM: participant recruitment and ethical standards. KK, SM, SG, and MS: review and editing. AN: funding acquisition. All authors contributed to the article and approved the submitted version.

Funding

This work was supported in part by the research project "202CM" funded by the JPI Climate Solstice and French National Research Agency (ANR-20-SOLS-0001-01).

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.935209/full#supplementary-material

References

Abramowitz, A. I. (1989). Viability, electability, and candidate choice in a presidential primary election: a test of competing models. *J. Politics* 51, 977–992.

Acock, A. C., and DeFleur, M. L. (1972). A configurational approach to contingent consistency in the attitude-behavior relationship. *Am. Sociol. Rev.* 37, 714–726. doi: 10.2307/2093582

Adger, N. (2003). Social capital, Collective action, and adaptation to climate change. *Econ. Geography* 79, 387–404.

Ajzen, I. (1988). *Attitudes, Personality, and Behavior*. Milton Keynes: Open University Press.

Ajzen, I. (1991). The theory of planned behavior. *Organ. Behav. Hum. Decision Proc.* 50, 179–211. doi: 10.1016/0749-5978(91)90020-T

Ajzen, I., and Fishbein, M. (1977). Attitude-behavior relations: a theoretical analysis and review of empirical research. *Psychol. Bull.* 84, 888–918. doi: 10.1037/0033-2909.84.5.888

Ajzen, I., Fishbein, M., Lohmann, S., and Albarracın, D. (2018). The influence of attitudes on behavior. *Basic Principles Handb. Attitudes* 1, 197–255.

Ajzen, I., and Schmidt, P. (2020). "Changing behavior using the theory of planned behavior," in *The Handbook of Behavior Change*, eds M. S. Hagger, L. D. Cameron, K. Hamilton, N. Hankonen, and T. Lintunen (Cambridge: Cambridge University Press), 17–31. doi: 10.1017/9781108677318.002

Aldy, J. E., Orszag, P. R., and Stiglitz, J. E. (2001). "Climate change: an agenda for global collective action," in *Paper Prepared for the Conference on the Timing of Climate Change policies, Pew Center on Global Climate Change*, (Washington, DC).

Armitage, C. J., and Conner, M. (2001). Efficacy of the theory of planned behaviour: a meta-analytic review. *Br. J. Soc. Psychol.* 40, 471–499. doi: 10.1348/014466601164939

Asch, S. A. (1951). "Effect of group pressure upon the modification and distortion of judgments," in *Groups, Leadership, and Men*, ed. H. Guetzkow (Pittsburgh, PA: Carnegie Press), 177–190.

Asch, S. E. (1956). Studies of independence and conformity: I. a minority of one against a unanimous majority. *Psychol. Monographs: General Appl.* 70, 1–70. doi: 10.1037/h0093718

Aschemann-Witzel, J., and Niebuhr Aagaard, E. M. (2014). Elaborating on the attitude-behaviour gap regarding organic products: young Danish consumers and in-store food choice. *Int. J. Consumer Stud.* 38, 550–558. doi: 10.1111/ijcs.12115

Aubin, J. (2014). Empreinte environnementale de la viande et des produits carnés. *Viandes Produits Carnés* 30, 1–7.

Bagozzi, R. P., and Schnedlitz, P. (1985). Social contingencies in the attitude model: a test of certain interaction hypotheses. *Soc. Psychol. Quarterly* 48, 366–373. doi: 10.2307/2786698

Barma, M. C., Saidur, R., Rahman, S. M. A., Allouhi, A., Akash, B. A., and Sait, S. M. (2017). A review on boilers energy use, energy savings, and emissions reductions. *Renewable Sustainable Energy Rev.* 79, 970–983. doi: 10.1016/j.rser.2017.05.187

Bellard, C., Bertelsmeier, C., Leadley, P., Thuiller, W., and Courchamp, F. (2012). Impacts of climate change on the future of biodiversity. *Ecol. Lett.* 15, 365–377. doi: 10.1111/j.1461-0248.2011.01736.x

Bergquist, M., and Nilsson, A. (2016). I saw the sign: promoting energy conservation via normative prompts. *J. Environ. Psychol.* 46, 23–31. doi: 10.1016/j.jenvp.2016.03.005

Bohner, G., and Dickel, N. (2011). Attitudes and attitude change. *Annu. Rev. Psychol.* 62, 391–417. doi: 10.1146/annurev.psych.121208.131609

Bolderdijk, J. W., and Jans, L. (2021). Minority influence in climate change mitigation. *Curr. Opinion Psychol.* 42, 25–30. doi: 10.1016/j.copsyc.2021.02.005

Bresnahan, M., Zhuang, J., and Zhu, X. (2016). Why is the vegan line in the dining hall always the shortest? understanding vegan stigma. *Stigma Health* 1, 3–15. doi: 10.1037/sah0000011

Chai, B. C., van der Voort, J. R., Grofelnik, K., Eliasdottir, H. G., Klöss, I., and Perez-Cueto, F. J. A. (2019). Which diet has the least environmental impact on our planet? a systematic review of vegan, vegetarian and omnivorous diets. *Sustainability* 11, 4110–4128. doi: 10.3390/su11154110

Cholez, L.-A. (2021). *Menu Sans Viande Dans les Cantines Scolaires?: la Polémique en Cinq Actes*. Available online at: https://reporterre.net/Menus-sans-viande-a-Lyon-les-contre-verites-des-politiques (accessed May 1, 2021)

Christensen, N. S., Wood, A. W., Voisin, N., Lettenmaier, D. P., and Palmer, R. N. (2004). The effects of climate change on the hydrology and water resources of the Colorado River basin. *Climatic change* 62, 337–363.

Chung, A., and Rimal, R. N. (2016). Social norms: a review. *Rev. Commun. Res.* 4, 1–28.

Cialdini, R. B., Reno, R. R., and Kallgren, C. A. (1990). A focus theory of normative conduct: recycling the concept of norms to reduce littering in public places. *J. Pers. Soc. Psychol.* 58, 1015–1026. doi: 10.1037/0022-3514.58.6.1015

Conner, M., Sparks, P., Povey, R., James, R., Shepherd, R., and Armitage, C. J. (2002). Moderator effects of attitudinal ambivalence on attitude-behaviour relationships. *Eur. J. Soc. Psychol.* 32, 705–718. doi: 10.1002/ejsp.117

de Groeve, B., Hudders, L., and Bleys, B. (2021). Moral rebels and dietary deviants: how moral minority stereotypes predict the social attractiveness of veg* ns. *Appetite* 164:105284. doi: 10.1016/j.appet.2021.105284

Deffuant, G., Roozmand, O., Huet, S., Khamzina, K., Nugier, A., and Guimond, S. (2022). "Can biases in perceived attitudes explain anti-conformism?," in *Proceedings of the IEEE Transactions on Computational Social Systems*, (Piscataway, NJ).

Falomir-Pichastor, J. M., Mugny, G., Quiamzade, A., and Gabarrot, F. (2008). Motivations underlying attitudes: regulatory focus and majority versus minority support. *Eur. J. Soc. Psychol.* 38, 587–600. doi: 10.1002/ejsp.494

Farjam, M., Nikolaychuk, O., and Bravo, G. (2019). Experimental evidence of an environmental attitude-behavior gap in high-cost situations. *Ecol. Econ.* 166:106434. doi: 10.1016/j.ecolecon.2019.106434

Fife-Schaw, C., Sheeran, P., and Norman, P. (2007). Simulating behaviour change interventions based on the theory of planned behaviour: impacts on intention and action. *Br. J. Soc. Psychol.* 46, 43–68. doi: 10.1348/014466605X85906

Fritsche, I., Jonas, E., and Kessler, T. (2011). Collective reactions to threat: implications for intergroup conflict and for solving societal crises. *Soc. Issues Policy Rev.* 5, 101–136. doi: 10.1111/j.1751-2409.2011.01027.x

Fuglestvedt, J., Berntsen, T., Myhre, G., Rypdal, K., and Skeie, R. B. (2008). Climate forcing from the transport sectors. *Proc. Natl. Acad. Sci. U S A.* 105, 454–458. doi: 10.1073/pnas.0702958104

Galperin, B. L. (2012). Exploring the nomological network of workplace deviance: developing and validating a measure of constructive deviance. *J. Appl. Soc. Psychol.* 42, 2988–3025. doi: 10.1111/j.1559-1816.2012.00971.x

Geiger, N., and Swim, J. K. (2016). Climate of silence: pluralistic ignorance as a barrier to climate change discussion. *J. Environ. Psychol.* 47, 79–90. doi: 10.1016/j.jenvp.2016.05.002

Grube, J. W., and Morgan, M. (1990). Attitude-Social support interactions: contingent consistency effects in the prediction of adolescent smoking, drinking, and drug use. *Soc. Psychol. Quarterly* 53, 329–339. doi: 10.2307/2786738

Guagnano, G., Stern, P., and Dietz, T. (1995). Influences on attitude behavior relationships: a natural experiment with curbside recycling. *Environ. Behav.* 27, 699–718. doi: 10.1177/0013916595275005

Guimond, S., de Oliveira, P., Lalonde, K. N., Lalonde, R. N., Pratto, F., Sidanius, J., et al. (2013). Diversity policy, social dominance, and intergroup relations: predicting prejudice in changing social and political contexts. *J. Pers. Soc. Psychol.* 104, 941–958. doi: 10.1037/a0032069

Guimond, S., Streith, M., and Roebroeck, E. (2015). Les représentations du multiculturalisme en France: décalage singulier entre l'individuel et le collectif. *Soc. Sci. Inform.* 54, 52–77. doi: 10.1177/0539018414554826

Gutmann-Kahn, L., and Lindstrom, L. (2015). "I just want to be myself": adolescents with disabilities who identify as a sexual or gender minority. *Educ. Forum* 79, 362–376. doi: 10.1080/00131725.2015.1068416

Hassouneh, D., Lutz, K. F., Beckett, A. K., Junkins, E. P. Jr., and Horton, L. L. (2014). The experiences of underrepresented minority faculty in schools of medicine. *Med. Educ. Online* 19:24768. doi: 10.3402/meo.v19.24768

Hayes, A. F. (2014). *SPSS, SAS, and Mplus Macros and Code*. Available online at: http://afhayes.com/spss-sas-and-r-macros-and-code.html (accessed January 3, 2021).

IPCC (2021). "Summary for policymakers," in *Proceedings of the Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the 6th Assessment Report of the Intergovernmental Panel on Climate Change*, (Cambridge: Cambridge University Press).

Katz, E., and Fialkoff, Y. (2017). Six concepts in search of retirement. *Ann. Int. Commun. Assoc.* 41, 86–91. doi: 10.1080/23808985.2017.1291280

Khamzina, K., Huet, S., Deffuant, G., Streith, M., and Guimond, S. (2021). Making the planet green again: the interplay of attitudes and group norms in the conversion to organic farming. *J. Appl. Soc. Psychol.* 51, 1073–1088. doi: 10.1111/jasp.12825

Krispenz, A., and Bertrams, A. (2020). Correlates of the intention to reduce meat consumption. *Sustainability* 12:4774. doi: 10.3390/su12114774

La Barbera, F., and Ajzen, I. (2020). Control interactions in the theory of planned behavior: rethinking the role of subjective norm. *Eur. J. Psychol.* 16:401. doi: 10.5964/ejop.v16i3.2056

Lalot, F., Falomir-Pichastor, J. M., and Quiamzade, A. (2018). Compensation and consistency effects in pro-environmental behaviour: the moderating role of majority and minority support for pro-environmental values. *Group Proc. Intergroup Relations* 21, 403–421.

Markowski, K. L., and Roxburgh, S. (2019). If I became a vegan, my family and friends would hate me:" anticipating vegan stigma as a barrier to plant-based diets. *Appetite* 135, 1–9. doi: 10.1016/j.appet.2018.12.040

Mildenberger, M., and Tingley, D. (2017). Beliefs about climate beliefs: the importance of second-order opinions for climate politics. *Br. J. Political Sci.* 49, 1279–1307. doi: 10.1017/S0007123417000321

Moscovici, S., and Lage, E. (1976). Studies in social influence III: majority versus minority influence in a group. *Eur. J. Soc. Psychol.* 6, 149–174. doi: 10.1002/ejsp.2420060202

Moscovici, S., Lage, E., and Naffrechoux, M. (1969). Influence of a consistent minority on the responses of a majority in a color perception task. *Sociometry* 32, 365–380. doi: 10.2307/2786541

Moscovici, S. (1991). *Psychologie des Minorités Actives*. Available online at: http://classiques.uqac.ca/ (accessed March 30, 2021).

Mugny, G., Kaiser, C., and Papastamou, S. (1983). Influence minoritaire, identification et relations entre groupes: étude expérimentale autour d'une votation. *Cahiers Psychol. Soc.* 19, 1–30.

Nardini, G., Rank-Christman, T., Bublitz, M. G., Cross, S. N., and Peracchio, L. A. (2021). Together we rise: how social movements succeed. *J. Consumer Psychol.* 31, 112–145. doi: 10.1002/jcpy.1201

Niemiec, R. M., Champine, V., Vaske, J. J., and Mertens, A. (2020). Does the impact of norms vary by type of norm and type of conservation behavior? a meta-analysis. *Soc. Nat. Resources* 33, 1024–1040. doi: 10.1080/08941920.2020.1729912

Noelle-Neumann, E. (1993). *The Spiral of Silence: Public Opinion–Our Social Skin*. Chicago, IL: University of Chicago Press.

Noelle-Neumann, E. (1974). The spiral of silence a theory of public opinion. *J. Commun.* 24, 43–51. doi: 10.1111/j.1460-2466.1974.tb00367.x

Packer, D. J. (2008). On being both with us and against us: a normative conflict model of dissent in social groups. *Pers. Soc. Psychol. Rev.* 12, 50–72. doi: 10.1177/1088868307309606

Packer, D. J. (2009). Avoiding groupthink: whereas weakly identified members remain silent, strongly identified members dissent about collective problems. *Psychol. Sci.* 20, 546–548. doi: 10.1111/j.1467-9280.2009.02333.x

Packer, D. J., and Chasteen, A. L. (2010). Loyal deviance: testing the normative conflict model of dissent in social groups. *Personal. Soc. Psychol. Bull.* 36, 5–18. doi: 10.1177/0146167209350628

Prentice, D. A., and Miller, D. T. (1993). Pluralistic ignorance and alcohol use on campus: some consequences of misperceiving the social norm. *J. Pers. Soc. Psychol.* 64, 243–256. doi: 10.1037/0022-3514.64.2.243

Riebl, S. K., Estabrooks, P. A., Dunsmore, J. C., Savla, J., Frisard, M. I., Dietrich, A. M., et al. (2015). A systematic literature review and meta-analysis: the theory of planned behavior's application to understand and predict nutrition-related behaviors in youth. *Eating Behav.* 18, 160–178. doi: 10.1016/j.eatbeh.2015.05.016

Salazar, G., Neves, J., Alves, V., Silva, B., Giger, J. C., and Veríssimo, D. (2021). The effectiveness and efficiency of using normative messages to reduce waste: a real world experiment. *PLoS One* 16:e0261734. doi: 10.1371/journal.pone.0261734

Salonen, A. O., and Helne, T. T. (2012). Vegetarian diets: a way towards a sustainable society. *J. Sustainable Dev.* 5, 10–24.

Sanchez-Sabate, R., and Sabaté, J. (2019). Consumer attitudes towards environmental concerns of meat consumption: a systematic review. *Int. J. Environ. Res. Public Health* 16:1220. doi: 10.3390/ijerph16071220

Sandri, G., and Seddone, A. (2015). Sense or sensibility? political attitudes and voting behaviour of party members, voters, and supporters of the Italian centre-left. *Italian Political Sci. Rev. Rivista Italiana Sci. Politica* 45, 25–51.

Scheufele, D. A., and Moy, P. (2000). Twenty-five years of the spiral of silence: a conceptual review and empirical outlook. *Int. J. Public Opinion Res.* 12, 3–28. doi: 10.1093/ijpor/12.1.3

Schittly, R. (2021). *Le Menu Sans Viande des Écologistes Dans Les Cantines de Lyon n'est Pas au Goût du Gouvernement*. Paris: Le monde.

Schulte, M., Bamberg, S., and Rees, J. (2021). We, the change: outlining research lines of how psychology can contribute to the understanding of societal transition processes. *Eur. Psychol.* 26:172. doi: 10.1027/1016-9040/a000445

Sharma, G. (2017). Pros and cons of different sampling techniques. *Int. J. Appl. Res.* 3, 749–752.

Sherif, M. (1936). *The Psychology of Social Norms*. New York, NY: Harper.

Steg, L. (2018). Limiting climate change requires research on climate action. *Nat. Climate Change* 8, 759–761. doi: 10.1038/s41558-018-0269-8

Steg, L., and Vlek, C. (2009). Encouraging pro-environmental behaviour: an integrative review and research agenda. *J. Environ. Psychol.* 29, 309–317.

Steinmetz, H., Knappstein, M., Ajzen, I., Schmidt, P., and Kabst, R. (2016). How effective are behavior change interventions based on the theory of planned behavior? a three-level meta-analysis. *Zeitschrift Psychol.* 224:216. doi: 10.1027/2151-2604/a000255

Symmank, C., Mai, R., Hoffmann, S., Stok, F. M., Renner, B., Lien, N., et al. (2017). Predictors of food decision making: a systematic interdisciplinary mapping (SIM) review. *Appetite* 110, 25–35. doi: 10.1016/j.appet.2016.11.023

Thøgersen, J. (2006). Norms for environmentally responsible behaviour: an extended taxonomy. *J. Environ. Psychol.* 26, 247–261. doi: 10.1016/j.jenvp.2006.09.004

Tukker, A., and Jansen, B. (2006). Environmental impacts of products: a detailed review of studies. *J. Industrial Ecol.* 10, 159–182. doi: 10.1162/jiec.2006.10.3.159

Vadera, A. K., Pratt, M. G., and Mishra, P. (2013). Constructive deviance in organizations: integrating and moving forward. *J. Manag.* 39, 1221–1276. doi: 10.1177/0149206313475816

Van Valkengoed, A. M., Steg, L., and Perlaviciute, G. (2021). Development and validation of a climate change perceptions scale. *J. Environ. Psychol.* 76:101652. doi: 10.1016/j.jenvp.2021.101652

Wan, C., Shen, G. Q., and Choi, S. (2017). Experiential and instrumental attitudes: interaction effect of attitude and subjective norm on recycling intention. *J. Environ. Psychol.* 50, 69–79. doi: 10.1016/j.jenvp.2017.02.006

Watson, R. T., Zinyowera, M. C., Moss, R. H., and Dokken, D. J. (eds) (1998). *The Regional Impacts of Climate Change: an Assessment of Vulnerability*. Cambridge: Cambridge University Press.

Whitmarsh, L., and Capstick, S. (2018). "Perceptions of climate change," in *Psychology and Climate Change: Human Perceptions, Impacts, and Responses*, eds S. Clayton and C. Manning (Cambridge, MA: Academic Press), 13–33. doi: 10.1016/B978-0-12-813130-5.00002-3

Willis, K. J., and Bhagwat, S. A. (2009). Biodiversity and climate change. *Science* 326, 806–807. doi: 10.1126/science.1178838

Wilson, M. S., Weatherall, A., and Butler, C. (2004). A rhetorical approach to discussions about health and vegetarianism. *J. Health Psychol.* 9, 567–581. doi: 10.1177/1359105304044040

Wullenkord, M. C., and Hamann, K. R. (2021). We need to change: integrating psychological perspectives into the multilevel perspective on socio-ecological transformations. *Front. Psychol.* 12:655352. doi: 10.3389/fpsyg.2021.655352

Wynes, S., and Nicholas, K. A. (2017). The climate mitigation gap: education and government recommendations miss the most effective individual actions. *Environ. Res. Lett.* 12:074024. doi: 10.1088/1748-9326/aa7541

frontiers | Frontiers in Nutrition

TYPE Original Research
PUBLISHED 03 October 2022
DOI 10.3389/fnut.2022.997632

OPEN ACCESS

EDITED BY
Jared Piazza,
Lancaster University, United Kingdom

REVIEWED BY
Aida Turrini,
Independent Researcher, Rome, Italy
Lenore Lauri Newman,
University of the Fraser Valley, Canada

*CORRESPONDENCE
Garrett M. Broad
broad@rowan.edu

SPECIALTY SECTION
This article was submitted to Nutrition and Sustainable Diets, a section of the journal Frontiers in Nutrition

RECEIVED 19 July 2022
ACCEPTED 15 September 2022
PUBLISHED 03 October 2022

CITATION
Broad GM, Zollman Thomas O, Dillard C, Bowman D and Le Roy B (2022) Framing the futures of animal-free dairy: Using focus groups to explore early-adopter perceptions of the precision fermentation process. *Front. Nutr.* 9:997632. doi: 10.3389/fnut.2022.997632

Framing the futures of animal-free dairy: Using focus groups to explore early-adopter perceptions of the precision fermentation process

Garrett M. Broad[1]*, Oscar Zollman Thomas[2], Courtney Dillard[3], Daniel Bowman[4] and Brice Le Roy[2]

[1]Department of Communication Studies, Rowan University, Glassboro, NJ, United States, [2]Formo, Berlin, Germany, [3]Mercy For Animals, Los Angeles, CA, United States, [4]School of English, The University of Sheffield, Sheffield, United Kingdom

This paper reports on the findings from a series of virtual focus groups that explored consumer perceptions of animal-free dairy (AFD), an emerging type of animal product alternative produced using the tools of synthetic biology and precision fermentation. Focus group participants came from an international sample of potential "early adopters." To stimulate conversation, participants were presented with a series of visual "moodboards" that framed key arguments both in favor of and in opposition to AFD. Three primary thematic clusters emerged from the discussion. The first focused on issues of "process, safety, and regulation," centered on the general reaction of participants to the concept of AFD, their primary concerns, key questions, and the assurances they would need in order to support its advancement. The second focused on issues of "consumer preferences and priorities," highlighted by the often complicated, and sometimes outright contradictory, stated consumer interests of the participants. The third focused on issues of "food technology and the future," wherein participants expressed broader views on the role of food technology in society, generally speaking, and the potential futures of AFD, specifically. The general consensus among participants was a cautious openness to the idea of AFD. Outright opposition to the concept was rare, but so too was unabashed enthusiasm. Instead, respondents had a number of questions about the nature of the technological process, its overall safety and regulatory standards, its potential contributions to individual health and climate change mitigation, as well as its organoleptic qualities and price to consumers. Among the positive frames, claims about animal welfare were deemed the most pertinent and convincing. Among the negative frames, concerns about messing with nature and creating potential health risks to individuals were seen as the strongest arguments against AFD. The findings suggest that the key to AFD's future as a viable market option will depend

in large part on the extent to which it can clearly demonstrate that it is preferable to conventional dairy or its plant-based competitors, particularly in the arena of taste, but also across considerations of health and safety, nutrition, environmental effects, and animal well-being.

KEYWORDS

animal-free dairy, precision fermentation, consumer perceptions, alternative proteins, framing, food technology

Introduction

In June of 2022, a joint press release from the animal-free dairy startup Perfect Day and the confectionery multinational Mars, Incorporated announced the launch of a "new sustainability inspired chocolate experience, CO2COA™." The product was touted as the Mars company's "first ever earth-friendly and animal-free chocolate innovation," with a name that gave a nod to the product's Rainforest Alliance-certified cocoa and the reduction in greenhouse gas emissions (CO2) that came from product sourcing. The press release described Perfect Day's flagship product as the world's first precision-fermented protein, developed by utilizing "microflora to create proprietary animal-free milk protein" (1). On that very same day, the Non-GMO Project – a non-profit organization that advocates against GM foods and promotes its independent non-GMO label standard – held a webinar entitled, "How do you milk a microbe? How synbio is disrupting the dairy industry." There, a series of panelists raised a host of concerns about the emerging technology and industry of animal-free dairy, critiquing it for a lack of transparency, raising questions about unknown health and environmental impacts, and insisting that it represented the wrong approach for the future of dairy and the food system. As promotional materials for the event put it: "These new GMOs are largely unregulated and unlabeled, and they're flying under the radar of the natural products industry" (2).

These dueling announcements made it clear that a "frame contest" over animal-free dairy (AFD) – an emerging type of animal product alternative produced using the tools of synthetic biology and precision fermentation – had begun (3). The aim of this paper is to provide early-stage insight into that question, as it reports on the findings from a series of virtual focus groups held on the topic of AFD that explored consumer perceptions and reactions to positive and negative frames about the technology and its implications. The research was the product of a multi-sectoral partnership that included an academic researcher, a researcher from an animal protection non-profit, and a researcher from an AFD company, as well as several other collaborators in supporting roles. Focus group participants came from an international sample of potential "early adopters," with representation from the United States, United Kingdom, Germany, and Singapore.

The primary goal of the research was to understand how potential consumers make sense of this new way to make dairy, to explore their general level of interest and concern regarding the technology, to see what types of positive or negative arguments about AFD resonate as convincing or pertinent, and to interrogate what questions they have about the process and its implications. The project's conceptual and methodological foundations were grounded in framing theory, a wide-ranging approach that is based in the recognition that a single issue can be viewed from a variety of perspectives, as well as construed as having implications for different sets of values (4). The paper proceeds from here by outlining the broader landscape of animal product alternatives and situates AFD within existing research and practice on the topic. It outlines the conceptual and methodological approach of the research process, then details the key thematic takeaways of the focus groups. It concludes by offering reflections on the work's implications in the areas of research, advocacy, and private sector consumer engagement.

Animal product alternatives and animal-free dairy

The category of animal product analogs and alternatives has experienced notable growth over the past several decades. While there is a long and storied history of food products that are intended to substitute for conventional meat, dairy, or eggs, in recent years there has been significant financial and human capital invested to promote innovation and market expansion in this arena (5). A variety of advocates believe that new technological and market-based developments in alternative proteins – that which can draw from a mix of plant-based, fermentation-based, and cell-cultivation approaches to create products that closely mimic or are compositionally identical to their animal counterparts – could have a transformative impact on local and global food systems (6). The impetus for this focus involves several key considerations, including concerns about the environmental and climate-related impacts of industrialized

animal food production, the nutritional and public health costs of animal-derived products, and the ethical problems with respect to the treatment of animals in large-scale production processes, among other considerations (7). Across each of these topics, of course, there is widespread contestation regarding the merits and drawbacks of industrial animal food production, as well as of alternative or small-scale animal production, and the promotion of non-animal analogs.

The global market for meat substitutes – which primarily consists of a mix of minimally processed soy products like tofu and tempeh, processed vegetable protein and wheat analogs, and fermented mycoprotein products – was valued at approximately $5.5 billion in 2020 and is projected to reach $11.2 billion by 2030 (8). The global dairy alternatives market – which uses plant-based ingredients such as soy, almonds, oats, and rice to create analogs for milk, yogurt, ice cream, cheese, and other products – was estimated at $22.6 billion in 2020 and is projected to reach $40.6 billion by 2026 (9). In the United States, plant-based milk alternatives make up an estimated 10–15% of the entire milk category. An estimated 67% of adults have tried a non-dairy milk, approximately one in three adults drink alternative milks at least once per week, and the product is stocked in approximately 12% of US households, which is third in the category behind only whole and 2% milk (10, 11).

At the same time as these plant-based analogs have increased in prominence, a parallel science and industry called *cellular agriculture* has emerged as a new player in the animal product alternative landscape. The primary concept behind cellular agriculture is to use the tools of synthetic biology and tissue engineering to create products that are molecularly identical to conventionally produced animal foods without the need for raising and slaughtering animals. The field can be broadly divided into cellular products (made from live or formerly live cells) or acellular products (not containing cells). Cell-cultured (also called cultivated) meat production falls into the former category, with the process working through acquiring stem cells from an animal, encouraging those cells to grow by feeding them a cell-culture nutrient medium in a bioreactor, and then harvesting and assembling them into final meat analog products.

Acellular products, such as milk ingredients, can be created via similar techniques by culturing milk-producing mammary cells, which in turn produce milk. However, the foremost approach is through precision fermentation, wherein microorganisms (such as yeast) can be genetically programmed to express specific proteins, then mixed with nutrients and sugars in a bioreactor until those proteins are produced. From there, proteins are mixed with minerals, sugar, water, and plant-based (or, potentially, fermentation-based) fats to create "animal-free dairy" (AFD) products such as milk and ice cream (12–14). The production of this AFD is actually an extension of well-established processes of precision fermentation that have been used to create products such as synthetic insulin for diabetic treatment and genetically engineered rennet for mainstream cheese production (15). Indeed, in recent years these same acellular techniques can and have been used to produce non-animal food products such as vanillin (a primary component of vanilla flavor) as well as non-food products used in cosmetics, materials, and other related industries.

Both plant-based and cell-cultured products have been explored from a variety of scholarly angles, with researchers considering their key promises, potentials, and drawbacks from a host of critical, empirical, and philosophical perspectives. A significant body of research has focused on consumer perceptions and preferences related to these products (16). Much of this inquiry confirms what has long been understood about how and why consumers choose to eat or avoid particular foods. That is to say, consumer perceptions of food safety, taste, price, and nutrition are consistently found to be, on average, the most important factors that consumers note as determinants of their food choices. A host of other intersecting factors, including but not limited to convenience, hunger and physiological needs, emotional status, social dynamics and tradition, and the appearance of food also play a significant role in food decision-making. In addition, value-oriented considerations such as environmental impacts, labor practices, food origin, and perceived naturalness can be a significant factor for some consumers (17–19).

With that said, a persistent "attitude-behavior gap," in which there is a disconnect between one's stated value-oriented preferences for sustainable foods, on one hand, and actual eating habits, on the other, has long been observed. This gap could be explained as the result of socially desirable misstatements from consumers, or alternately as the product of food environments that present too many obstacles to desired food purchasing (20). When it comes to the topic of innovative food technologies and products, their perceived benefits, risks, and naturalness are central to consumer perception. Attitudes toward innovative foods are influenced by surrounding social, economic, and political environments, such that trust in relevant food system institutions and a belief in the benefits of a new food product will be predictive of consumer openness and interest (21, 22).

With respect to plant-based animal product alternatives, specifically, research shows that purchasing intent is driven first and foremost by taste, followed by a sense that products appear familiar and match traditional meat or dairy counterparts (15). Health and nutrition, as well as altruistic benefits such as improved animal welfare and environmental benefits, matter more for particular consumer segments that have specific interest in these issues, as compared to less value-driven eaters (23). While those most likely to eat plant-based meat products are young, college educated, wealthier than average, and vegetarian, a nationally representative consumer survey from the International Food Information Council (24) found that nearly 50% of the sample of US adults had tried a meatless alternative, with the most cited motivation being a general interest in trying new foods. Other leading factors included

curiosity; taste; an effort to eat less meat; as well as a belief that the alternatives are better for the environment, animals, or their personal health. Notably, concern about not liking the taste was cited as the main reason why respondents had not tried a plant-based meat alternative. Research into motivations for trying plant-based dairy alternatives has found similar results, confirming general curiosity about taste and perceived health benefits as primary drivers, alongside the influence of close friends and family (25). For some consumers, the perception that plant-based dairy is better than conventional in terms of greenhouse gas emissions or animal welfare also plays a role (26).

Despite the fact that cell-cultured meats are not yet a widely available consumer product, there have been a number of investigations into consumer perceptions of the topic. Indeed, several systematic reviews have already been published that summarize key findings related to consumer interest and concerns. Bryant and Barnett (27) found evidence to suggest that most consumers would try cell-cultured meat, but not necessarily use it as a replacement for conventional meat on a regular basis. Their review also suggested that younger people, men, educated consumers, people who eat meat (as opposed to vegetarians), and those familiar with the concept were more open to the product. Major barriers to acceptance included perceived unnaturalness, safety concerns, nutrition concerns, and questions about taste and price. They noted that attitudes toward cultured meat could be improved with information about its benefits, and highlighted the importance of targeted framing in this process. A review from Pakseresht et al. (28) found that the acceptance level of cultured meat is relatively low, that there are significant cross-cultural differences in consumer response, and that environmental and animal welfare advantages do not appear strong enough motivators to convince heavy meat-eaters to switch, while those who do opt for alternatives generally prefer plant-based options. They also noted that there remains a generally low level of knowledge about the technology, and that supplying information to potential consumers can yield mixed results, depending on the framing of that information and the prior cognitive predispositions of the respondents. This finding about the persuasive role of framing aligns with previous research on the topic in the cellular agriculture arena (29).

Interestingly, to date, significantly less scholarly attention has been paid to AFD products made through the precision fermentation process. This is despite the fact that, unlike cell-cultured meats, these products are already available for purchase in the United States, and have the potential for a swifter technological and regulatory advancement in other global contexts. A few studies have focused on the social and economic implications of AFD. Newman et al. (30) explored the potential influence of AFD on future land use change, with a particular focus on the environmental implications of using sugar as a feedstock for cellular dairy production processes. They noted that, depending on the industry's development and agricultural approach, a mix of potentially environmentally harmful or positive land use approaches could take shape.

Koch et al. (31) offered a wide-ranging scenario analysis of the global dairy industry, charting four potential futures for dairy over the course of the next decade. One of several key questions in their analysis was the potential role of precision fermentation-based dairy alternatives – across their various scenarios, they projected a range of possibilities, stretching from the technology remaining small-scale and niche up to reaching cost-effective mass market scalability. Mendly-Zambo et al. (32) provided a general overview of what they called "Dairy 3.0," situating fermentation-derived dairy products within a broader conversation related to dairy alternatives and cellular agriculture. They highlighted questions around land use, regulation, and consumer acceptance as key areas of inquiry for scholars and practitioners interested in the topic.

In the consumer perception literature, specifically, a 2018 survey in the United Kingdom by *The Grocer,* conducted in collaboration with Harris Interactive, explored basic consumer reactions to the topic of AFD. That research found that a strong majority of respondents were unaware of the technology, and that younger consumers tended to have more positive perceptions of the concept. Taken as a whole, 28% of the sample expressed willingness to purchase what the survey termed "synthetic milk," compared to approximately 40% who expressed outright rejection. The primary objections from respondents included concerns about potentially unsafe chemicals, unnaturalness, and possible long-term side effects (33).

In the peer-reviewed literature, Zollman Thomas and Bryant (34) conducted a large survey of respondents from across Brazil, Germany, India, the UK and the US. Their study found low levels of outright rejection, ranging from 2.1% in Brazil up to 17.2% in the US. In terms of willingness to try AFD cheese, an average of 78.8% of consumers across the five different countries indicated they would probably or definitely do so, ranging from over 90% in Brazil to approximately 65% in the US. Intentions to regularly buy the product ranged from a high of 73.9% in India to a low of 34.6% in the UK. Across all countries, higher perceptions of tastiness predicted purchasing intent, while considerations of ethics and environmental friendliness were also predictive in some, but not all, of the national contexts. Of all dietary practices with which respondents identified, flexitarianism was the strongest predictor of willingness to buy AFD products. Those with high levels of current cheese consumption tended to show the highest level of interest in trying the novel products. Compared to surveys on consumer willingness to try or purchase cell-cultured meat, openness to consuming AFD was generally more enthusiastic, which could be the result of any number of methodological, technological, or value-oriented considerations.

Overview

Significant questions remain about the potential future of AFD, including key questions about consumer understanding and interest. With that in mind, this study set out to use focus groups to explore basic consumer perceptions on the topic. Our initial research question sought to understand how respondents make sense of a basic technological description of the AFD process, interrogating the general valence of their reaction and the key questions that would arise in response. From there, our second research question aimed to explore how respondents would react to a mix of positive and negative arguments about AFD and its implications, providing a qualitative assessment of the relative strength and weakness of these frames. The next section of this article offers more detail on the conceptual and practical elements of the methodological approach we employed, before turning to an in-depth discussion of the findings and implications.

Materials and methods

In order to investigate these questions, we conducted 10 focus group discussions in October of 2021, with two sessions composed of respondents in the United States, Germany, and Singapore, respectively, and four sessions composed of respondents in the United Kingdom. There were several factors involved in the selection of these nations as targets, most notably a desire to have international representation while maintaining English as the primary language for data collection. In addition, consultation with industry informants identified each nation as important potential markets for AFD, albeit with varied pathways to market access. Specifically, AFD is already approved for retail sale in the United States and Singapore, while not available in Germany or the United Kingdom. All of the focus groups were held virtually via video conferencing software, due to the ongoing Covid-19 pandemic and the desire to collect data from international samples. We followed a set of best practices for virtual focus groups, including the recruitment of smaller groups of participants than is customary for in-person research, the use of a familiar video-conferencing platform (Zoom), and the employment of slides as visual aids, among other tactics (35, 36). Participant recruitment was aided by a professional global research platform (Testing Time), and participants received a monetary honorarium equivalent to €40 via that platform after their focus group concluded.

Participants were pre-screened using questions that explored their levels of interest or aversion to trying new foods, as well as their general attitudes toward the application of new technologies. In total, 42 participants took part in the focus groups, with group size ranging from a minimum of three participants to a maximum of five participants. Eight of the groups, consisting of 34 participants, focused on potential "early adopters," a determination based on their generally favorable attitudes toward trying new foods and having a positive outlook on the role of technology in society, as measured via the pre-screening survey. This current study reports on the findings from those focus groups, excluding insights from the two "late adopter" focus groups (both of which were conducted with participants in the United Kingdom). Previous research has identified ∼25–30% of society in highly developed nations can be classified as early adopters of new technologies (37). Our focus on early adopters in this current study builds upon the argument of House (38), who suggested that researchers should grant greater analytical attention to early adopters and potential early adopters when focusing on consumer perceptions of novel foods, as opposed to focusing on the general population as a whole. We agree with that author's assessment that, before industry actors or researchers can begin to think about factors that might contribute to the increased consumption of a novel food product among the general public, some degree of established consumption must first be achieved, such that it is, "the early adopters who ultimately determine if a novel food will stand or fall" (39). We determined that perspectives from late adopters, while interesting, were too limited in terms of sample size to be analyzed independently, and sufficiently dissimilar from those of early adopters such that inclusion would skew results.

An official moderator guide was developed and deployed by two different moderators across the ten total groups. An additional note-taker and assistant moderator were also in the virtual focus group to provide back-up support. All elements of the research process were approved by the lead author's university Institutional Review Board. Following the conclusion of the focus groups, the research team met to discuss whether additional early adopter sessions would be required to pursue our research questions, or whether theoretical saturation had been achieved. A review of our notes suggested new themes had not been introduced in the final set of focus groups and therefore the sample was sufficient for our study purposes.

In the initial focus group introductions, the moderator described the goal of the focus group as aiming to understand their reactions to a new type of food product, and emphasized that there were no right or wrong answers. The focus group moderator then offered a basic description of the concept and technological principles of making dairy through precision fermentation. It aimed for balanced language throughout, and solicited participants' general responses to the description, as well as asked them what key questions they had. Notably, the term "animal-free dairy" was not used in this description, nor throughout the whole of the focus group, in favor of more neutral phrases like "new type of dairy." A final section of the focus groups, not reported on in depth in this current article, did ask participants for feedback on potential names for AFD. The full description of the food technology, displayed on-screen and read aloud by the moderator, was as follows:

> *A number of companies and researchers are working to create dairy products without any animals involved. These products are not the same as plant-based milks that you might already be familiar with – like soy, almond, or oat milk. Instead, they have the same basic ingredients as milk made from animals, but the ingredients are made in a different way. In these new products, similar to beer or soy sauce production, microorganisms are used to produce the ingredients, which in the case of dairy, are the proteins whey and casein. To begin this process, a database of cow DNA is referenced, with the DNA that makes milk proteins copied and inserted into the microorganisms' genes. Through fermentation, the microorganisms start to produce proteins that are the same as those a cow would make. These proteins are collected and turned into products such as cheese, ice cream and yogurt. This new way of making dairy doesn't involve any animals, doesn't contain lactose, and tastes and behaves exactly the same as dairy we know today. Initial assessments anticipate this new way of making dairy will have a significantly reduced impact on the environment, although some think this technology may not live up to its promises.*

Following this aspect of the conversation, the focus group presented a series of visual "moodboards" that used a mix of images and brief text as a way to frame key arguments both in favor of and in opposition to the technology and its products (available as Supplementary material). This methodological strategy was guided by an understanding of two related communicative concepts: sense-making and framing. Sense-making refers to the processes by which people attempt to understand ambiguous issues and events. This meaning creation is based on current and prior interpretations of thoughts, generated by a mix of external stimuli, focused memory retrieval, and associative working memory (40, 41). The goal in sense-making research is to explore the intersecting frameworks, schemas, representations, and mental maps upon which sense-making is constructed (42).

Fundamentally, public sense-making about science and technology topics, including novel food products, occurs not through unfiltered reception, but rather through a variety of frames constructed by journalists, advocates, and other public communication professionals. Framing theory is an umbrella concept that explains how issues can be viewed from a variety of perspectives and have implications for different value sets (4). As part of a "frame contest," one interpretive frame might gain influence over others in the mind of an individual or of broader collectives (3). Previous research has demonstrated the importance of framing for how people come to make sense of the benefits, risks, and overall value of novel foods, generally, and the products of cellular agriculture, specifically (28, 29). Through a review of scholarly research and media coverage, as well as conversations with industry and advocacy experts, the research team developed a set of positive and negative frames in order to explore participants' responses. Positive frames were presented first, with moodboards that focused on the potential value of AFD in terms of animal welfare, climate change and the environment, the overall power of technology, individual health benefits, and the reduction of public health risks, respectively. For each frame, respondents were asked the extent to which they believed these were strong or weak arguments in favor of AFD. From there, the group was asked to come to a consensus ranking, from the most convincing argument in favor to the least convincing argument in favor. This process was then repeated for the negative frames, with moodboards that focused on the potential negative potential of AFD in terms of messing with nature, creating health risks, hurting farmers, and increasing corporate power.

Following the conclusion of the focus groups, the video-recorded sessions were transcribed verbatim. Several members of the research team produced a topline report based on an initial review of those transcripts. Separately, the lead author of this article reviewed all transcripts in full and analyzed them following an adapted grounded theory approach (43). This included a multi-step coding process, moving from line-by-line open coding, to a focused coding that combined initial codes, and then to a final stage of refinement and consolidation of codes into themes. The initial coding process yielded over 800 open codes, which were then collapsed into ∼75 secondary codes, which were subsequently ranked by frequency and clustered into overarching themes. Throughout the process, the motivating research questions were kept in mind, as were considerations of participant's word choice, views, intensity of feeling, levels of agreement and disagreement (44). The lead author produced initial thematic memos that were checked for validity by the other members of the research team. Following additional conversation and refinement, this process led to the confirmation of several primary thematic takeaways from the focus groups, described in full and summarized in Table 1 below. The pull quotes highlighted in the results section were identified during the coding process as illustrative of key participant insights and agreed upon by the research team as demonstrative of the thematic takeaways.

Results

Process, safety, and regulation

When encountering information about AFD, including both positive and negative frames about the technology and its impacts, respondents consistently raised questions about the technical process through which the products were created, as well as its overall safety for potential consumers. From there, they outlined the types of regulatory assurances they would need in order to support AFD's advancement. These perspectives echoed existing public opinion research, which

TABLE 1 Thematic categories, characteristics, and key participant questions.

Category	Characteristics	Participant questions
Process, safety, and regulation	• Emphasizing the need for assurances that the safety of AFD processes and products has been reviewed and approved • Prioritizing concerns about potential impacts on individual bodily health above broader public health or environmental concerns	• What exactly is in AFD and how is it created? • In what ways is AFD similar or different from genetically modified (GM) foods? • Have governmental regulatory bodies, food companies, and independent scientists assessed AFD safety?
Consumer preferences and priorities	• Expressing concern for animal welfare in industrialized animal food production • Subordinating animal welfare values to taste, price, convenience, and nutrition • Seeing AFD as a new option among many conventional, organic, and plant-based dairy products and alternatives	• What makes AFD a superior product when compared to existing dairy and plant-based dairy alternatives? • Will the nutritional profile of AFD match up to conventional dairy? • Should AFD be considered dairy? Should it be considered vegan?
Animal-free dairy, food technology, and the future	• Offering ambivalent perspectives on the relationship between food and technology • Anticipating that AFD could become a niche option within a future dairy product and dairy alternative landscape	• Is there a way to balance natural food with the use of some elements of food technology? • What would happen to dairy cows if AFD became more popular?

has shown that people tend to hold official governmental regulatory agencies and food companies the most responsible for ensuring food safety, even as these institutions lag behind family members, medical professionals, and a host of other sources of food information in terms of their perceived trustworthiness (22, 45). Generally speaking, very few participants within this early adopter sample expressed strong initial opposition to the concept of AFD and its development. They did, however, have several questions and concerns, with most on the fence as to whether they would be interested in ever consuming the product themselves, pending that clarifying information. Notably, the moderator did not provide direct responses to these questions, but instead encouraged a spirit of open inquiry among participants. Ultimately, the respondents called for transparent communication from all parties involved in developing, regulating, and selling AFD, and from there believed they could make a decision as to whether it was something they were interested in consuming.

Many of the participants' requests for additional information focused on the technical aspects of AFD production. The initial descriptive text offered at the start of the focus group was seen as leaving many open questions. Participants sought to have a better understanding of the specific ingredients used in the AFD process, the role played by DNA, and other basic information about how AFD was actually made. Similarly, in response to information that suggested the benefits of AFD – including in the initial description, as well positively framed moodboards focused on the importance of acting on climate change, the health benefits of animal-free diets, and the public health risks of conventional animal products – participants wanted more concrete information that showed these claims were verified and that safety assurances were backed by independent researchers:

> To make me rest assured I would need to know about the process of how the actual dairy product is produced to give me peace of mind and actually make me want to consume the product. So I think, like, transparency would be very important in this case. (Singapore Group 2)

Probes about the types of safety concerns that were important to participants demonstrated that individual bodily health – as opposed to broader public health or environmental concerns – were most salient. Here, they wanted to know exactly what type of safety testing would be conducted to ensure that AFD would not have negative human health impacts. Notably, the perceived unnaturalness of AFD was seen as a cause for potential concern. At the same time, however, a number of participants pushed back against negative framings that they felt leaned toward a fearmongering tone. Specifically, moodboards headlined with "We shouldn't mess with nature" and "We shouldn't eat what we don't understand" were seen by many as overly dramatic and disconnected from the realities of the modern food system. Fundamentally, participants tended to express faith in the judgment of official regulatory structures, including government agencies that oversaw food products and retail outlets, such that they would trust a product's safety if it was allowed to be sold in stores and restaurants:

> I think it is understandable that people will be a bit afraid of something new and messing with DNA and things. But generally, I think nothing's gonna make it to your supermarket that's gonna change your DNA or kill you or whatever (UK Group 1).

Indeed, one key area in which there was significant contestation and, in some instances, outright confusion, was

in discussions about how AFD was related to or distinct from other forms of genetically modified (GM) food products. The general sentiment of the focus group participants toward GM foods skewed slightly negative, and when pressed, most of those with negative perceptions of GM foods reported a general sense that they were not particularly good for individual health or the environment. Other respondents, however, pushed back on this idea, suggesting that anti-GM sentiment was overblown and not as salient as it had been in the past, pointing out that many people often eat GM products without realizing it and do not suffer negative consequences.

With this debate in mind, participants wrestled with whether AFD should or should not be considered a GM food. The initial description noted that, in the AFD process, "a database of cow DNA is referenced, with the DNA that makes milk proteins copied and inserted into the microorganisms' genes," and one of the negatively framed moodboards made reference to concerns about genetically modified foods. The specific question as to whether or not AFD was a GM food was kept intentionally undetermined, however, in order to gauge participants' organic responses. Previous research that explores public perceptions of GM food demonstrates that understanding about the process is widely varied and attitudes about the technology can be highly charged (37). Recent research has also shown that extreme opposition to GM food tends to be associated with lower levels of objective knowledge about science and genetics, even as strong opposition is also associated with higher levels of self-reported understanding of GM food technology (46). The conversation about AFD was layered on top of this already muddled landscape. While the role of DNA and the mention of "genes" suggested to many that it was in some way connected to GM foods, others seemed to think the processes were distinct. Notably, for a number of participants, the analogy of beer brewing via fermentation made them more comfortable with the technology and helped them understand the principles of the AFD process. At the same time, a few grappled with the question as to whether AFD production was the same as traditional fermentation. Overall, the conversations demonstrated the murky terrain of knowledge and attitudes on the topic:

> For me it depends. How is the food being genetically modified to begin with? We're not talking about human DNA. We're talking about a new way to prepare food. I mean, beer is fermented. I think you mentioned that earlier. Fermented milk, it sounds like a great idea, I think, but yeah. Like anything else we need extensive testing, maybe 5 years of data points, something like that (USA Group 2).

> You just use the DNA to produce the milk, right? Then it is okay. But if it is genetically modified and made into a complete different version, then I'm concerned. But if it's just the copy of DNA or something, which you make the protein, then I think it's not a big deal. But it depends (Germany Group 2).

Consumer preferences and priorities

Prompts about the potential benefits and drawbacks of AFD consistently led to broader discussions about what participants prioritized as determinants of their food purchasing and consumption. Here, respondents outlined a host of often complicated, and sometimes outright contradictory, set of food preferences, reinforcing existing research on attitude-behavior gaps and other complex dynamics in food choice (17, 18, 20). This set the stage as to whether these early adopters saw AFD as a product they would be excited to consume, be open to it as an option, or be entirely opposed to trying. While a few expressed enthusiastic support or steadfast disinterest in the product, the majority voice of the participants saw AFD as another viable choice to add to the market of dairy and its alternatives. Whether it became part of their actual eating habits would depend mostly on classic food choice factors, notably its organoleptic qualities and its price parity with standard options, a common refrain in research on alternative proteins (47).

A clear finding from the focus group discussions was that respondents were amenable to critiques about the problems of industrial farm animal production. When presented with moodboards that framed conventional practices as bad for animal welfare and harmful to the planet, many expressed familiarity with these issues, and nearly all expressed that they hoped that their eating practices would be positive on these fronts. As a response to these critiques, though, a number of participants were quick to point out distinctions between different types of animal food production, noting that animals produced in "factory farms" were too often treated poorly. A number of participants noted that they did not believe dairy production was as harmful as meat production, thus making the value proposition of AFD slightly less clear than meat alternatives. A common belief was that consumers had the power to opt for a diverse set of alternative products – indicated by official and unofficial labels such as humane, traditional, natural, local, and/or organic – that had more positive animal welfare ratings and were better from an environmental perspective:

> I'm more the type that I'm trying to treat the animal better. You know, to get like a better product, not necessarily trying to find an alternative to what we have been eating (USA Group 1).

Even as they outlined concerns about animal welfare and planetary health, participants also admitted that these value-oriented propositions were often subordinated to self-oriented

considerations and long-standing habits in their food choice. Here, organoleptic qualities like taste and texture, alongside price and the impact on individual health, were identified as their primary determining factors. In order to become a regular consumer, any AFD product would likely have to be better, or at the very least match, the taste and utility of conventional dairy products, as well as existing plant-based dairy alternatives. Indeed, many participants outlined that they were already consumers of alternative dairy products, either exclusively or occasionally, while others noted that they simply preferred conventional animal products and were unlikely to ever shift away from consuming them in favor of an alternative, AFD or otherwise:

> We already have products to avoid eating animals, for example, there is soy and so on. So my question would be, what is the, what is the new thing about this product? If it really tastes one hundred percent like the normal dairy, then maybe I will consume it (Germany Group 1).

Participants also worked to situate AFD within broader discourses about healthy food, processed foods, and vegan animal product alternatives. A moodboard headlined "An animal free diet has health benefits" sparked spirited discussions about the nature of healthy eating, its importance to their lives, and their admitted shortcomings in terms of their own healthy eating practices. When it came to identifying and describing unhealthy food, participants consistently identified "highly processed" foods as the problem, reflecting increased public interest in "clean label" dietary trends across the globe (48). Vegan foods, many noted, could range in terms of their level of processing – several participants recounted stories of "unhealthy vegans" who lacked proper nutrition and relied too much on a diet of heavily processed foods, while others told stories of vegetarians and vegans they knew who had thrived on a healthy plant-based diet.

From there, participants also noted that much of their own diet consisted of processed foods, at least in part. While they understood that reducing processed foods would be good for them, ultimately their food choice was determined by taste, price, and overall convenience. In a number of instances, participants reflected on the own inconsistency between their ideal dietary practices and the realities of their everyday eating; many seemed to struggle with this mismatch, while others were content with admitting that they were not particularly conscious eaters:

> I eat trash all the time. Like, for example, chicken that is not free range for example, we don't know what's going on, and things like processed food…So, if let's say milk is something that I don't understand, but then potentially beneficial. Why not, you know? (Singapore Group 1).

In terms of the potential health benefits of AFD, specifically, a number of participants were attracted by the lack of lactose in the product, which many noted would be useful for either themselves or close family or friends with lactose intolerance. However, they wondered whether the general nutritional profile of AFD would stack up to conventional dairy, and hoped for more information on this topic. They also wondered exactly how to categorize AFD, asking whether it should be considered vegan or plant-based at all, as well as whether it should be considered real dairy.

In sum, among this sample of early adopters, the general consensus was that participants were open to the idea of AFD as a choice. Some expressed enthusiasm about trying AFD, while many expressed a desire to taste-test it before making any further determination as to whether they were truly interested. A number of participants suggested they were fine with its development, but were ultimately happy with their existing options, be it conventional dairy or plant-based dairy. Once again, very few expressed strong opposition to the concept as a whole.

Animal-free dairy, food technology, and the future

Several of the presented frames in the focus group prompted participants to speak more generally about their perceptions of food technology, the future of food and agriculture, and the potential place of AFD within that context. The conversations showed that participants held ambivalent perceptions about the relationships between food and technology. These findings are consistent with previous research on consumer perceptions of the food system, which has found members of the public to be divided on the risks and benefits of new food technology (37). Consumers tend to be simultaneously distrustful of "Big Food" companies (22), while also mostly satisfied with their own diet and food options (49).

In response to the moodboard headlined "Breakthrough technology makes new things possible," for instance, several participants reflected on the positive contributions that innovation has brought, and could continue to bring, to the food system. For these participants, innovation was seen as a way to make the food system healthier, more accessible for diverse consumers, better for the environment, and better for animals. In so doing, they brought up a number of examples of food system innovations – including earlier forms of plant breeding, or new developments in alternative meats – as well as pointed to what they saw as positive innovations in other sectors, particularly the technology and consumer electronics industries. They pushed back against the moodbard titled "We shouldn't eat what we don't understand," which included the popular missive to not eat "anything your great-grandmother wouldn't recognize

as food," by describing the many types of tasty and healthy food products they had access to that their ancestors had not, seeing that as positive progress:

> I know many of the fruits we eat today, before they were cultivated, you almost couldn't eat them because the seeds were too big. So they were bred to be edible and enjoyable. So, I think ever since humans started to cultivate food, they use technology to get more out of the plants and to make the food better. So I think we always have used technology, and to improve our food and going forward, it's still going to happen, which is a good thing (Germany Group 1).

This enthusiasm was tempered, however, by a number of participants who were skeptical of positive framings about food and technology, and found negative framings about avoiding food that comes from a "chemist's laboratory," as one moodboard put it, to be resonant. These respondents simply asserted that a mix of food and technology was not appetizing, and that we should be striving for more natural processes in the future of our food systems. Others called for a middle way, recognizing that there would certainly be elements of technology in modern food production and processing, but that we should also look for ways to retain traditional practices and natural foods moving forward:

> I do think that we can do a lot of work with, you know, new technologies to develop new food and make it more eco-friendly and sustainable. However, I still think we should not totally substitute what the human touch would do. Because, you know, the best food is the easiest and more natural, et cetera. So I think a balance between them would be great (UK Group 2).

When it came to the specific role of AFD in the future of food, the vast majority of respondents, including those who saw value in the concept, did not believe that it would be a transformative technology with major social and economic impacts, at least in the short term. Negatively framed moodboards about the impact of AFD, headlined "Farmers will go out of business" and "It will mean more corporate power," were seen as cause for concern by a few respondents, but were met by most with major skepticism. These respondents believed that issues of farmer strife and corporate power in the food system preceded AFD, caused by a host of other social and economic factors that were entirely independent of AFD and other animal product alternatives. As an aside, several respondents did wonder, if AFD *were* to achieve significant success and market share, what would happen to the cows who would no longer be needed for milking? Fundamentally, given that most respondents believed AFD would remain a niche product for the foreseeable future, they did not believe it made sense to focus on AFD as a major cause of food system concerns, even as these issues as a whole were seen as problems that needed to be addressed:

> There's going to be plenty of people that will continue to eat their dairy because they love dairy. And you know, I live in Idaho where people are, we're not technologically advanced, we're very behind the rest of the world. And I think people will continue to drink dairy…This is not going to knock it out. The dairy industry, I'm not worried about, at least my fellow dairy neighbors (USA Group 1).

Ultimately, the focus group respondents acknowledged that there were many challenges in the food system, ranging from the need to produce enough food for a growing population, to concerns about health, sustainability, and animal welfare. They generally saw consumer choice as having some potential for positive impact, and believed that AFD could emerge as yet another consumer choice with potential benefits. However, several also pointed out the shortcomings of consumer-based approaches to social and environmental change, identifying "Big Food" as the real culprit of food system problems. In order for large-scale transformation to take shape, they noted, there would be a need for broader structural, governmental, and corporate changes, above and beyond what consumer choice could determine.

Ranking the frames

Following the presentation of the positive and negative frames, respectively, respondents were asked to come to a consensus as a group to determine which of the frames were the most convincing, either in favor of or against AFD. Our analysis of these rankings is summarized in Table 2, below. The research suggests that, among the positive frames, the argument that was deemed the most pertinent was far and away claims about animal welfare. Respondents saw this as a clear problem with conventional animal food production and saw AFD as responding directly to that concern. Arguments about climate and environmental benefits ranked second, even as a number of respondents wanted more information to verify claims in this regard. Claims about the general value of breakthrough technologies, as well as the health benefits of animal-free diets, followed from there, as both were seen as connected to the potential of AFD, but also brought out feelings of ambivalence and differences of opinion. Finally, the frame that focused on broader public health benefits was ranked as the least convincing, as respondents were dubious of the moodboard in its attempt to connect animal food production with pandemic risks, and generally did not see dairy production as a major public health problem, especially when compared to industrialized meat production.

TABLE 2 Ranking frames from most to least resonant.

Positive moodboards	Negative moodboards
1. Animals deserve to be well-treated	1. We shouldn't mess with nature
2. We all need to act against climate change	2. We shouldn't eat what we don't understand
3. Breakthrough technology makes new things possible	3. It will mean more corporate power
4. An animal-free diet has health benefits	4. Farmers will go out of business
5. Animal products carry risks to humans	

In terms of the negative frames, the two moodboards that focused on messing with nature and creating potential health risks to individuals were seen as the strongest arguments against AFD. While this group of early adopters was not wholly convinced by these frames, they saw potential risks in these arenas, and also saw ways that opponents of AFD could effectively leverage these concerns when discussing the technology with the broader public. As previously noted, frames about risks to farmer economies and the further consolidation of corporate power were generally seen as unconvincing. This was not because respondents did not see these as problems at all, which some did, but rather because they just did not imagine AFD would be a strong enough force to have major impacts. Taken as a whole, following the presentation of both positive and negative frames, the general sentiment of participants toward AFD was moderately positive. With that said, a number of significant questions remained about both the process and the product, and the extent to which their perceptions would be swayed further in one direction or another would largely depend on future information and direct experiences.

Discussion

Among our sample of potential early adopters, the general consensus was a cautious openness to the idea of AFD. Outright opposition to the concept was rare, but so too was unabashed enthusiasm. Instead, respondents had a number of questions about the nature of the technological process, its overall safety and regulatory standards, its potential contributions to individual health and climate change mitigation, as well as its organoleptic qualities and price to consumers. Through these conversations, they grappled with their own ambivalence about eating animal products, as well as their mixed feelings regarding the role of technology in food. They pushed back against what they felt were overly hyperbolic claims, both in favor of and against AFD, and called for transparent communication from all parties. Participants tended to understand that much of the food we eat today has changed over time, and saw challenges to small-scale food producers as long-standing, subject to global trends, and often due to competition with industrial food producers, not alternative protein products. Most doubted that AFD would become a dominant part of the dairy market in the years ahead, but could see it finding some consumer base, if it tasted good enough and its claimed benefits could be verified. Lingering concerns about the role and impacts of genetic modification were present as well, and while analogies to beer brewing and other traditional forms of fermentation were seen as assuring for many, some still had their reservations, and could see how any mention of "genes" might be a deal breaker for other people in their social orbit.

This research offers a useful contribution to the scholarly literature on food choice and public perceptions of novel food technologies, generally. It provides confirmation of long-standing conclusions in that field, particularly in that it demonstrates the complex and sometimes internally inconsistent ways that people think about the motivations for their eating behaviors (18, 20). Within research on animal product alternatives, it represents one of the first ever explorations of consumer perceptions of AFD, a curious gap considering its relatively advanced technological and market-based status (34). Here, it provides further confirmation of the potential power of framing effects in shaping public reactions to alternative proteins (29), as well as the vital importance of taste and price parity for the products' viability as a consumer option (47).

For companies at the forefront of introducing AFD to the market, this research highlights that beyond satisfying the sensorial, functional, and price expectations of consumers, thoughtful and inclusive discourse with society will be central in determining consumer interest in AFD. In this way, companies should understand their role not merely as contributors to already packed grocery aisles, but also as participants in a discussion about our relationship with the food we eat and the future of food system reform. Specifically, the importance of transparency and clarity was apparent throughout the process, and it is already a key issue that groups like the Non-GMO project are identifying as a central reason for opposition. Although focus group participants did see a significant role for regulators and retailers in helping them gauge the safety of novel food products like AFD, companies would be wise to proactively engage with consumers to explain the nature of precision fermentation and the principles of synthetic biology underlying it, as well as advocate for robust and trustworthy official regulatory processes.

The relationship between AFD and GM foods will continue to be a hot-button topic of conversation and contestation. From an industry perspective, there is clear value in forthright communication that outlines the scientific overlaps and distinctions between these technological approaches.

Avoiding this discussion entirely could very well create more opportunities for opponents to attack AFD, effectively linking a lack of transparency to a broader culture of distrust of Big Food (22). Meanwhile, advocates who are skeptical of AFD's use of synthetic biology should be mindful of the effects of their communication as well. While global attitudes toward GM foods remain generally negative, there is recent evidence to suggest that much of the general public is relatively neutral to the process, and that the most ardent opponents often have basic misconceptions about the objective science of the topic (46). Hyperbolic claims about the dangers of AFD could resonate with a niche group of highly motivated technological skeptics, but could also cloud the overall quality of the communication environment, and a lack of credibility could potentially undermine the broader goals of those who promote lower-tech future food approaches. A shared goal should be to accurately contextualize AFD technology and give consumers the opportunity to assess varied arguments in a straightforward manner. In many respects, the focus groups aimed to provide a platform for exactly this type of discourse, and participants expressed appreciation throughout the discussions for the opportunity to think through the processes and implications of AFD. In this particular sample of early adopters, that conversation often led to moderately positive perceptions of AFD by the conclusion of the group, but that may not be the case with all participants.

For organizations engaged in advocacy to shift food system practices, a particularly notable finding centered on the power of animal welfare framings as a potential benefit of AFD. In the focus group conversations, the animal welfare frame was seen as the most compelling reason to support AFD; further, in subsequent discussions about nomenclature preferences, the name "animal-free dairy" was consistently found to be superior to others, in that it highlighted the benefits of removing animals from the dairy production process. In recent years, advocates for animal product alternatives have often shied away from focusing on farmed animal suffering in their public communication, believing that consumers would be more motivated to reduce animal product consumption or try alternatives based on health or environmental concerns. Despite these assumptions, a growing body of research demonstrates that animal cruelty-focused messages might be the most powerful for actually shifting attitudes and promoting dietary behavior changes away from conventional animal foods (50). This may not be an ideal marketing strategy for companies developing and selling AFD and other alternative animal products, but it does speak to the potential for future collaborations between industry and farmed animal welfare advocates. While many people choose alternative protein products after reflecting on the implications of animal food production, the reverse may also hold true, such that the existence of appealing alternatives to animal-derived products could prompt consumers to reflect on the problems of animal welfare in food production, and from there examine the implications of their dietary choices. With this in mind, campaigns that coordinate shared messaging and leverage the power of opinion leaders on social media platforms could emphasize the animal welfare problems of conventional practices while touting the advantages of AFD and other alternatives in this domain.

The work presented in this article is necessarily limited by elements of the focus group research approach. Notably, the small sample size and focus on early adopters could constrain overall generalizability. The fact that the group conversation was driven by the researchers' interests and conceptual framing might have encouraged biases in the data, including social desirability and forced response. Related, while peer-to-peer conversational dynamics are often seen as a strength of focus group research, it can also emerge as a limitation if it encourages group conformity; while lack of variance in perspectives did not appear to be a major issue in these focus groups, the concern remains worthy of consideration (51). In addition, the virtual environment did lead to a few technical difficulties and internet connectivity problems for both moderators and participants, and at times might have led to distracted participation. Overall, consistent with previous research, effective preparation and management allowed for these obstacles to be overcome (35). Future scholarship should use a mix of qualitative, quantitative, and experimental methods to explore consumer perceptions of AFD with diverse samples, as well as to trace broader media coverage and public discourse on the topic.

As noted throughout this paper, the key to AFD's future as a viable market option will depend in large part on the extent to which it can clearly demonstrate that it is preferable to conventional dairy or its plant-based competitors. In addition to meeting the taste preferences of consumers, the industry and its advocates should be forthright and transparent in terms of the science underlying AFD, as well as its health and safety implications, nutritional components, environmental effects, and animal welfare implications, all as a means to allow a clear public assessment. This means ongoing conversations and cooperation with governments, regulators, incumbent players (both small and large), and advocacy organizations with varied perspectives on the risks and benefits of AFD. The findings of this current research demonstrate that members of the eating public take the flaws of conventional dairy production into consideration and are open to having a conversation about AFD. The way that conversation plays out will go a long way toward determining whether and how AFD becomes a significant part of the future dairy ecosystem.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Fordham University Institutional Review Board. The patients/participants provided their written informed consent to participate in this study.

Author contributions

GB, OZ, and CD: conceptualization, research design, data collection, and writing manuscript. GB: ethics application and data analysis. DB: data collection. BL: research design and data collection. All authors contributed to the article and approved the submitted version.

Funding

A grant from Formo to Mercy For Animals provided financial support for the research. Funding was used for payments to focus group participants and open access publication fees. None of the funding was used to compensate the authors of this paper directly.

Acknowledgments

Thanks to Marci Regambal and Angelina Zervos for transcription support, and to members of Formo for serving as practice focus group participants.

Conflict of interest

Author OZ was a researcher for Formo, an animal-free dairy company. CD was a researcher at Mercy For Animals, a farmed animal welfare organization. DB was a research fellow with Mercy For Animals. BL was a researcher for Formo. The research was overseen by GB and conducted in the absence of any other commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fnut.2022.997632/full#supplementary-material

References

1. Mars Incorporated. Mars introduces CO2COA^{TM}: a sustainability inspired animal-free, planet-friendly chocolate innovation in partnership with perfect day. *PR Newswire*. (2022). Available online at: https://www.prnewswire.com/news-releases/mars-introduces-co2coa-a-sustainability-inspired-animal-free-planet-friendly-chocolate-innovation-in-partnership-with-perfect-day-301569160.html (accessed September 8, 2022).

2. Non-GMO Project. *New GMOs*. (2022). Available online at: https://www.nongmoproject.org/newgmos/ (accessed September 8, 2022).

3. Nisbet MC, Newman TP. Framing, the media, and environmental communication. In A. Hansen and R. Cox (Eds.) *The Routledge Handbook of Environment and Communication*. New York, NY: Routledge (2015). p. 345–58.

4. Chong D, Druckman JN. Framing theory. *Ann Rev Pol Sci*. (2007) 10:103–26. doi: 10.1146/annurev.polisci.10.072805.103054

5. Broad GM. Making meat, better: the metaphors of plant-based and cell-based meat innovation. *Environ Commun*. (2020) 14:919–32. doi: 10.1080/17524032.2020.1725085

6. Sexton AE, Garnett T, Lorimer J. Framing the future of food: the contested promises of alternative proteins. *Environ Plann E: Nat Space*. (2019) 2:47–72. doi: 10.1177/2514848619827009

7. Santo RE, Kim BF, Goldman SE, Dutkiewicz J, Biehl E, Bloem MW, et al. Considering plant-based meat substitutes and cell-based meats: a public health and food systems perspective. *Front Sust Food Sys*. (2020) 134. doi: 10.3389/fsufs.2020.00134

8. Chouhan N, Vig H, Deshmukh R. *Meat substitute market*. Allied Market Research. (2022). Available online at: https://www.alliedmarketresearch.com/meat-substitute-market (accessed September 8, 2022).

9. Markets and Markets (2022). Dairy Alternatives Market. Available online at: https://www.marketsandmarkets.com/Market-Reports/dairy-alternative-plant-milk-beverages-market-677.html (accessed September 8, 2022).

10. Hale M. Exploring the Growth of Plant-Based Milk. *Food Manufacturing*. (2021). Available online at: https://www.foodmanufacturing.com/consumer-trends/article/21723117/exploring-the-growth-of-plantbased-milk (accessed September 8, 2022).

11. Meyers A. Demand for Alternative Dairy Is Here to Stay. *Morning Consult*. (2021). Available online at: https://morningconsult.com/2021/03/30/alternative-milk-non-dairy-popularity/ (accessed September 8, 2022).

12. Eibl R, Senn Y, Gubser G, Jossen V, van den Bos C, Eibl D, et al. Cellular agriculture: opportunities and challenges. *Annu Rev Food Sci Technol*. (2021) 12:51–73. doi: 10.1146/annurev-food-063020-123940

13. Kyriakopoulou K, Keppler JK, van der Goot AJ. Functionality of ingredients and additives in plant-based meat analogues. *Foods*. (2021) 10:600. doi: 10.3390/foods10030600

14. Lawton G. Brewing milk. *New Scientist*. (2021) 251:46–9. doi: 10.1016/S0262-4079(21)01431-7

15. Saavoss M. How might cellular agriculture impact the livestock. dairy, and poultry industries? *Choices*. (2019) 34:1–6. Available online at: https://www.jstor.org/stable/26758666

16. Onwezen MC, Bouwman EP, Reinders MJ, Dagevos H. A systematic review on consumer acceptance of alternative proteins: pulses, algae, insects, plant-based meat alternatives, and cultured meat. *Appetite*. (2021) 159:105058. doi: 10.1016/j.appet.2020.105058

17. Lusk JL, Briggeman BC. Food values. *Am J Agric Econ*. (2009) 91:184–96. doi: 10.1111/j.1467-8276.2008.01175.x

18. Renner B, Sproesser G, Strohbach S, Schupp HT. Why we eat what we eat. *The Eating Motivat Surv (TEMS) Appet*. (2012) 59:117–28. doi: 10.1016/j.appet.2012.04.004

19. Ronteltap A, Van Trijp JCM, Renes RJ, Frewer LJ. Consumer acceptance of technology-based food innovations: lessons for the future of nutrigenomics. *Appetite*. (2007) 49:1–17. doi: 10.1016/j.appet.2007.02.002

20. Yamoah FA, Acquaye A. Unravelling the attitude-behaviour gap paradox for sustainable food consumption: insight from the UK apple market. *J Clean Prod*. (2019) 217:172–84. doi: 10.1016/j.jclepro.2019.01.094

21. Siegrist M, Hartmann C. Consumer acceptance of novel food technologies. *Nat Food*. (2020) 1:343–50. doi: 10.1038/s43016-020-0094-x

22. Center for Food Integrity. A dangerous food disconnect: When consumers hold you responsible but don't trust you. (2018). Available online at: https://www.foodintegrity.org/wp-content/uploads/2018/01/CFI_Research_8pg_010918_final_web_REV2-1.pdf (accessed September 8, 2022).

23. Parry J, Szejda K. *How to drive plant-based food purchasing: Key findings from a Mindlab study into implicit perceptions of the plant-based category*. The Good Food Institute. (2019). Available online at: https://go.gfi.org/Mindlab-Strategic-Recommendations (accessed September 8, 2022).

24. International Food Information Council. A consumer survey on plant alternatives to animal meat. FoodInsight.org. (2020). Available online at: https://foodinsight.org/wp-content/uploads/2020/01/IFIC-Plant-Alternative-to-Animal-Meat-Survey.pdf (accessed September 8, 2022).

25. Adamczyk D, Jaworska D, Affeltowicz D, Maison D. Plant-based dairy alternatives: consumers' perceptions, motivations, and barriers—results from a qualitative study in Poland, Germany, and France. *Nutrients*. (2022) 14:2171. doi: 10.3390/nu14102171

26. Schiano AN, Harwood WS, Gerard PD, Drake MA. Consumer perception of the sustainability of dairy products and plant-based dairy alternatives. *J Dairy Sci*. (2020) 103:11228–43. doi: 10.3168/jds.2020-18406

27. Bryant C, Barnett J. Consumer acceptance of cultured meat: an updated review (2018–2020). *Applied Sciences*. (2020) 10:5201. doi: 10.3390/app10155201

28. Pakseresht A, Kaliji SA, Canavari M. Review of factors affecting consumer acceptance of cultured meat. *Appetite*. (2022) 170:105829. doi: 10.1016/j.appet.2021.105829

29. Bryant C, Dillard C. The impact of framing on acceptance of cultured meat. *Front Nutri*. (2019) 6:103. doi: 10.3389/fnut.2019.00103

30. Newman L, Newell R, Mendly-Zambo Z, Powell L. Bioengineering, telecoupling, and alternative dairy: agricultural land use futures in the Anthropocene. *Geograph J*. (2021) 3:2392. doi: 10.1111/geoj.12392

31. Koch C, Johansson M, Kalling T, Kärreman M. the future of the dairy industry – 2030 scenario analysis. *IIM Industry Report Series*. (2021) 2021:22. Available online at: https://lucris.lub.lu.se/ws/portalfiles/portal/101683299/IIM_Report_on_the_Future_of_the_Dairy_Industry.pdf (accessed September 21, 2022).

32. Mendly-Zambo Z, Powell LJ, Newman LL. Dairy 3.0: cellular agriculture and the future of milk. *Food Cult Soc*. (2021) 24:675–93. doi: 10.1080/15528014.2021.1888411

33. Perkins C. 'Test tube milk' more likely to win Brits than lab-grown meat. *The Grocer*. (2018). Available online at: https://www.thegrocer.co.uk/sourcing/test-tube-milk-more-likely-to-win-brits-than-lab-grown-meat/571598.article (accessed September 8, 2022).

34. Zollman Thomas O, Bryant C. Don't have a cow, man: consumer acceptance of animal-free dairy products in five countries. *Front Sust Food Sys*. (2021) 223. doi: 10.3389/fsufs.2021.678491

35. Archibald MM, Ambagtsheer RC, Casey MG, Lawless M. Using Zoom videoconferencing for qualitative data collection: perceptions and experiences of researchers and participants. *Int J Qual Meth*. (2019) 18:1–8. doi: 10.1177/1609406919874596

36. Nobrega S, El Ghaziri M, Giacobbe L, Rice S, Punnett L, Edwards K, et al. Feasibility of virtual focus groups in program impact evaluation. *Int J Qual Meth*. (2021) 20:1–10. doi: 10.1177/16094069211019896

37. Funk C, Kennedy B. The new food fights: U.S. public divides over food science. Pew Research Center. (2016). Available online at: https://www.pewresearch.org/science/2016/12/01/the-new-food-fights/ (accessed September 8, 2022).

38. House J. Consumer acceptance of insect-based foods in the Netherlands: academic and commercial implications. *Appetite*. (2016) 107:47–58. doi: 10.1016/j.appet.2016.07.023

39. Kennedy B, Funk C. 28.% of Americans are 'strong' early adopters of technology. Pew Research Center. (2016). Available online at: https://www.pewresearch.org/fact-tank/2016/07/12/28-of-americans-are-strong-early-adopters-of-technology/ (accessed September 8, 2022).

40. Golob U. Sense-making. In Heath RL, Johansen W (Eds.), *The International Encyclopedia Strategic Communication*. (2018). Hoboken, NJ: Wiley. doi: 10.1002/9781119010722.iesc0159

41. Woodside AG. Sense making in marketing organizations and consumer psychology: theory and practice. *Psychol Mark*. (2001) 18:415–21. doi: 10.1002/mar.1014

42. Dervin B, Naumer C. Sense-making. In S.W. Littlejohn and K. Foss (Eds.), *Encyclopedia of Communication Theory*. Thousand Oaks, CA: Sage (2009) Vol. 2 (pp. 877–881).

43. Charmaz K. *Constructing Grounded Theory: A Practical Guide Through Qualitative Analysis*. Thousand Oaks, CA: Sage (2006).

44. Krueger RA, Casey MA. Designing and conducting focus group interviews. In: Krueger RA, Casey MA, Donner J, Kirsch S, Maack JN (Eds). *Social analysis: Selected Tools and Techniques*. Social Development Paper, 36 (pp. 4-23). Washington, DC: The World Bank (2001).

45. Lloyd's Register Foundation and Gallup (2019). *The Lloyd's Register Foundation World Risk Poll*. Available online at: https://wrp.lrfoundation.org.uk/LRF_WorldRiskReport_Book.pdf (accessed September 8, 2022).

46. Fernbach PM, Light N, Scott SE, Inbar Y, Rozin P. Extreme opponents of genetically modified foods know the least but think they know the most. *Nat Hum Behav*. (2019) 3:251–6. doi: 10.1038/s41562-018-0520-3

47. Szejda K, Urbanovich T, Wilks M. *Accelerating Consumer Adoption of Plant-Based Meat*. The Good Food Institute. (2020). Available online at: go.gfi.org/plant-based-meat-consumer-adoption.

48. Asioli D, Aschemann-Witzel J, Caputo V, Vecchio R, Annunziata A, Næs T, et al. Making sense of the "clean label" trends: a review of consumer food choice behavior and discussion of industry implications. *Food Res Int*. (2017) 99:58–71. doi: 10.1016/j.foodres.2017.07.022

49. Lusk J, Polzin S. Consumer food insights. *Cent Food Dem Anal Sust Vol*. (2022) 1:5. https://ag.purdue.edu/cfdas/wp-content/uploads/2022/06/Report_05-2022.pdf (accessed September 8, 2022).

50. Bryant, C. *Animal Cruelty Messages Are Persuasive - If We Can Overcome Avoidance*. The Vegan Society. (2022). Available online at: https://www.vegansociety.com/get-involved/research/research-news/animal-cruelty-messages (accessed September 8, 2022).

51. Morgan, D. *Focus Groups as Qualitative Research*. Thousand Oaks, CA: SAGE Publications. (1997). doi: 10.4135/9781412984287

frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 10 October 2022
DOI 10.3389/fpsyg.2022.971107

OPEN ACCESS

EDITED BY
Christopher J. Hopwood,
University of Zurich,
Switzerland

REVIEWED BY
Srivatsa Srinivasan,
M S Ramaiah University of Applied Sciences, India
Marc Linzmajer,
University of St. Gallen, Switzerland

*CORRESPONDENCE
Desheng Wang
wdesheng@sdu.edu.cn

SPECIALTY SECTION
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

RECEIVED 16 June 2022
ACCEPTED 23 September 2022
PUBLISHED 10 October 2022

CITATION
Li T, Wang D and Yang Z (2022) Inspiration or risk? How social media marketing of plant-based meat affects young people's purchase intention.
Front. Psychol. 13:971107.
doi: 10.3389/fpsyg.2022.971107

Inspiration or risk? How social media marketing of plant-based meat affects young people's purchase intention

Tingting Li, Desheng Wang* and Zhihao Yang

Department of Marketing, School of Management, Shandong University, Jinan, China

As an alternative protein product to animal meat, plant-based meat is considered to play an essential role in improving animal welfare and protecting the environment. However, why do a few consumers choose plant-based meat but others do not? Despite the increasing research on plant-based meat marketing, little is known about the psychological mechanism by which plant-based meat marketing affects consumers' purchasing decisions. We utilize dual-system theory to understand how social media marketing of plant-based meat influences cognitive fluency, customer inspiration, perceived risk, and purchase intention. Four studies (i.e., Studies 1, 2, 3, and 4) show that social media marketing can increase young people's purchase intention of plant-based meat more than traditional marketing. In Studies 1 and 2, increased intensity of social media marketing can enhance young people's cognitive fluency and further promote purchase intention. Study 3 explores how cognitive fluency relates to purchase intention through two psychological mechanisms. We suggest that a higher level of cognitive fluency increases customer inspiration and improves purchase intention. However, a lower level of cognitive fluency reduces purchase intention by increasing perceived risk. Study 4 manipulated members' in-group or out-group status to show a boundary condition for the effect of brand community identity on purchase intention. These studies provide insight into how brand marketers can use social media to promote consumer inspiration and advertising engagement, how managers can offer fluency-increasing mechanisms to ensure a low level of perceived risk, and how enterprise practitioners may want to consider brand community publicity to attract out-group members.

KEYWORDS

plant-based meat, social media marketing, dual-system theory, cognitive fluency, customer inspiration, perceived risk, brand community identity

Introduction

Food production and consumption represent one of the most significant contributors to environmental issues (Vermeulen et al., 2012). Recent years have seen increasing interest in research on plant-based food marketing because it is vital for environmental protection and improvement in animal welfare. For example, using soy protein concentrate (SPC) as

raw material, plant-based meat now provides prospects for improving human health, and reducing environmental pollution and meat consumption (Grebenyuk and Ravin, 2017). China has been identified as a prime country to conduct consumer surveys on plant-based meat since it has the highest population and the rising economy in the world (Bryant and Julie, 2018). Meanwhile, with increasing demand for meat consumption coming from developing countries (Bryant et al., 2018), research on consumer acceptance of plant-based meat could help China achieve carbon neutrality.

Academicians have paid attention to consumer attitudes and behaviors toward plant-based meat (Yu et al., 2014; Bryant and Sanctorum, 2021). McCarthy et al. (2015) verified that Chinese purchase intention of plant-based meat was driven by altruistic concerns (i.e., environment and animal welfare concerns) and self-interest (i.e., health concerns and food safety concerns). Shan et al. (2022) also investigated that the Chinese were more willing to buy artificial meat under positive information. Other studies showed that the growth of plant-based meat sales was significant in the last few years, and younger had relatively stronger preferences for plant-based meat than farm-raised meat (Loo et al., 2020; Zhao et al., 2022). Although previous studies have provided essential evidence on the factors of plant-based meat' consumption, there is a lack of exploration in specific contexts, mainly in social media marketing (Qutteinq et al., 2019; He et al., 2020). Social media marketing is more in line with the habits of young people, significantly improving the interaction between consumers and plant-based meat (Moreira et al., 2021). Specifically, consumers rely on expert opinions, friend recommendations, and advertising on social media to acquire knowledge of plant-based meat and be influenced by them (Thompson et al., 2016). Therefore, research is needed to explore these views in more detail and understand whether and how social media marketing may influence young people's cognitions and attitudes toward plant-based meat.

The rise of social media has blurred the boundary between brand operation and media management, enabling timely dissemination, sharing, and user interaction of product information (Hanna et al., 2011; Aliosha et al., 2013; Appel et al., 2019). Baetzgen and Tropp (2013) pointed out that product communication is not limited to traditional advertising, brand implantation, soft text, sponsorship, and content marketing but has also been widely used in social media. In this way, enterprises push plant-based meat to social media through diversified advertising methods, expecting to bring a low-cost and significant flow interaction effect, thus expanding brand influence and value (Yu et al., 2017). In addition, based on high participation and interaction of social media, enterprises can receive consumers' feedback and suggestions in real-time and understand consumers' attitudes toward plant-based meat as consumers are no longer merely passive recipients in the marketing exchange process (Felix et al., 2016). Despite what academics and practitioners have studied on the advantages of social media marketing, the psychological mechanisms consumers interact with plant-based meat are unclear (Appel et al., 2019). In this research, we examine whether social media marketing of plant-based meat motivates young people to interact more and impacts their cognition, emotion, and purchase intention. Furthermore, we inspect how cognitive fluency influences young people's engagement with plant-based meat marketing. The resulting emotional and cognitive states have the potential to provide valuable information on plant-based meat social media advertising success.

Interestingly, research findings also suggest that consumers may experience differential positive and negative cognitions from plant-based meat (Yu et al., 2014; McCarthy et al., 2015). In general, plant-based meat is considered an increasingly important tool in reducing the consumption of animal products for environmental, public health, and ethical reasons, affecting consumers' positive cognitions and attitudes (McCarthy et al., 2015). Conversely, Bryant et al. (2018) indicated that consumers held more risks because they had less experience with plant-based meat. Perceived risk is easy to diminish consumers' purchase intention and weaken other factors' positive impact on consumer behavior (Ueland et al., 2012). In addition, plant-based meat has a low repurchase rate while being sought after by the middle and young, suggesting that there have been many instances wherein consumers have raised social and health concerns about such products (Rojas-Méndez et al., 2012). The individuals have opposite perceptions of inspiration and risk of plant-based meat, further affecting their purchase intention (Radford and Bloch, 2011). Despite the above conclusions, none of the studies have measured plant-based meat consumption with an integrated mechanism of cognition in the social media marketing context. Therefore, understanding how can enhance acceptance of plant-based meat through different psychological processes is required.

Thus, our research seeks to answer the following questions to advance theory and research on plant-based meat marketing: (1) Whether marketing through social media can promote young people's purchase intention? Moreover, (2) If so, by what mechanism is it achieved? We draw on dual-system processing theory to answer those questions, which states that people have two independent information processing systems, including sensibility (quick, intuitive, and effortless) and rationality (slow, analytical, and deliberate; Alter et al., 2007). First, this theory provides a general framework for understanding young people's cognitive processes and decision-making when evaluating plant-based products (Study 1 and 2: social media marketing intensity, cognitive fluency, and purchase intention). Furthermore, dual-system processing theory suggests that two mechanisms (customer inspiration and perceived risk) account for the effects of social media marketing on purchase intention (Study 3: customer inspiration and perceived risk as mediating mechanisms). We also go one step further and examine a vital boundary condition of whether brand community identity influences young people's purchasing decisions on plant-based meat (Study 4: the moderating role of in-group and out-group). We do not pre-register hypotheses and will conduct exploratory

studies to reason and test the above questions. The resulting model allows us to answer why, how, and for whom social media marketing of plant-based meat is effective.

Overall, our paper offers three key contributions. First, we explore the relationship between social media marketing of plant-based meat and young people's purchase intention. This advances research on plant-based meat marketing by identifying a new psychological mechanism that clarifies the cognitive and decision-making processes of young people. Second, and perhaps more importantly, we show that customer inspiration and perceived risk are the two paths of consumer perception. This challenges the assumption that marketing of plant-based meat and purchase intention will constantly interact positively or negatively (Yu et al., 2014; McCarthy et al., 2015) and also enriches the classic dual-system processing theory. Third, we demonstrate that consumers' identification with the brand community can influence whether customers are inspired or perceived as at risk. Our work enriches the range of mechanisms associated with plant-based meat research, answering calls to examine the boundary condition of social media marketing of plant-based products.

Literature review and hypotheses

Social media marketing of plant-based meat and young people's purchase intention

Social media marketing refers to using social media, such as blogs, MicroBlog, WeChat, and shared forums, to enhance the visibility and recognition of enterprises, brands, and products (Krishen et al., 2016). Celebrities have linked plant-based meat to fitness and shared their reviews on social media, making this new product gradually known to Chinese consumers. Appel et al. (2019) showed that most consumers could benefit from product reviews and sharing on social media. With less knowledge about plant-based meat, young people are not aware of its utilitarian and hedonic functions when they first come into contact with plant-based meat. However, social media marketing displays plant-based meat' features and attributes through text descriptions, data indicators, pictures, animation, celebrities' live broadcasts, and user evaluations, allowing individuals to learn more about plant-based meat (Couldry and Markham, 2007). Meanwhile, social media allows young people to interact with friends and browse product information posted by celebrities. Young people prefer to purchase products based on peers' or celebrities' opinions rather than ads shared by a brand (Yu et al., 2017; Murphy et al., 2020). Therefore, we suggest that compared with traditional advertising, social media marketing enables young people to be aware of the environmental and health concerns of plant-based meat, and timely sharing with peers also enhances social attributes, thus increasing purchase intention.

Studies also showed that unfamiliarity gave the Chinese lower acceptance rates of plant-based meat (Bryant et al., 2018). Meanwhile, curiosity was regarded as one of the strongest motivating factors for purchasing plant-based meat (Hwang et al., 2020). This paper predicts that with the increase in social media marketing intensity, young people are more willing to buy plant-based meat. On the one hand, intensive marketing means young people have more opportunities to learn product details, reducing unfamiliarity with plant-based meat. On the other hand, social media allows young people to connect with friends extensively, presenting pictures or sharing experiments with plant-based meat (Davis, 2012; Holmberg, 2016). Young people's curiosity will be piqued when peers talk more about plant-based meat (Yau and Reich, 2018; Hwang et al., 2020). Based on this, we predict the following:

> *Hypothesis 1*: Social media marketing significantly enhances young people's purchase intention toward plant-based meat compared with traditional advertising. In addition, there is a positive relationship between social media marketing intensity and purchase intention of plant-based meat.

Dual-system processing theory

We draw upon dual-system processing theory to further explain young people's cognitive process to plant-based meat. Cognitive information processing (CIP) theory focuses on how individuals process and interpret information in social situations (Crick and Dodge, 1994), which is the basis of dual-system processing theory. Lemerise and Dodge (2000) developed the CIP theory to demonstrate how individuals encode information cues, classify goals, extract responses, make decisions, and implement behaviors. Dual-system processing theory is the extension of CIP theory. Different from the CIP theory, which comprehensively summarizes cognitive and decision-making processes, the dual-system processing theory focuses on explaining the other decision-making mechanisms of consumers (Alter et al., 2007). The basic tenet is that individuals have both perceptual (system 1) and rational (system 2) decision-making systems and decide which procedure plays a dominant role according to the specific context. According to dual-system processing theory, one of the conditions for system 1 or system 2 to be activated is the individual's experience of information processing difficulty (Alter et al., 2007). If consumers perceive information processing to be easy, system 1 is more likely to be activated, leading to intuitive, effortless, and rapid processing (Alter et al., 2013). Conversely, if consumers perceive information processing to be complex, system 2 is more likely to be activated, and individuals put more mental effort into it and turn to analytical thinking (Shen and Rao, 2016).

According to the dual-system processing theory, this paper believes that young people first form different product cognition of plant-based meat. The fluency of information processing determines which system is activated faster, and further stimulates customer inspiration and perceived risk. Therefore, we identify three main factors to explain the acceptance process

of plant-based meat: (1) cognitive fluency, (2) customer inspiration, and (3) perceived risk.

The mediating effect of cognitive fluency

Cognitive fluency reflects an individual's subjective experience about information processing, mainly referring to low-level processing (Lee and Labroo, 2004; Shen and Rao, 2016). Information processing produces cognitive and emotional consumption, so consumers are unwilling to spend extra energy on cognition (Aydinli et al., 2014). Hu et al. (2017) demonstrated this opinion by suggesting that product familiarity reduces cognitive load. Since plant-based meat advertisements usually contain non-empirical information, processing may increase consumer cognitive load and lead to adverse communication effects. However, compared with traditional advertising, social media marketing enables youngers to interact with plant-based meat promptly and form specific cognition (Liu et al., 2021). The resulting familiarity increases cognitive fluency. In addition, Nunes et al. (2015) also showed that repeated promotions, easy-to-understand instructions, product appearance, and consumer visual habits induced cognitive fluency. That is to say, the increase in marketing intensity can improve young people's cognitive fluency.

Cognitive fluency will further influence young people's judgment of product authenticity, thus affecting their decision-making. When cognitive fluency is high, young people do not need to consume many cognitive resources to process information; otherwise, they need to invest more cognitive efforts (Thompson and Ince, 2013; Graf et al., 2018). For example, Labroo and Pocheptsova (2016) showed that consumers increased their liking for products due to the fluent processing of product descriptions, designs, and advertisements. However, when the cognition is not fluent, consumers are less favorable of the product (Jiang et al., 2016). In the context of social media marketing, we predict that cognitive fluency positively affects young people's purchase intention, for the following reasons: (1) Fluency experience motivates consumers to maintain more knowledge about plant-based meat, while familiarity enhances consumers' purchase intention (Graf et al., 2018); (2) The smoother the advertising message, the more easily consumers are persuaded (Seo and Scammon, 2017). Social media provides fewer information gaps, increasing advertisements' persuasiveness (Kwan et al., 2017). On this basis, we hypothesize:

> *Hypothesis 2*: Cognitive fluency is mediating between the marketing intensity of social media and young people's purchase intention for plant-based meat.

Customer inspiration and perceived risk as mediating mechanisms

Social media marketing affects purchase intention by changing young people's cognitive fluency with plant-based meat. However, cognitive fluency is a leading factor in consumers' purchasing decisions but not the ultimate determinant (Parker et al., 2016). Drawing from dual-system processing theory, consumers engage in deep and abstract information processing when cognitive fluency is low. Individuals increase emotional pleasure and imagination when cognitive fluency is high (Carr et al., 2016; Labroo and Pocheptsova, 2016). Thus, we suggest that the subsequent impact of cognitive fluency on purchase intention depends on whether customer inspiration or perceived risk is dominant.

Classical inspiration theory holds that new ideas from outside stimulate the generation of customers' inspiration and put individuals in an incentive state to put their ideas into practice (Thrash and Elliot, 2004). Böttger et al. (2017) further proposed that customer inspiration includes "inspired-by" and "inspired-to" two stages. According to the dual-system processing theory, smooth information triggers system 1 so consumers conduct intuitive heuristic reasoning mode and respond quickly (Alter et al., 2013). Customer inspiration represents this temporary motivational state of consumers. Although system 1 and system 2 interact, smooth information will trigger system 1 and activate customer inspiration more. Next, customer inspiration can effectively predict consumers' attitudes and behavior (Böttger et al., 2017). Böttger et al. (2017), for example, designed a series of experiments in which three subjects were asked to shop online with product descriptions of different inspirations. The research found that products with high inspiration led to more purchase intentions.

Social media advertisements provide young people with detailed and rich information about plant-based meat, making them have an intuitive feeling about plant-based meat (Liang et al., 2016; Ho et al., 2017). This paper predicts that the greater the fluency of young people's perception, the easier it is to promote their immediate imagination on plant-based meat's taste and environmental protection function (Chen and Zheng, 2015). In addition, smooth information is often accompanied by positive emotions, further promoting the inspiration of young people, such as detached experience, joy shared with friends, and surprise, triggering unplanned purchase intentions (Fu and Elliott, 2013; Wang et al., 2014). Once young people are inspired, their subsequent consumption behavior becomes more spontaneous and impulsive. On this basis, we hypothesize cognitive fluency's positive, indirect effect on purchase intention through customer inspiration.

> *Hypothesis 3*: Compared with a lower level of cognitive fluency, a higher level of cognitive fluency is more likely to generate customer inspiration and improve purchase intention.

Like customer inspiration, the perceived risk exists in the evaluation and decision-making process, thus becoming an important tool to reveal individual behavior and decision-making rules (Garretson and Clow, 1999; Mitchell, 1999). It is a multidimensional concept, including financial risk, performance

risk, physical risk, social risk, psychological risk, and time risk (Stone and Grønhaug, 1993). However, perceived risk may provide contrary theoretical support for our hypothesis. According to the dual-system processing theory, disfluent information triggers system 2, at which point consumers tend to conduct deeper, more abstract, and more careful analysis (Shen and Rao, 2016). This will significantly increase individuals' risk perception, affecting purchase intention (Hirunyawipada and Paswan, 2006). Empirical studies have also proved this point. For example, Ueland et al. (2012) indicated in the BRA model that perceived risk can easily reduce consumers' purchase intention and weaken the positive impact of other factors on consumer behavior.

In this study, plant-based meat uses new technology or formula but is expensive, which will increase financial risk for young people (Dholakia, 2001; Bryant and Julie, 2018). Chinese have a diet of traditional animal meat, and the composition of plant-based meat may cause young people's perception of health risks. A variety of social media information results in cognitive load, increasing young people's perception of health risks (Hirunyawipada and Paswan, 2006). Beyond that, consumers need more emotion and cognition to sort out product information and suffer from uncertain results, which will increase psychological risk. However, consumers would actively avoid information with poor cognitive fluency (Seo and Scammon, 2017). When the risks of plant-based meat cause too much anxiety, young people choose not to purchase them. In summary, we propose the hypothesis that when cognitive fluency is low, young people will generate more perceived risks while arousing inspiration, thus reducing the purchase intention of plant-based meat.

> *Hypothesis 4*: Compared with a higher level of cognitive fluency, a lower level of cognitive fluency is more likely to stimulate perceived risk, thus reducing purchase intention.

The moderating effect of brand community identity

While social media enhances users' willingness to share, it also makes users' behavior more susceptible to influence (Yau and Reich, 2018). Consumers, especially the young, also refer to and follow their peers' posts. Thus, this paper uses brand community identity to describe consumer status. Brand community is a social relationship formed by brand lovers without geographical restrictions. Community members usually have a solid psychological identity, connections, or belonging to a brand community (Chadborn and Reysen, 2018). Notably, most members are existing or potential users of the brand, who constitute the core users of the brand (Thompson et al., 2016). Based on this, we use in-group and out-group to further distinguish consumers' situation.

In examining the effect of brand identity on community members, previous research found that identity strength affected the motivation individuals received in groups (Kleine et al., 1993). Social and sharing motivations guide in-group members' purchase intention, significantly increasing inspiration's intensity, frequency, and emotional component (Algesheimer et al., 2005). In addition, in-group members perceive themselves as part of the brand community. The dependence generated by familiarity with products makes them insensitive to plant-based meat' risks. Indeed, they are more likely to imagine themselves sharing product-related posts or shopping experiences with friends in a positive mood (Chadborn and Reysen, 2018). For these reasons, we expect that social media marketing will lead to smoother cognition of plant-based meat among in-group members, generating more customer inspiration and thus increasing purchase intention. Unlike in-group members who tend to imagine, out-group consumers are more cautious and monitor their environment continuously to avoid mistakes (Kardes et al., 2004). They have a common understanding of the functions and attributes of plant-based meat and do not have close relationships with community members. The lack of purchasing habits for such plant-based meat makes members fail to improve cognitive fluency and customer inspiration. In addition, unfamiliar information also increases out-group consumers' perceived risk. Accordingly:

> *Hypothesis 5*: In the social media marketing condition, when consumers are in-group, they are more likely to generate (a) higher cognitive fluency and (b) customer inspiration, further enhancing purchase intention.

> *Hypothesis 6*: When consumers are out-group, they are more likely to generate (a) lower cognitive fluency and (b) perceived risk, further reducing purchase intention.

In summary, we presented our conceptual framework in Figure 1.

Study design and result analysis

Study overview

We conducted four studies to examine how social media marketing of plant-based meat affects young people's purchase intention and the underlying mechanism by testing the mediating roles of cognitive fluency, customer inspiration, and perceived risk. In Study 1, we first used authentic plant-based meat brands to provide preliminary tests of our theorizing, demonstrating that plant-based meat's social media marketing (vs. traditional marketing) had a greater impact on purchase intention. In Study 2, we used an authentic plant-based meat brand (Plant Diary) in China as a stimulus to establish the primary main effect of social media marketing on purchase intention and the mediation effect of cognitive fluency through a lab study. Study 3 further tested the mediating roles of customer inspiration and perceived risk. Participants formed, through direct experience, an authentic

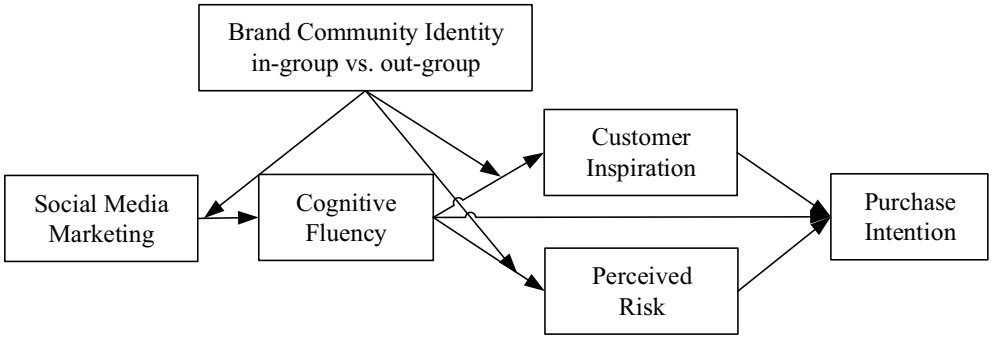


FIGURE 1
The conceptual framework.

individual preference for a product. Study 4 tested the moderating effect of brand community identity. These four studies tested our theoretical framework's psychological mechanism and boundary condition. We designed these four studies by referring to the experimental methods and sample sizes in previous studies, and reported the stimulus materials, manipulation, data exclusion, and methods. This paper involved several manipulative experiments, requiring complex design and offline labs. Therefore, we mainly adopted small sample study, which would also be explained as a limitation.

Study 1: Main effect

Design and method

Study 1 aimed to test whether social media marketing can increase young people's purchase intention of plant-based meat more than traditional marketing. Firstly, we collected ten emergings, authentic plant-based meat brands (such as Plant Diary, Beyond Meat, Protein Meat, Harvest Gourmet, Future Meat, and Qishan Food) from China's most extensive shopping site Taobao.com. We then invited ten experts and Ph.D. students in marketing to discuss the ten brands we collected. The stimulus materials should meet two conditions: brand familiarity was low, and product types included in the brand were widely accepted by customers. After discussion, we chose Plant Diary, Beyond Meat, and Protein Meat as the experimental stimulus and designed advertising content for each brand. Table 1 shows the details of the stimulus materials and the manipulation methods of traditional and social media marketing. We simulated the interaction process of consumers in the context of social media marketing with "participants can make comments after posts." Other experimental conditions were completely the same except for advertising methods. In addition, we would initially test consumers' brand preference degree to exclude the influence of consumer preferences.

Data were collected for `4 days in May 2022 with a support of Questionnaire site, an online survey institution. We recruited 180 participants and evenly divided them into six groups (115 females, $M_{age} = 26.50$, ranging from 18 to 32 years old) for the test. We first tested participants for brand familiarity ("I'm familiar with the brand"; 1 = strongly disagree, 7 = strongly agree) and brand preference ("I love this brand"; 1 = strongly disagree, 7 = strongly agree). Then, we manipulated the three plant-based meat brands into six groups according to the manipulation method in Table 1. The participants were asked to read the material and answer the following question, "What kind of marketing do you think this is" (1 = traditional marketing, 7 = social media marketing). We also asked participants to rate the degree to which they agree with the following statement (Kim and Chung, 2013): "I am willing to buy this product" and "This product is what I want to buy" (1 = strongly disagree, 7 = strongly agree; $\alpha = 0.93$).

Results and discussion

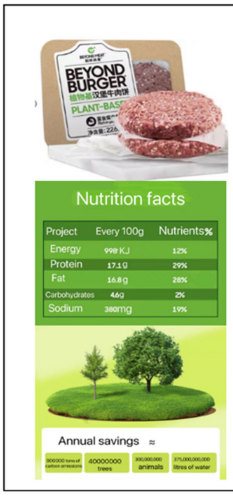
Manipulation check

T-test results showed significant differences between traditional marketing and social media marketing of Plant Diary ($M_{traditional} = 2.20$, $M_{social\ media} = 5.70$, $t = -12.38$, $p < 0.001$), Beyond Meat ($M_{traditional} = 2.17$, $M_{social\ media} = 6.10$, $t = -15.81$, $p < 0.001$), and Protein Meat ($M_{traditional} = 2.01$, $M_{social\ media} = 5.87$, $t = -16.75$, $p < 0.001$), indicating successful variable manipulation. Especially, there was no significant difference in brand familiarity and brand preference degree among each group. This suggested that the above three brands can be manipulated.

Purchase intention

The results showed a significant difference in purchase intention scores between the two groups. Social media marketing of Plant Diary ($M = 4.90$, $SD = 1.56$) was significantly higher than traditional marketing of Plant Diary ($M = 3.47$, $SD = 1.53$; $t = 3.78$, $p < 0.001$). The same was true for social media marketing of Beyond Meat ($M = 5.17$, $SD = 1.29$) and traditional marketing of Beyond Meat ($M = 3.00$, $SD = 0.95$; $t = 6.89$, $p < 0.001$) and social media marketing of Protein Meat ($M = 5.00$, $SD = 1.14$) and traditional marketing of Protein Meat ($M = 3.17$, $SD = 1.29$; $t = 5.35$, $p < 0.001$). By manipulating different advertising methods for three brands, we proved that social media marketing of plant-based meat could promote young people's purchase intention more than traditional marketing.

TABLE 1 Manipulation materials (Study 1).

Plant-based meat brand	Traditional marketing	Social media marketing
 This product is made of soybean, pea, wheat and other crops as raw materials to separate and purify high-quality plant proteins required by human body, and then through a series of steps such as extrusion, extrusion, shaping and freezing, to simulate the texture, taste and flavor of mutton in taste, juiciness, color, fragrance and other aspects. The nutritional content of this product can completely replace animal meat. Plant-based meat now provides prospects for improving human health, reducing environmental pollution, and meat consumption. Compared with 113.4 grams of ordinary animal meat, the product can reduce greenhouse gas emissions by 90%, water consumption by 99% and energy consumption by 46%.	We provided the participants with a product poster via email about Plant Diary, introducing nutrition composition, taste, environmental protection concepts, and other contents of plant-based meat in the form of pictures and texts.	We provided the participants with a product promotion post about Plant Diary through WeChat, introducing nutrition composition, taste, environmental protection concepts, and other contents of plant-based meat in the form of pictures and texts. Participants can post comments after the post.
 This hamburger is made of soybean, pea, wheat and other crops as raw materials to separate and purify high-quality plant proteins required by human body, and then through a series of steps such as extrusion, extrusion, shaping and freezing, to simulate the texture, taste and flavor of beef in taste, juiciness, color, fragrance and other aspects. The nutritional content of this product can completely replace beef. Plant-based meat now provides prospects for improving human health, reducing environmental pollution, and meat consumption. Compared with 113.4 grams of ordinary animal meat, the product can reduce greenhouse gas emissions by 90%, water consumption by 99% and energy consumption by 46%.	We provided the participants with a product poster via email about Beyond Meat, introducing nutrition composition, taste, environmental protection concepts, and other contents of plant-based meat in the form of pictures and texts.	We provided the participants with a product promotion post about Beyond Meat through WeChat, introducing nutrition composition, taste, environmental protection concepts, and other contents of plant-based meat in the form of pictures and texts. Participants can post comments after the post.
 This product is made of soybean, pea, wheat and other crops as raw materials to separate and purify high-quality plant proteins required by human body, and then through a series of steps such as extrusion, extrusion, shaping and freezing, to simulate the texture, taste and flavor of beef in taste, juiciness, color, fragrance and other aspects. The nutritional content of this product can completely replace beef. Plant-based meat now provides prospects for improving human health, reducing environmental pollution, and meat consumption. Compared with 113.4 grams of ordinary animal meat, the product can reduce greenhouse gas emissions by 90%, water consumption by 99% and energy consumption by 46%.	We provided the participants with a product poster via email about Protein Meat, introducing nutrition composition, taste, environmental protection concepts, and other contents of plant-based meat in the form of pictures and texts.	We provided the participants with a product promotion post about Protein Meat through WeChat, introducing nutrition composition, taste, environmental protection concepts, and other contents of plant-based meat in the form of pictures and texts. Participants can post comments after the post.

Study 2: Main effect and mediation effect

Design and method

Study 2 aimed to test whether cognitive fluency mediates the relationship between social media marketing intensity and purchase intention. We conducted a lab study to test these hypotheses. We invited students to experiment in a comprehensive university located in northern China, and finally recruited a separate sample consisting of 200 students and MBA (97 females, $M_{age} = 25.40$, ranging from 19 to 29 years old) in exchange for course credit.

Next, we chose Plant Diary as the stimulus and carried out this experiment in the lab. To test whether increased social media marketing intensity can improve consumers' cognitive fluency and purchase intention toward plant-based meat, we designed the following experiment scenario: "Plant-based meat has become a popular choice in recent years. Using soy protein concentrate (SPC) as raw material, plant-based meat has become a substitute for traditional animal meat. Now there is a new brand of plant-based meat on the market." Then, we provided the participants with a product post about Plant Diary through WeChat, introducing nutrition composition, taste, environmental protection concepts, and other contents in the form of pictures and texts. Participants were asked to post comments and read others' posts on their phones. Especially, experimental stimulus, situation, process, and rewards for participants in study 2 were the same as in study 1.

Finally, participants were asked to fill in the questionnaire for marketing intensity ("you feel this company has a lot of marketing intensity"; 1 = strongly disagree, 7 = strongly agree), cognitive fluency through a four-item scale used by Dragojevic et al. (2017) (e.g., "I can easily read the information of the advertisement"; 1 = strongly disagree, 7 = strongly agree; $\alpha = 0.97$), and purchase intention (Cronbach's $\alpha = 0.91$). Meanwhile, our study used product knowledge and brand preference as control variables to exclude their interference. Demographic information was also required. However, we did not include them in our analysis because of fewer differences among all samples. After excluding invalid questionnaires, there were 188 valid questionnaires (93 females, $M_{age} = 25.17$, SD = 3.02). Table 2 shows the demographic information of the samples.

Results and discussion

First, ANOVA on purchase intention revealed a significant main effect of social media marketing intensity [$F(1,187) = 376.25$, $p < 0.001$]. Second, cognitive fluency positively affected consumers' purchase intention [$F(1,187) = 981.97$, $p < 0.001$].

Mediation effect

We applied mediation analysis to test the expected underlying roles of cognitive fluency (Hayes, 2013; Model 4: 5000 bootstrapped samples). The results showed that the confidence interval of indirect effects (95% CI: 0.23–0.56, $p < 0.01$) did not include 0, which means the mediating effect of cognitive fluency was significant, and the effect score was 0.39. After controlling the mediating variables, marketing intensity also directly affected purchase intention ($\beta = 0.40$, Se = 0.14; 95% CI: 0.13–0.67, $p < 0.01$). The result is shown in Table 3. The indirect effect proved that cognitive fluency partly mediated the relationship between the intensity of social media marketing and young people's purchase intention, supporting H1 and H2.

TABLE 2 Demographic composition of the participants (Study 2).

Variables	Items	Number	Percentage
Sex	Male	95	51%
	Female	93	49%
Age	15–19 years old	5	3%
	20–24 years old	83	44%
	25–29 years old	100	53%
Education level	Undergraduate	66	35%
	Graduate student or more	122	65%

Study 3: Mediation effect of customer inspiration and perceived risk

Design and method

Study 3 aimed to test whether customer inspiration and perceived risk play a mediating role (H3 and H4). We adopted a one-factor, three-level (marketing intensity: once a week vs. three times a week vs. seven times a week), between-subjects design. These three levels of marketing intensity represented the low, medium, and high frequency, respectively. We also invited a blogger on WeChat to assist us in conducting this online experiment. This blogger had a community of more than 2000 members, mainly composed of university students, bank employees, college teachers, and company employees. Then, we sent research invitations to the members, and finally, 300 members were recruited to participate in study 3 (N = 300, 176 female, $M_{age} = 26.90$, ranging from 18 to 34 years). At this point, participants were randomly assigned to three WeChat groups, with an average of 100 each.

Study 3 selected Plant Diary from study 1 as a stimulus, and the intensity of social media marketing was manipulated. The blogger sent product information to three WeChat groups weekly, three times a week, and seven times a week, respectively. In particular, the conditions were the same except for the frequency at which sent the manipulated material ads. We initially measured the "brand familiarity" of the three groups and found that there was no significant difference ($M_{once} = 1.30$, $M_{three\text{-}times} = 1.45$, $M_{seven\text{-}times} = 1.62$, $p > 0.05$).

After a week, we asked participants to fill out a 7-point Likert scale for marketing intensity ("you feel this company has a lot of marketing intensity"; 1 = strongly disagree, 7 = strongly agree), cognitive fluency (Cronbach's $\alpha = 0.89$), and purchase intention (Cronbach's $\alpha = 0.93$). As for the measurement of customer inspiration, since "purchase intention" contains the content of "inspired-to," we finally selected a five-item scale to focus on

TABLE 3 Mediation effect of cognitive fluency (Study 2).

	Effect	SE	*t*	*p*	LLCI	ULCI
Direct effect	0.40	0.14	1.37	0.00	0.13	0.67
Indirect effect	0.39	0.12	-	-	0.23	0.56

measuring the "inspired-by" of participants (e.g., "This product captured my imagination" and "This product has broadened my horizons"; Cronbach's α = 0.91) (Thrash and Elliot, 2004; Böttger et al., 2017; Jian et al., 2021). We measured perceived risk through a five-item scale used by Stone and Grønhaug (1993) (e.g., "It may take me a lot of time to learn how to use this product" and "I do not think it makes economic sense to buy this product"; Cronbach's α = 0.94; 1 = strongly disagree, 7 = strongly agree). The specific content of the scale is shown in Table 4. Meanwhile, study 2 required all participants to provide demographic information. Table 5 shows the demographic data of the samples. Participants received a small payment after completing the questionnaire. Finally, there were 288 valid questionnaires (173 females, $M_{age} = 27.25$, SD = 3.88).

TABLE 4 Contents of the scale.

Variable name	Item content
Cognitive fluency (Dragojevic et al., 2017)	I can easily read the information of the advertisement
	I can master the product knowledge conveyed in the advertisement
	I can easily understand the product information in the advertisement
	I can clearly grasp new product features
Customer inspiration (Thrash and Elliot, 2004; Böttger et al., 2017; Jian et al., 2021)	This product captured my imagination
	This product gave me a sudden new idea
	This product has broadened my horizons
	It made me discover something new
	The inspiration for this product is exciting
Perceived risk (Stone and Grønhaug, 1993)	It may take me a lot of time to learn how to use this product
	I do not think it makes economic sense to buy this product
	This product may cause me physical discomfort
	I'm worried that this product is not an effective solution to the problems I'm facing
	This product may cause me psychological discomfort
Purchase intention (Kim and Chung, 2013)	I am willing to buy this product
	This product is what I want to buy

TABLE 5 Demographic composition of the participants (Study 3).

Variables	Items	Number	Percentage
Sex	Male	115	40%
	Female	173	60%
Age	15–19 years old	14	5%
	20–24 years old	89	31%
	25–29 years old	123	43%
	30–34 years old	62	21%
Occupation	University student	87	30%
	Company employee	120	42%
	College teacher	35	12%
	others	46	16%
Education level	Undergraduate	179	62%
	Graduate student or more	109	38%

Results and discussion

Manipulation check

There was a significant difference between the three groups ($M_{once} = 1.90$, $M_{three\text{-}times} = 3.70$, $M_{seven\text{-}times} = 6.30$, $t = 22.76$, $p < 0.001$). Our manipulation of the marketing intensity was successful.

Purchase intention

Then, marketing intensity was set as three dummy variables (0 = once a week, 1 = three times a week, 2 = seven times a week) to conduct a logistic regression analysis. First, ANOVA on purchase intention showed a significant effect of marketing intensity [$F(1,287) = 80.63$, $p < 0.001$]. Second, ANOVA on cognitive fluency showed a significant effect of marketing intensity [$F(1,287) = 17.22$, $p < 0.001$]. Third, cognitive fluency positively affected customer inspiration [$F(1,287) = 317.76$, $p < 0.001$] and negatively affected perceived risk [$F(1,287) = 213.24$, $p < 0.001$]. Fourth, there was a significant effect of customer inspiration, perceived risk, and cognitive fluency as dependent variables on purchase intention [$F(3,285) = 374.83$, $p < 0.001$].

Specifically, when we marketed plant-based meat seven times a week, this group had the highest cognitive fluency ($M_{once} = 2.87$, $M_{three\text{-}times} = 4.38$, $M_{seven\text{-}times} = 5.60$, $p < 0.001$), customer inspiration ($M_{once} = 2.56$, $M_{three\text{-}times} = 4.45$, $M_{seven\text{-}times} = 5.68$, $p < 0.001$), and purchase intention ($M_{once} = 3.53$, $M_{three\text{-}times} = 4.38$, $M_{seven\text{-}times} = 5.62$, $p < 0.001$) than others. The group which marketed plant-based meat once a week had the highest perceived risk ($M_{once} = 4.89$, $M_{three\text{-}times} = 3.36$, $M_{seven\text{-}times} = 2.54$, $p < 0.001$; Figure 2).

Mediation effect

The indirect effect of social media marketing intensity on purchase intention was significant via cognitive fluency, with 95% confidence intervals excluding 0 (Model 4; β = 0.83, Se = 0.09; 95% CI: 0.66–1.01), showing further support for H2. In addition, the indirect effect of "social media marketing intensity →cognitive fluency →customer inspiration→ purchase intention" (β = 0.10, Se = 0.08; 95% CI: 0.00–0.14) and "social media marketing intensity →cognitive fluency →perceived risk→ purchase intention" were significant (β = 0.13, Se = 0.12; 95% CI: 0.04–0.27). The direct effect of social media marketing intensity on purchase intention was significant (β = 0.22, Se = 0.10; 95% CI: 0.02–0.42). That is to say, customer inspiration and perceived risk play a mediating role between social media marketing and purchase intention. In addition, a higher level of cognitive fluency is more likely to generate customer inspiration and improve purchase intention. In comparison, a lower level of cognitive fluency is more likely to stimulate perceived risk, thus reducing purchase intention. Therefore, H3 and H4 have been supported.

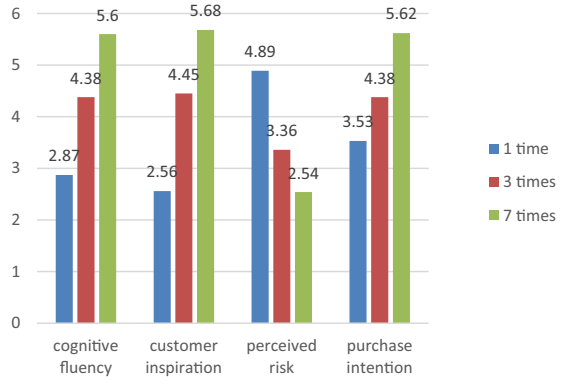


FIGURE 2
Mediation effect of customer inspiration and perceived risk.

Study 4: Brand community identity as a boundary condition

Design and method

To deepen our framework further, we designed Study 4 to include brand community identity as a boundary condition (H5 and H6), which was well recognized as an individual status feature. We chose Beyond Meat from study 1 as a stimulus and conducted this experiment online.

Study 4 adopted a 2 (brand community identity: in-group vs. out-group) × 3 (marketing intensity: once a week vs. three times a week vs. seven times a week) between-subjects design with brand community identity as an additional measured factor. First, we used the "Beyond Meat" forum on Microblog as a brand community. In-group members were fans from "Beyond Meat" forum, while recruited out-group members from the Questionnaire site. We also included the questions such as "To what extent do you think you belong to this brand" (1 = fully in; 7 = not at all) to test the validity of the members' identity. We sent invitations to the members, and a total of 300 participants (182 females, $M_{age} = 27.65$, ranging from 17 to 36 years) were willing to participate in the study for a small payment. There were 150 participants in the in-group and 150 participants in the out-group.

Next, we manipulated social media marketing intensity according to Study 3. We set up three WeChat groups, and the in-group and out-group participants were randomly assigned to three WeChat groups, with 100 participants each. We sent Beyond Meat's product information to three groups weekly, three times a week, and seven times a week, respectively. In particular, the conditions were the same except for the frequency at which sent the manipulated material ads.

After a week, participants were asked to fill in the questionnaire for "marketing intensity," "cognitive fluency" ($\alpha = 0.95$), "customer inspiration" ($\alpha = 0.92$), "perceived risk" ($\alpha = 0.92$), and "purchase intention" ($\alpha = 0.91$) similar to prior studies. The questionnaire also included the question "To what extent do you consider yourself a member of this brand community" to confirm members' identity. Meanwhile, study 4 required participants to provide demographic information. There were 292 valid questionnaires in study 4 (178 females, $M_{age} = 27.55$, $SD = 3.31$).

Results and discussion

Manipulation check

T-test results showed significant differences between in-group and out-group ($M_{in\text{-}group} = 6.00$, $M_{out\text{-}group} = 1.51$, $t = 49.79$, $p < 0.001$), indicating successful variable manipulation. In-group members considered themselves as members of the "Beyond Meat" forum, while out-group members considered themselves not fans of the "Beyond Meat" forum. The manipulation of marketing intensity was successful ($M_{once} = 1.82$, $M_{three\text{-}times} = 3.45$, $M_{seven\text{-}times} = 6.70$, $p < 0.001$).

Purchase intention

First, ANOVA on purchase intention revealed a significant main effect of cognitive fluency [$F(1,298) = 15.61$, $p < 0.001$]. Second, the interaction between cognitive fluency and in-group positively affected customer inspiration [$F(1,298) = 12.68$, $p < 0.001$]. Meanwhile, the interaction between cognitive fluency and in-group significantly influenced purchase intention [$F(1,298) = 6.67$, $p < 0.001$]. Third, the interaction effect between cognitive fluency and out-group on perceived risk was significant [$F(1,298) = 7.34$, $p < 0.01$]. In addition, the interaction between cognitive fluency and out-group significantly influenced purchase intention [$F(1,298) = 14.26$, $p < 0.001$].

Specifically, in-group members had higher cognitive fluency ($M_{in\text{-}group} = 5.44$, $M_{out\text{-}group} = 3.76$, $t = 13.85$, $p < 0.001$) and purchase intention ($M_{in\text{-}group} = 5.98$, $M_{out\text{-}group} = 5.16$, $t = 7.93$, $p < 0.001$) than out-group members. In addition, in-group members had higher customer inspiration ($M_{in\text{-}group} = 5.41$, $M_{out\text{-}group} = 4.43$, $t = 6.85$, $p < 0.001$), while out-group members had higher perceived risk ($M_{out\text{-}group} = 3.01$, $M_{in\text{-}group} = 1.84$, $t = 8.92$, $p < 0.001$; Figure 3).

Mediation effect

We used Model 7 (Hayes, 2013) to examine the moderated mediation effect in study 4. The results showed that the interaction effect of cognitive fluency and in-group on purchase intention was significant ($\beta = 0.20$, $p < 0.05$, 95% CI: 0.06–0.86), and the interaction effect of cognitive fluency and out-group on purchase intention was also significant ($\beta = -0.68$, $p < 0.05$, 95% CI: −1.16 to −0.12). The above results verified the existence of the moderated mediation effect in this study. In-group members are more likely to generate higher cognitive fluency and customer inspiration, further enhancing purchase intention. Out-group members are more likely to generate lower cognitive fluency and perceived risk, reducing purchase intention. Thus, H5 and H6 were supported.

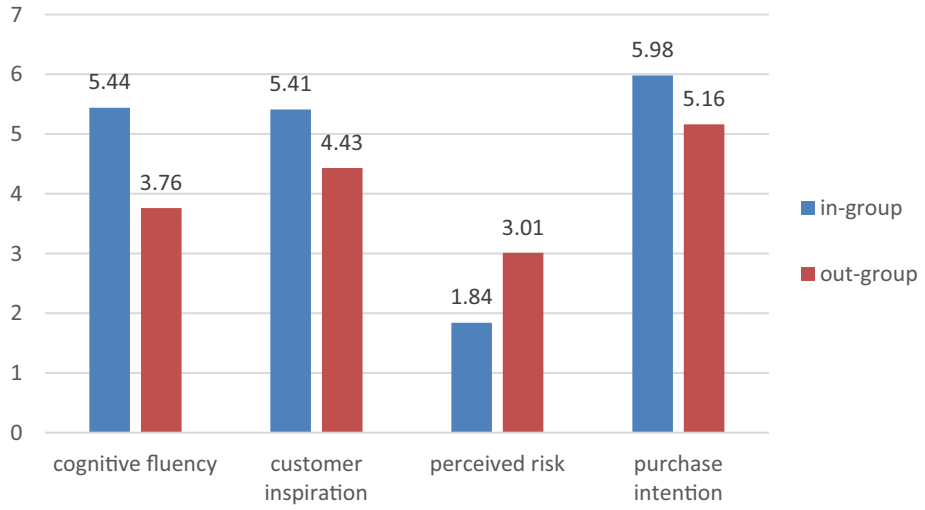


FIGURE 3
Moderating effect of brand community identity.

General conclusion and discussion

Research conclusion

This research examines how and why social media marketing of plant-based meat can affect young people's purchase intention. The results indicate that social media marketing generally obtains higher purchase intention, increasing marketing intensity in the plant-based meat promotion phase. Cognitive fluency is the important mediating variable linking social media marketing with consumers' purchase intention. This is because plant-based meat as a new product is unfamiliar to most Chinese, and the more frequent interaction on social media leads to increased cognitive fluency, attracting young people's intention.

We also verified that two motivations drove young people's purchase intentions: customer inspiration and perceived risk. After obtaining plant-based meat information, young people's purchase intention depends on which customer inspiration or perceived risk is dominant. When cognitive fluency is high, individuals are more likely to generate customer inspiration and improve their purchase intention. Conversely, a lower level of cognitive fluency is more likely to stimulate perceived risk and reduce young people's purchase intention.

Furthermore, brand community identity plays a moderating role in consumers' perception and purchase processing. Members' status will affect whether they perceive plant-based meat marketing as more imaginative or risky. In-group members have stronger cognitive fluency in plant-based meat than those out-group members. In addition, in-group members are more likely to generate customer inspiration and enhance purchase intention, while out-group members tend to stimulate perceived risk and reduce purchase intention.

Theoretical contributions

Our study makes theoretical contributions to the existing research in several ways. First, this paper contributes to the literature on cognitive fluency, explaining why social media marketing of plant-based meat can increase young people's purchase intention more than traditional marketing. Based on dual-system theory, we clarify the cognitive evaluation mechanisms between plant-based meat marketing and purchase intention such that individuals' cognitive fluency will influence their behavioral decisions. Although previous studies have demonstrated the factors influencing the marketing of plant-based meat, the micro research on young people's cognition in the context of social media has been neglected (Loo et al., 2020; Zhao et al., 2022). Our finding directly responds to the call that "the basic process of plant-based meat evaluation and special marketing context has still been ignored" (Qutteinq et al., 2019; Bryant and Sanctorum, 2021) by explaining how young people make decisions to adopt plant-based meat.

Second, by proving that the subsequent influence of cognitive fluency on purchase intention depends on customer inspiration or perceived risk, which is the dominant factor, we clarify the psychological mechanism of young people processing plant-based meat. Previous studies on plant-based meat have concluded that consumers keep a single positive or negative attitude (McCarthy et al., 2015; Bryant et al., 2018). However, this paper proves that consumers have two opposite cognitions of plant-based meat simultaneously, providing a new theoretical basis for studying plant-based meat purchases. In addition, this paper integrates the concepts of customer inspiration and perceived risk into the research framework of the cognitive evaluation process in the context of social media marketing for the first time, further enriching the dual-system processing theory.

Moreover, our study focuses on the role of consumers' states in the perception and decision-making process, revealing the moderating role of brand community identity. Prior research has found that brand identity leads to more fabulous inspiration (Algesheimer et al., 2005) and a more positive mood (Chadborn and Reysen, 2018). We contribute to this line of research by showing that in-group members with brand community identity have higher customer inspiration and purchase intention. In contrast, out-group members can enhance perceived risk and reduce purchase intention in the social media marketing. This response to the statement that "there should be a greater understanding of the reasons that hinder consumer acceptance of plant-based meat" (He et al., 2020). More importantly, the different perceptions and decisions of in-group members and out-group members are also consistent with dual-system theory, thus contributing to dual-system theory.

Practical implications

There are also some implications for entrepreneurship practice. First, consumers generally avoid sloppy information and prefer smooth product introduction (Hu et al., 2017; Graf et al., 2018). Thus, managers can look for ways to reduce young people's perception of effort and improve their fluency experience when designing plant-based meat advertisements, using our findings in which social media marketing improves young people's preferences more than traditional marketing. For example, with the help of artificial intelligence and system algorithms, social media marketing can choose different forms of information presentation, such as pictures and videos, according to young people's cognitive habits. In addition, managers can increase user interaction as much as possible to meet young people's social behaviors through plant-based meat's healthy and environmental protection products.

Second, young people have different perceptions of inspiration or risk for plant-based meat. On the one hand, customer inspiration can significantly improve purchase intention for plant-based meat. Therefore, enterprises adopt the traditional marketing model that mainly satisfies the individuals' basic requirements and introduce the marketing model that is inspired by young people's potential needs. Enterprises can design the packaging and formulation of plant-based products to be more open. In addition to the traditional evaluation of plant-based meat, such as appearance, practicality, and willingness to pay, can add the index of consumers' inspiration. On the other hand, managers also need to pay attention to negative effects and reduce risk perception by increasing information fluency. Companies thus can provide targeted information to different innovative individuals.

Third, to provide substantial value for managers and offer them actionable implications, we also tested the impact of community membership status. Community members are mostly existing, or potential brand users, and they are the preferred channels for enterprises to request participation and feedback on plant-based meat ideas. Considering that the community can significantly reduce customers' risk perception, improving the positive impact of cognitive fluency on customers' inspiration. When launching new plant-based products, enterprises can preferentially select in-group customers to try them out, capturing insights and opinions through user-generated content analysis. Meanwhile, managers can also carry out brand community publicity, attracting out-group members to join through vouchers and discounts.

Limitations and future research

Some limitations of this study suggest avenues for further research. First, plant-based meat as a new product is updated quickly, and the experimental materials cannot cover all categories of plant-based products. Social media marketing of different types of plant-based products may have other effects. For example, the fluency experience of hedonic products can increase product purchase, while it does not influence practical products (Shen et al., 2016). In other words, consumers have different perceptions of plant-based meat's functions, leading to opposite purchase intentions. Therefore, it is necessary to consider whether plant-based meat is marketed for environmental or practical purposes. We welcome further research to address this exciting research question with different product types.

The research samples and method in this paper may have some limitations. As this paper mainly adopts lab study, the sample size is relatively small. It would be difficult to predict all young Chinese' attitude toward plant-based meat. Follow-up studies are expected to use larger sample sizes. In addition, in manipulating the traditional marketing of plant-based meat and social media marketing, this paper has made efforts to control the consumers' characteristics that may affect their purchase intention. However, "participants can post comments after the post" in the social media marketing condition will lead to participants' engagement and further change their purchase intention. These interfering factors may affect the validity of the conclusion. Therefore, improving research methods and enhancing research validity are essential for future efforts.

Although we have built a basic model about the social media marketing of plant-based meat on purchase intention and explored the path of mediation, we encourage researchers to study the mediation mechanism through more scientific methods. This paper finds that customer inspiration and perceived risk are parallel intermediary processes, which can produce opposite results on purchase intention. But the extent of their effects is still unclear. For instance, it is possible that purchase intention actually causes increases in inspiration through a dissonance mechanism. For the research model with multiple mediator variables, it is hoped that future scholars can conduct strong inferences about the order of the effects.

Lastly, our research about social media marketing of plant-based meat on purchase intention is based on a general situation.

Individuals need to use visual, tactile, auditory, and other senses to obtain product information when evaluating products (Troye and Supphellen, 2013). Different advertising designs have other sensory stimuli for consumers. It is hoped that more dimensions of social media marketing and advertising designs (text, pictures, animation, exhibition, et al.) can be tapped as independent variables for further exploration. In addition, does over-marketing of plant-based meat have the opposite effect on younger? How do shopping tasks with different degrees of difficulty affect young people? Under what circumstances can young people produce a negative shopping mood? These questions offer directions for further research among both academics and practitioners.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the patients/participants or patients/participants legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Funding

This research was supported by the National Social Science Foundation of China (21BGL131).

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

Algesheimer, R., Dohlakia, U. M., and Herrmann, A. (2005). The social influence of brand community: evidence from European car clubs. *J. Manag.* 69, 19–34. doi: 10.1509/jmkg.69.3.19.66363

Aliosha, A., Bryan, L., and Emin, B. (2013). The effects of social and self-motives on the intentions to share positive and negative word of mouth. *J. Acad. Mark. Sci.* 41, 531–546. doi: 10.1007/s11747-012-0323-4

Alter, A. L., Oppenheimer, D. M., and Epley, N. (2013). Disfluency prompts analytic thinking—but not always greater accuracy: response to. *Cognition* 128, 252–255. doi: 10.1016/j.cognition.2013.01.006

Alter, A. L., Oppenheimer, D. M., Epley, N., and Eyre, R. N. (2007). Overcoming intuition: metacognitive difficulty activates analytic reasoning. *J. Exp. Psychol. Gen.* 136, 569–576. doi: 10.1037/0096-3445.136.4.569

Appel, G., Grewal, L., Hadi, R., and Stephen, A. T. (2019). The future of social media in marketing. *J. Acad. Mark. Sci.* 48, 79–95. doi: 10.1007/s11747-019-00695-1

Aydinli, A., Bertini, M., and Lambrecht, A. (2014). Price promotion for emotional impact. *J. Mark.* 78, 80–96. doi: 10.1509/jm.12.0338

Baetzgen, A., and Tropp, J. (2013). "Owned media": developing a theory from the buzzword. *Stud. Media. Comm.* 1, 1–10. doi: 10.11114/smc.v1i2.172

Böttger, T., Rudolph, T., Evanschitzky, H., and Pfrang, T. (2017). Customer inspiration: conceptualization, scale development, and validation. *J. Mark.* 81, 116–131. doi: 10.1509/jm.15.0007

Bryant, C., and Julie, B. (2018). Consumer acceptance of cultured meat: a systematic review. *Meat Sci.* 143, 8–17. doi: 10.1016/j.meatsci.2018.04.008

Bryant, C., and Sanctorum, H. (2021). Alternative proteins, evolving attitudes: comparing consumer attitudes to plant-based and cultured meat in Belgium in two consecutive years. *Appetite* 161:105161. doi: 10.1016/j.appet.2021.105161

Bryant, C. J., Szejda, K., Deshpande, V., Parekh, N., and Tse, B. (2018). A survey of consumer perceptions of plant-based and clean meat in the USA, India, and China. *Front. Sustain. Food Syst.* 3:11. doi: 10.3389/fsufs.2019.00011

Carr, E. W., Rotteveel, M., and Winkielman, P. (2016). Easy moves: perceptual fluency facilitates approach-related action. *Emotion* 16, 540–552. doi: 10.1037/emo0000146

Chadborn, D., and Reysen, S. (2018). Moved by the masses: a social identity perspective on inspiration. *Curr. Psychol.* 37, 625–631. doi: 10.1007/s12144-016-9545-9

Chen, H. H., and Zheng, Y. H. (2015). Creativity: a review of influencing situational factors and directions of future research in consumer behavior domain. *J. Mar. Sci.* 11, 51–68.

Couldry, N., and Markham, T. (2007). Celebrity culture and public connection: bridge or chasm? *Int. J. Cult. Stud.* 10, 403–421. doi: 10.1177/1367877907083077

Crick, N. R., and Dodge, K. A. (1994). A review and reformulation of social-information-processing mechanisms in children social adjustment. *Psychol. Bull.* 115, 74–101. doi: 10.1037/0033-2909.115.1.74

Davis, K. (2012). Friendship 2.0: adolescents' experiences of belong and self-disclosure online. *J. Adolesc.* 35, 1527–1536. doi: 10.1016/j.adolescence.2012.02.013

Dholakia, U. M. (2001). A motivational process model of product involvement and consumer risk perception. *Eur. J. Mark.* 35, 1340–1362. doi: 10.1108/EUM0000000006479

Dragojevic, M., Giles, H., Beck, A. C., and Tatum, N. T. (2017). The fluency principle: why foreign accent strength negatively biases language attitudes. *Commun. Monogr.* 84, 385–405. doi: 10.1080/03637751.2017.1322213

Felix, R., Rauschnabel, P. A., and Hinsch, C. (2016). Elements of strategic social media marketing: a holistic framework. *J. Bus. Res.* 70, 118–126. doi: 10.1016/j.jbusres.2016.05.001

Fu, F. Q., and Elliott, M. T. (2013). The moderating effect of perceived product innovativeness and product knowledge on new product adoption: an integrated model. *J. Mark. Theory Pract.* 21, 257–272. doi: 10.2753/MTP1069-6679210302

Garretson, J. A., and Clow, K. E. (1999). The influence of coupon face value on service quality expectations, risk perceptions and purchase intentions in the dental industry. *J. Serv. Mark.* 13, 59–72. doi: 10.1108/08876049910256122

Graf, L. K., Mayer, S., and Landwehr, J. R. (2018). Measuring processing fluency: one versus five items. *J. Consum. Psychol.* 28, 393–411. doi: 10.1002/jcpy.1021

Grebenyuk, A., and Ravin, N. (2017). The long-term development of Russian biotech sector. *Foresight* 19, 491–500. doi: 10.1108/FS-06-2016-0024

Hanna, R., Rohm, A., and Crittenden, V. L. (2011). We're all connected: the power of the social media ecosystem. *Bus. Horiz.* 54, 265–273. doi: 10.1016/j.bushor.2011.01.007

Hayes, A. F. (2013). in *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*. ed. J. H. Bolin, Journal of Educational Measurement. *3rd* ed (New York, NY: The Guilford Press)

He, J., Evans, N. M., Liu, H., and Shao, S. (2020). A review of research on plant-based meat alternatives: driving forces, history, manufacturing, and consumer attitudes. *Compr. Rev. Food Sci. Food Saf.* 19, 2639–2656. doi: 10.1111/1541-4337.12610

Hirunyawipada, T., and Paswan, A. K. (2006). Consumer innovativeness and perceived risk: implications for high technology product adoption. *J. Consum. Mark.* 23, 182–198. doi: 10.1108/07363760610674310

Ho, H. C., Lado, N., and Rivera-Torres, P. (2017). Detangling consumer attitudes to better explain co-branding success. *J. Prod. Brand. Manag.* 26, 704–721. doi: 10.1108/JPBM-11-2015-1039

Holmberg, N. (2016). Adolescents' presentation of food in social media: an explorative study. *Appetite* 99, 121–129. doi: 10.1016/j.appet.2016.01.009

Hu, J. H., Hu, H. F., and Fang, X. (2017). Examining the mediating roles of cognitive load and performance outcomes in user satisfaction with a website: a field quasi-experiment. *MIS Q.* 41, 975–987. doi: 10.25300/MISQ/2017/41.3.14

Hwang, J., You, J., Moon, J., and Jeong, J. (2020). Factors affecting consumers' alternative meats buying intentions: Plant-based meat alternative and cultured meat. *Sustainability* 12:5662. doi: 10.3390/su12145662

Jian, Y., Zhu, L., and Zhou, Z. (2021). The mechanism of brand alliance attitude toward cross-over co-development: based on the perspective of consumer inspiration theory. *Nankai Bus. Rev.* 24, 25–36.

Jiang, Y. W., Gorn, G. J., Galli, M., and Amitava, C. (2016). Does your company have the right logo? How and why circular- and angular-logo shapes influence brand attribute judgments. *J. Consum. Res.* 42, 709–726. doi: 10.1093/jcr/ucv049

Kardes, F. R., Posavac, S. S., and Cronley, M. L. (2004). Consumer inference: a review of processes, bases, and judgment contexts. *J. Consum. Psychol.* 14, 230–256. doi: 10.1207/s15327663jcp1403_6

Kim, H. Y., and Chung, J. (2013). Consumer purchase intention for organic personal care products. *J. Consum. Mark.* 28, 40–47. doi: 10.1108/07363761111101930

Kleine, R. E., Kleine, S. S., and Kernan, J. B. (1993). Mundane consumption and the self: a social-identity perspective. *J. Consum. Psychol.* 2, 209–235. doi: 10.1016/S1057-7408(08)80015-0

Krishen, A. S., Berezan, O., Agarwal, S., and Kachroo, P. (2016). The generation of virtual needs: recipes for satisfaction in social media networking. *J. Bus. Res.* 69, 5248–5254. doi: 10.1016/j.jbusres.2016.04.120

Kwan, C. M., Dai, X. C., and Wyer, R. J. (2017). Contextual influences on message persuasion: the effect of empty space. *J. Consum. Res.* 44, 448–464. doi: 10.1093/jcr/ucx051

Labroo, A. A., and Pocheptsova, A. (2016). Metacognition and consumer judgment: fluency is pleasant but disfluency ignites interest. *Curr. Opin. Psychol.* 10, 154–159. doi: 10.1016/j.copsyc.2016.01.008

Lee, A. Y., and Labroo, A. A. (2004). The effect of conceptual and perceptual fluency on brand evaluation. *J. Mark. Res.* 41, 151–165. doi: 10.1509/jmkr.41.2.151.28665

Lemerise, E. A., and Dodge, K. A. (2000). "The development of anger and hostile interactions" in *Handbook of Emotions*. eds. M. Lewis and J. M. Haviland (NewYork, NY: Guilford), 594–606.

Liang, J., Chen, Z., and Lei, J. (2016). Inspire me to donate: the use of strength emotion in donation appeals. *J. Consum. Psychol.* 26, 283–288. doi: 10.1016/j.jcps.2015.09.001

Liu, X., Shin, H., and Burns, A. C. (2021). Examining the impact of luxury brand's social media marketing on customer engagement: using big data analytics and natural language processing. *J. Bus. Res.* 125, 815–826. doi: 10.1016/j.jbusres.2019.04.042

Loo, E., Caputo, V., and Lusk, J. L. (2020). Consumer preferences for farm-raised meat, lab-grown meat, and plant-based meat alternatives: does information or brand matter. *Food Policy* 95:101931. doi: 10.1016/j.foodpol.2020.101931

McCarthy, B. L., Liu, H. B., and Chen, T. (2015). Trends in organic and green food consumption in China: opportunities and challenges for regional Australian exporters. *J. Econ. Soc. Policy* 17:6. doi: 10.13140/RG.2.2.25964.59529

Mitchell, V. W. (1999). Consumer perceived risk: Conceptualisations and models. *Eur. J. Mark.* 33, 163–195. doi: 10.1108/03090569910249229

Moreira, M. N. B., da Veiga, C. R. P., Su, Z., Reis, G. G., Pascuci, L. M., and da Veiga, C. P. (2021). Social media analysis to understand the expected benefits by plant-based meat alternatives consumers. *Foods* 10:3144. doi: 10.3390/foods10123144

Murphy, G., Corcoran, C., Tatlow, G. M., Boyland, E., and Rooney, B. (2020). See, like, share, remember: adolescents' responses to unhealthy-, healthy- and non-food advertising in social media. *Int. J. Environ. Res. Public Health* 17:2181. doi: 10.3390/ijerph17072181

Nunes, J. C., Ordanini, A., and Valsesia, F. (2015). The power of repetition: repetitive lyrics in a song increase processing fluency and drive market success. *J. Consum. Psychol.* 25, 187–199. doi: 10.1016/j.jcps.2014.12.004

Parker, J. R., Lehmann, D. R., and Xie, Y. (2016). Decision comfort. *J. Consum. Res.* 43, 113–133. doi: 10.1093/jcr/ucw010

Qutteinq, Y., Hallez, L., Mennes, N., Backer, C., and Smits, T. (2019). What do adolescents see on social media? A diary study of food marketing images on social media. *Front. Psychol.* 10:2637. doi: 10.3389/fpsyg.2019.02637

Radford, S. K., and Bloch, P. H. (2011). Linking innovation to design: consumer responses to visual product newness. *J. Prod. Innov. Manag.* 28, 208–220. doi: 10.1111/j.1540-5885.2011.00871.x

Rojas-Méndez, J. I., Ahmed, S. A., Claro-Riethmüller, R., and Spiller, A. (2012). Acceptance of genetically modified foods with health benefits: a study in Germany. *J. Food Prod. Mark.* 18, 200–221. doi: 10.1080/10454446.2012.666453

Seo, J. Y., and Scammon, D. L. (2017). Do green packages lead to misperceptions? The influence of package colors on consumers' perceptions of brands with environmental claims. *Mark. Lett.* 28, 357–369. doi: 10.1007/s11002-017-9420-y

Shan, L., Jiao, X., Wu, L., Shao, Y., and Xu, L. (2022). Influence of framing effect on consumers' purchase intention of artificial meat—based on empirical analysis of consumers in seven cities. *Front. Psychol.* 13. doi: 10.3389/fpsyg.2022.911462 [Epub ahead of print]

Shen, H., and Rao, A. (2016). Looks good to me: how eye movements influence product evaluation. *J. Consum. Psychol.* 26, 435–440. doi: 10.1016/j.jcps.2015.11.003

Shen, H., Zhang, M., and Krishna, A. (2016). Computer interfaces and the "direct-touch" effect: can iPads increase the choice of hedonic food. *J. Mark. Res.* 53, 745–758. doi: 10.1509/jmr.14.0563

Stone, R. N., and Grønhaug, K. (1993). Perceived risk: further considerations for the marketing discipline. *Eur. J. Mark.* 27, 39–50. doi: 10.1108/03090569310026637

Thompson, D. V., and Ince, E. C. (2013). When disfluency signals competence: the effect of processing difficulty on perceptions of service agents. *J. Mark. Res.* 50, 228–240. doi: 10.1509/jmr.11.0340

Thompson, S., Kim, M., and Smith, K. (2016). Community participation and consumer-to-consumer helping: does participation in third party-hosted communities reduce one's likelihood of helping. *J. Mark. Res.* 53, 280–295. doi: 10.1509/jmr.13.0301

Thrash, T. M., and Elliot, A. J. (2004). Inspiration: core characteristics, component processes, antecedents, and function. *J. Pers. Soc. Psychol.* 87, 957–973. doi: 10.1037/0022-3514.87.6.957

Troye, S. V., and Supphellen, M. (2013). Consumer participation in coproduction: "I made it myself" effects on consumers' sensory perceptions and evaluations of outcome and input product. *J. Mark.* 521, 33–46. doi: 10.1509/jm.10.0205

Ueland, G. H., Holm, F., Kalogeras, N., and Verhagen, H. (2012). State of the art in benefit-risk analysis: consumer perception. *Food Chem. Toxicol.* 50, 67–76. doi: 10.1016/j.fct.2011.06.006

Vermeulen, S. J., Campbell, B. M., and Ingram, J. S. (2012). Climate change and food systems. *Annu. Rev. Environ. Resour.* 37, 195–222. doi: 10.1146/annurev-environ-020411-130608

Wang, Q. Z., Yao, Q., and Ye, Y. (2014). The influence of price discount and sales volume on impulse purchase intention of online group-buying. *J. Ind. Eng. Manag.* 28, 37–47.

Yau, J. C., and Reich, S. M. (2018). "It's just a lot of work": adolescents' self-presentation norms and practices on Facebook and Instagram. *J. Res. Adolesc.* 29, 196–209. doi: 10.1111/jora.12376

Yu, X., Gao, Z., and Zeng, Y. (2014). Willingness to pay for the "green food" in China. *Food Policy* 45, 80–87. doi: 10.1016/j.foodpol.2014.01.003

Yu, W., Li, D., and Zhang, Y. (2017). Study on the spread of Microblog topics of new product promotion based on the derivative effect. *Soft. Sci.* 31:123, 114–117. doi: 10.13956/j.ss.1001-8409.2017.01.25

Zhao, S., Wang, L., Hu, W., and Zheng, Y. (2022). Meet the meatless: demand for new generation plant-based meat alternatives. *Appl. Econ. Perspect. P.* doi: 10.1002/aepp.13232

frontiers | Frontiers in Nutrition

TYPE Original Research
PUBLISHED 10 November 2022
DOI 10.3389/fnut.2022.1016858

OPEN ACCESS

EDITED BY
Christopher John Bryant,
University of Bath, United Kingdom

REVIEWED BY
Danny Cliceri,
University of Trento, Italy
Dora Marinova,
Curtin University, Australia

*CORRESPONDENCE
Muriel C. D. Verain
muriel.verain@wur.nl

SPECIALTY SECTION
This article was submitted to Nutrition and Sustainable Diets, a section of the journal Frontiers in Nutrition

RECEIVED 11 August 2022
ACCEPTED 26 October 2022
PUBLISHED 10 November 2022

CITATION
Verain MCD and Dagevos H (2022) Comparing meat abstainers with avid meat eaters and committed meat reducers.
Front. Nutr. 9:1016858.
doi: 10.3389/fnut.2022.1016858

Comparing meat abstainers with avid meat eaters and committed meat reducers

Muriel C. D. Verain* and Hans Dagevos

Wageningen Economic Research, Wageningen University & Research, Wageningen, Netherlands

Shifting our eating patterns toward less animal-based and more plant-based diets is urgently needed to counter climate change, address public health issues, and protect animal welfare. Although most consumers agree that these are important topics, many consumers are not particularly willing to decrease the meat intensity of their diets. In supporting consumers to shift their diets, it is important to understand consumers' attitudes, motivations, and preferences related to meat consumption and to take differences across consumers on these aspects into account. This study aims to in-depth research meat abstainers (vegetarians and vegans), and to explore how and to what extent they differ from avid meat eaters and committed meat reducers in terms of their (1) socio-demographic characteristics, (2) attitudes and norms, (3) food choice motives, and (4) food preferences and behavior. A survey has been conducted among a representative sample of Dutch adults. Comparisons show that meat abstainers (N = 198) differ from committed meat reducers (N = 171) and avid meat eaters (N = 344) on the four included categories of variables. In terms of demographics, we largely confirm the stereotype of vegans and vegetarians being highly educated females. In attitudes and norms, large differences exist with meat abstainers being least pro-meat and avid meat eaters being most pro-meat. Food choice motives confirm this, with meat abstainers valuing animal welfare and a good feeling higher than committed meat reducers and avid meat eaters. Finally, differences across the groups are most pronounced in terms of their food preferences and consumption, with a much higher appreciation of plant-based protein sources among meat abstainers, a high appreciation of non-meat animal-based proteins across committed meat reducers and a high appreciation of meat products among avid meat eaters. This shows that although differences across the groups are gradual and expected, in terms of reduction motivations and preferences of protein sources the three groups (frequent meat consumption-meat reduction-meat avoidance) are very distinct, which makes it unlikely to expect big shifts from one group to another in the short term.

KEYWORDS

meat abstainers, vegetarians, vegans, flexitarians, consumer segments, meat consumption curtailment, meat eaters, meat reducers

Introduction

More than a quarter of a century of scholarly attention has generated mounting scientific evidence about the pressing need for a dietary shift toward less animal-based and more plant-based diets in order to alleviate climate change, address public health issues and safeguard animal welfare. This field of research has made its way into such top-tier journals as *Science* (1, 2), *Nature* (3, 4), and *The Lancet* (5, 6). Despite broad scientific consensus on the urgency of shifting away from meat-heavy diets—first and foremost in high-income countries—in many western countries today's consumption of (red and processed) meat is much higher than recommended (7), and on a global scale is meat consumption projected to rise in the upcoming decade (8, 9). Although meat-reduced (flexitarian) diets are slowly but gradually becoming more mainstream in various countries (10), and many consumers consider meat reduction as part of a healthy and sustainable diet (11), a large portion is not particularly willing to decrease their meat consumption (10, 12).

This also holds for the Netherlands, where a substantial increase in the number of self-identified flexitarians was observed in the past decade, but meat consumption remains relatively stable at a level beyond dietary recommendations (13, 14). Meat consumption patterns appear to be as notoriously difficult to change as other habitual behavior. Perhaps even more so, because of the strong symbolic meanings of meat, both socio-culturally (e.g., festivity, sense of belonging) and individually (e.g., strength, masculinity). Besides, various other reasons have been suggested to explain why people are "meathooked" (15) and attached to meat (16), ranging from liking the taste of meat and enjoyment of eating meat to limited cooking skills or culinary capital, as well as convenience, financial or family pressure factors. Simultaneously, however, also a small minority group exists today, with deep roots in Dutch food culture (17), who abstains from meat entirely. In spite of differences within and between (ovo-, lacto-, pesco-) vegetarians and vegans (18) meat abstainers have at least one main thing in common: they have meat cut out of their diet and can apparently resist the deeply-ingrained meat cravings of omnivores.

Just for this reason a focus on comparing meat abstainers, who already made the dietary transition away from meat, with different dietary groups is of interest. Investigations into characteristics of meat abstainers shed light on how distinct this dietary consumer group is from full-time meat eaters at one side of the meat-eating spectrum and committed meat reducers at the other side (see **Figure 1**). These committed meat reducers—also known as semi-vegetarians or heavy flexitarians—are closest to meat abstainers in terms of their meat consumption but have not (yet) decided to completely abandon meat from their diet. Is this just an almost inconsiderable difference, or are flexitarians and vegetarians really distinct population subgroups? And if so, what characteristics differentiate these groups? Avid meat eaters in turn make completely different dietary choices than meat abstainers and committed meat reducers. Is their sumptuous meat consumption pattern reflected in their attitudes, motives and norms, or proof passionate meat eaters less distinct from meat abstainers than they seem to be? Getting more insightful answers to the questions how omnivores differ from meat abstainers improves our understanding of what to expect with respect to changing diets into less meat-centric directions. Some of our preliminary observations indicate that dietary shifts away from meat-rich diets appear anything but self-evident: flexitarianism is not necessarily a forerunner of vegetarianism (19, 20) and meat-reducing intentions have not resulted yet in a trend in which meat consumers move from light flexitarianism (mild reduction in meat consumption) toward more heavy flexitarianism (significant reduction in meat consumption) (14).

The present study follows a recent systematic review by Holler et al. (21) on differences between omnivores and vegetarians in which it was concluded that further studies about vegetarianism are needed—also in relation to adherents of meat-reduced diets. The current work also follows one of the suggestions for future research we have made in previous studies (10, 14), namely, to explore further how and to what extent meat abstainers differ from meat lovers and flexitarians.[1] This study aims to in-depth research meat abstainers and compare them with avid meat eaters (i.e., self-declared meat eaters that consume meat every day of the week) and committed meat reducers (i.e., self-declared flexitarians that consume meat one or two times a week) on a broad range of characteristics: (1) socio-demographic features, (2) attitudes and norms, (3) motivational differences, and (4) food consumption preferences. By including a multitude of variables, we can provide a broad picture on similarities and differences across these three consumer groups.

The present study would also want to place itself in the research tradition devoted to commonalities and differences of vegetarianism in comparison to other—and more common—dietary forms of meat-attached consumers. This stream of literature originated a few decades ago (22, 23), and kept flowing thanks to studies like the ones by McEvoy et al. (24), Ruby (25), Rothgerber (26), De Backer and Hudders (27), De Backer and Hudders (28) or Allès et al. (29), and Mullee et al. (30).

1 We fully realize that there are and could be in-group differences in vegetarians and vegans as well as differences between both meat-abstaining diet groups. However, in the present work we took both groups together because the vegans in our sample constituted a small group (n = 24), and their integration into one dietary category of meat abstainers is further justified by the fact that closer scrutiny revealed that both groups did not differ much except for vegans being slightly younger than vegetarians. With respect to the group of committed meat reducers or heavy flexitarians included in this study, it is relevant to point out that there is no single agreed-upon definition of flexitarianism [see further in Dagevos (10)]. A flexitarian occasionally eats meat, where it varies how often. Therefore, flexitarians could be subdivided into light, medium or moderate, and heavy flexitarians, for example, based on the number of days meat is eaten.

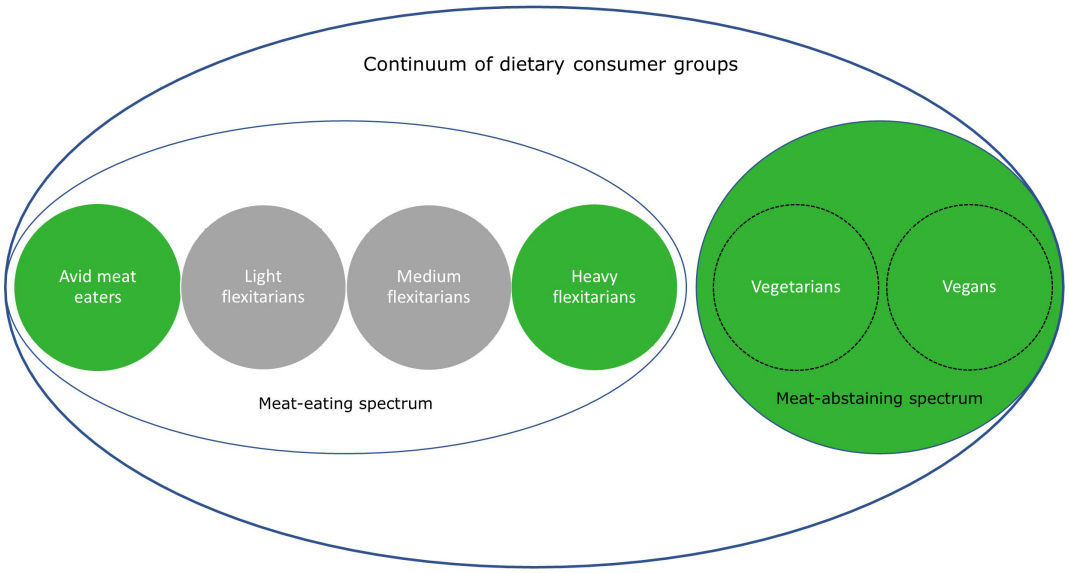


FIGURE 1
Continuum of dietary consumer group (green groups are included in the analysis).

But particularly in recent years scholarly interest in comparing vegetarians, vegans, flexitarians, and omnivores has gained traction and turned into a blossoming field of study (21, 31–38). The goal of the current study is to add to this field of research by deepening our understanding in what characteristics particularly differentiate these dietary groups.

Materials and methods

Participants and procedure

Data was collected in an online survey in autumn 2019. Questions were posed in Dutch. A professional research agency (MSI-ACI Europe B.V.) recruited participants from existing panels by email. Quota were set for gender, age, and level of education, to get a balanced cross-sectional sample of the Dutch adult population. Vegetarians and vegans were oversampled, to retain a large enough group size for the analyses. Informed consent was organized at the level of the research agency and only anonymized data was shared with the researchers.

The initial dataset included 2,383 respondents. Data was cleaned by removing 203 participants who showed no dispersion in their answers, indicating insufficient effort. For a segmentation of all remaining meat consumers in the dataset we refer to Verain et al. (14). A subset of the data was used, since for this paper we were only interested in the poles of the continuum, i.e., those who do consume very limited amounts of meat or no meat at all vs. those who consume meat daily. This focus on the ends implies that a large middle segment of consumers who consume meat 3 to 6 days a week is neglected in the present study (see Figure 1). In total, 713 respondents were included in the analysis: 198 meat abstainers who self-identified as a vegetarian or vegan, 171 committed meat reducers who self-identified as a flexitarian/meat reducer and indicated to consume meat for diner 1 or 2 days a week, and 344 avid meat eaters who self-identified as a meat eater and indicated to consume meat for dinner 7 days a week (see below for the formulation of these questions).

Measures

Socio-demographic characteristics

Screening questions were included on age ("what is your age?…"), gender ("I am a [man/woman]") and level of education ("Could you indicate your highest level of education completed?") (six answering options related to the Dutch educational system, recoded as low, middle and high, and an option "I'd rather not answer that" recoded as missing). In addition, questions were asked on household size ("How many people does your household consist of, including yourself?" and "How many of them are under 18"), household composition ("What is the composition of your household?" [Single without children (living at home)/Single with children living at home/Married/living together without children (living at home)/Married/living together with children living at home/Living with parents/Otherwise, namely…]), degree of urbanization of the residence ("What kind of place do you live in?" [In a village not adjacent to a city/In a village adjacent to a city/In a city of up to 30,000 inhabitants/In

a city between 30,000 and 100,000 inhabitants/In a city of more than 100,000 inhabitants]) and country of birth of the respondent and its parents ("What is your country of birth?" "What is your father's country of birth?" "What is your mother's country of birth?" with answering options [The Netherlands/Turkey/Morocco/Suriname/Antilles/Aruba/Indonesia/Germany/Belgium/Poland/Other country]). Finally, participants were asked to *self-identify* as a meat eater, flexitarian, vegetarian, or vegan with the following question: "I would describe myself as a…[meat eater/meat reducer/flexitarian, I alternately eat meat and alternatives to meat/vegetarian, I do not eat meat/vegan, I do not eat or use any products of animal origin]".

Attitudes and norms

Meat affection was measured with nine self-developed items based on the work by Lea and Worsley (39), Roos et al. (40), and Steptoe et al. (41). Factor analysis revealed two underlying constructs: appreciation of meatless meals and need for meat. *Appreciation of meatless meals* was measured with four items, with higher scores indicating a higher appreciation (Cronbach's alpha $\alpha = 0.820$). The included items were: "The day after a barbeque with meat, I eat less meat," "I can do without meat for a day," "I like a meal without meat," and "It is easy to prepare a tasty meal without meat." *Need for meat* was operationalized with five items ($\alpha = 0.876$). The included items were: "After a day without meat I feel extra need for meat," "Eating meat is an important part of who I am as a person," "I think meat completes a meal," "My family members or roommates like to eat meat," and "If I do not eat meat for a whole day, I feel weaker."

Ethical considerations concerning the consumption of meat were operationalized through seven items, adopted from de Boer et al. (42) and Vanhonacker and Verbeke (43) and were inspired by Lacroix and Gifford (44). Factor analysis revealed two underlying constructs. *Importance of environmental and animal welfare* was measured with three items ($\alpha = 0.860$): "If I buy meat, I want to know it has been produced in an animal-friendly way," "If I buy meat, I want to know it has been produced in an environmentally friendly way," and "Animal wellbeing is important to me." *Dislike of animals as a source for consumption* was measured with four items ($\alpha = 0.844$): "The idea that meat comes from animals gives me an unhappy feeling," "The consumption of meat is harmful to nature and the environment," "Eating less meat is better for the environment," and "I can accept that meat comes from animals."

Three items dealt with the *price* of meat and were adopted from Steptoe et al. (41) and Eertmans et al. (45). Two items formed a reliable scale to measure whether meat was perceived as cheap ($\alpha = 0.844$): "Meat is not expensive" and "Meat is too cheap." One item dealt with value for money and is included as a single item.

Perceived positive health effects of reduced meat consumption were measured with five items, based on Lea and Worsley (39). After deleting one item (If I don't eat meat, I don't get enough nutrients) the scale was reliable ($\alpha = 0.899$). The included items are: "Eating meat is unhealthy," "Meat causes heart disease," "Meat causes cancer," and "Meat makes you fat." The deleted item is included as a single item.

Three items were included that deal with *convenience* and ease of meatless meals, based on Malek et al. (46). Factor analysis revealed one construct to measure ease to prepare a meal without meat with two items ($\alpha = 0.960$): "A meal without meat is easy to prepare" and "A meal without meat is easy to cook." The other item is included as a single item and measures availability of meatless meals in shops.

Personal norms to consume less meat were operationalized with three items, based on Bamberg et al. (47) and Gärling et al. (48). One item was about the moral obligation to consume less/no meat and was asked in the same way to all respondents. This item is included as a single item. In addition, two items have been included that were adapted to the dietary group to which the respondent belongs. For meat consumers, the items measure their personal norm to consume less meat and for meat abstainers the items measure their personal norm to consume no meat. The included items were: "Because of my own values and norms, I feel morally obliged to eat [less/no] meat" and "It is important that people in general eat [less/no] meat" ($\alpha = 0.868$).

Four items were included to measure *social injunctive norms* ($\alpha = 0.935$). The items were based on Ajzen (49), Bamberg et al. (47), and Minton and Rose (50). The included items were: "People who are important to me think that I should eat less/no meat" and "I believe that my [friends/family/colleagues] want me to reduce/stop consuming meat."

Perceived *status* of meat consumption was measured with four self-developed statements ($\alpha = 0.901$), inspired by Roos et al. (40) and Twigg (51): "Eating meat is "cool,"" "By eating meat, I feel I am on top of the food chain," "Eating meat gives one status," and "By eating less meat I feel myself as being unworthy."

Meat attachment was measured with two existing scales. The 16-item *Meat Attachment Questionnaire* (MAQ), developed by Graça et al. (16) was included. The four dimensions of the original MAQ-scale were computed by averaging the four items per dimension. All dimensions were reliable measures: hedonism ($\alpha = 0.953$), affinity ($\alpha = 0.905$), entitlement ($\alpha = 0.842$), and dependence ($\alpha = 0.897$). In addition, the 16-item *4Ns scale*, developed by Piazza et al. (52) was included. The original four dimensions were computed by averaging the four items per dimension. The Cronbach's alpha value of the dimension "normal" is rather low, but the other dimensions were reliable measures: Natural ($\alpha = 0.863$), Necessary ($\alpha = 0.922$), Normal ($\alpha = 0.668$), and Nice ($\alpha = 0.949$).

All answers on the above-mentioned items were given on a seven-point Likert scale, ranging from "Totally disagree" (1) to "Totally agree" (7).

Food choice motives

Importance of 13 single-item food choice motives have been measured with the question "When purchasing food, I think the following characteristics are important…" The items were based on Onwezen et al. (53): "Healthy," "animal friendly," "safe," "natural," "convenient (preparation and purchase convenience)," "affordable," "fairly produced (Fair Trade)," "sensory appealing (good taste, smell, and appearance)," "familiar to me," "makes me feel good," "environmentally friendly," "from the region," and "good for my waistline (weight)." The question has been repeated to ask for the motives that played a role in the decision to consume less or no meat. This question was only asked to the respondents who had indicated to have lowered their meat consumption in the past year or intend to do so in the coming year.

Food preferences and consumption

Current meat consumption was measured in average number of days per week a respondent consumes meat at the main meal, i.e., a warm meal at dinner. This question has not been asked to those who self-identified as a vegetarian or vegan. In addition, all respondents were asked about the number of days a week a person consumes a so-called *3-component meals* [a typical type of Dutch meals, consisting of three separate components for proteins, starch and vegetables, such as a sausage with potatoes and broccoli, comparable to the traditional "meat and two-three veg" dishes as mentioned by Kerslake et al. (54)], with or without meat and so-called *combined meals* (mixed ingredients, such as in a pasta dish, curry, or soup) with or without meat. Subsequently, the respondent was asked to select from a list of products what type of products he or she consumes when meat is left out of the dish (fish, plant-based meat substitutes, egg, cheese, tofu or tempeh, pulses, nuts, mushrooms, seaweed, insects, no alternative, or "other"). These questions have been based on Verain et al. (20).

Finally, the hierarchy of foods was used to measure *food preferences*. Respondents were asked for to rank a long list of protein sources, both animal-based and plant-based, from least preferred to most preferred [based on Twigg (51)]. The included products are displayed in **Table 3**.

Analysis

Statistical analyses were conducted in SPSS (version 25.0). Exploratory factor analyses were conducted to form constructs of the items on attitudes and norms. Reliability was checked with Cronbach's Alpha. Univariate analyses of variance (ANOVAs), with Games–Howell *post-hoc* comparisons of mean scores to test for significant differences between meat abstainers, committed meat reducers and avid meat lovers on the continuous variables. Cross-tabulations with Pearson chi-square tests were performed to test for significant differences between the dietary groups on categorical variables. Due to the unbalanced sample sizes and the violation of homogeneity of variance, the Brown–Forsythe and Welch F tests were conducted. Games-Howell *post-hoc* tests were performed because equal variances could not be assumed. This test is suitable when sample sizes are unequal, which is the case here [(55), p. 276].

Results

Socio-demographic characteristics

Characterization of meat abstainers

Meat abstainers are in majority female (79%), and this group has a mean age of 48 years. 14% has a lower level of education, 38% a medium level of education, and 48% has a high level of education. The average household size is 2.1 persons, and these are most frequently single households without kids at home (37%) or couples without kids at home (32%). Meat abstainers can be found in large cities (25%) as well as in rural villages (24%) and everything in between. 94% of meat abstainers in our sample are born in the Netherlands.

Comparing meat abstainers with committed meat reducers and avid meat eaters

The overrepresentation of females in the group of meat abstainers (79%) is similar among committed meat reducers (74%), but is in sharp contrast with avid meat eaters who are male in majority (65%). Meat abstainers are slightly younger than committed meat reducers [$F_{(2,710)} = 3.193$, $p = 0.042$] and are more often highly educated than avid meat eaters. Household size of meat abstainers is a bit larger than for committed meat reducers, but a bit smaller than for avid meat eaters [$F_{(2,710)} = 13.621$, $p < 0.001$]. Meat abstainers more often live in single households (37%) compared to avid meat eaters (**Table 1**).

Attitudes and norms

Characterization of meat abstainers

Meat abstainers do not derive status from consuming meat, have a low need for meat and are not attached to meat, indicated by their low scores on all dimensions of the Meat Attachment Questionnaire. In addition, they do not think that meat consumption is natural, necessary, normal, or nice. They highly appreciate meatless meals, believe that these are easy to prepare and well available in supermarkets. Meat abstainers score high on ethical considerations related to meat consumption such as animal welfare and environmental impact and they dislike the idea that meat comes from animals. They feel morally obliged to abstain from eating meat and have a high personal norm to avoid eating meat. In contrast, they do not perceive a high social norm to limit meat consumption. Meat abstainers believe that meat reduction can lead to some positive health effects, but this

TABLE 1 Socio-demographic characteristics per dietary consumer group.

	Meat abstainers	Committed meat reducers	Avid meat eaters
N	**198**	**171**	**344**
Male (%)	20.7[a]	25.7[a]	64.5[b]
Mean age (range)	48.0 (19–76)[a]	52.2 (18–81)[b]	49.2 (18–84)[a,b]
Education level (%)			
Low	13.6[a]	19.3[a]	21.2[a]
Middle	38.4[a]	36.8[a]	46.5[a]
High	48.0[a]	43.9[a]	32.0[b]
Household size	2.1[a]	1.8[b]	2.4[c]
Household type (%)			
Single	37.4[a]	47.4[a]	22.1[b]
Single with kids	8.1[a]	6.4[a]	5.5[a]
Partner	31.8[a,b]	28.1[a]	39.8[b]
Partner with kids	18.2[a,b]	13.5[a]	23.3[b]
Living with parents	4.5[a]	3.5[a]	7.8[a]
Urbanization (%)			
Rural village	23.7[a,b]	17.0[a]	27.9[b]
Village adjacent to a town	14.6[a]	14.6[a]	18.9[a]
Town < 30,000 inhabitants	13.1[a]	11.7[a]	9.9[a]
Town 30,000–1000,000 inhabitants	22.7[a]	20.5[a]	18.6[a]
City < 100,000 inhabitants	24.7[a,b]	35.1[a]	23.8[b]
Origin			
Born in NL (%)	94.4[a,b]	89.5[a]	96.5[b]
Father born in NL (%)	89.9[a,b]	85.4[a]	92.2[b]
Mother born in NL (%)	91.9[a,b]	84.2[a]	91.9[b]

[a–c]Different superscripts across rows indicate significant different means.

believe is not very strong and they do not see that a diet without meat would lead to deficiencies. Finally, they do not think that meat is expensive, but regardless they disagree that meat is worth the money (Table 2).

Comparing meat abstainers with committed meat reducers and avid meat eaters

Meat abstainers significantly differ from avid meat eaters on all included variables, except for social norms (Table 2), where avid meat eaters unsurprisingly score more in favor of meat consumption and less in favor of meatless meals. Differences are particularly pronounced for need for meat, meat attachment and the believe that meat consumption is nice.

The difference between meat abstainers and committed meat reducers is much smaller, although also between these two groups almost all included variables differ significantly in the expected direction (except for status, convenience, availability, and social norms). These two groups differ the most in their affinity with meat, dislike of animals as source of meat, positive health effects of meat reduction and the believe that meat is worth its money. Overall, the groups are very distinct in their attitudes and norms, with two exceptions: meat consumption does not seem to give status in any of the groups and social norms to reduce meat consumption are perceived to be low in all groups (Table 2). Differences are most outspoken between avid meat eaters and the other two groups.

Food choice motives

Characterization of meat abstainers

Animal welfare is the most important motive for meat abstainers in selecting their food, followed by healthiness, food safety, environmental welfare, and naturalness. Regional and familiarity are least important to them, although the absolute scores indicate that all included food choice motives are important to meat abstainers (all scores above neutral) (Figure 2). Animal friendliness is also the most important motive for meat abstainers to have stopped eating meat. In addition, "makes me feel good," environmental friendliness, health, and naturalness are important motives for stopping (Figure 3).

Comparing meat abstainers with committed meat reducers and avid meat eaters

Animal welfare, the most important food choice motive for meat abstainers, is not in the top three motives of committed meat reducers and avid meat eaters. For committed meat reducers, health is most important, followed by food safety and affordability. For avid meat eaters, affordability is most important, followed by food safety and sensory appeal. Like for meat abstainers, animal welfare is the number one motive for committed meat reducers to have reduced their meat consumption, followed by environmental friendliness and healthiness. The small number of avid meat eaters that has reduced indicate healthiness as the most important reason, followed by affordability and sensory appeal.

When comparing the mean scores, a lot of differences between the groups can be found in terms of their motivations. Animal welfare is significantly more important to meat abstainers than to the other two groups (and more important to reducers than to avid meat eaters). In addition, "makes me feel good" is more important to meat abstainers than to the other groups. On the other motives, meat abstainers do not differ from committed meat reducers, but the differences with avid meat eaters are almost all significant (except for sensory appeal, affordability, and convenience), with avid meat eaters attaching a higher importance to familiarity and a lower importance to all other motives (Figure 2).

Also in their motives to reduce, the groups differ much. Compared to committed reducers, animal friendliness and

TABLE 2 Mean scores on meat-related attitudes and norms per dietary consumer group.

	Meat abstainers	Committed meat reducers	Avid meat eaters
Appreciation of meatless meal	6.49[a]	6.19[b]	3.28[c]
Need for meat consumption	1.62[a]	2.03[b]	5.05[c]
Importance of environment/animal friendliness	6.34[a]	5.53[b]	4.20[c]
Dislike of animals as source of meat	5.95[a]	4.56[b]	2.90[c]
Meat is not expensive	4.60[a]	3.70[b]	3.12[c]
Meat is worth its money	2.36[a]	3.88[b]	5.39[c]
Perceived positive health effects of less meat	4.58[a]	3.32[b]	2.31[c]
Deficiency without meat	1.74[a]	2.44[b]	4.51[c]
Convenience	6.51[a]	6.25[a]	4.34[b]
Availability	5.13[a]	5.35[a]	4.44[b]
Personal norm to consume less meat [meat consumer] or no meat [meat abstainers]	5.49[a]	4.97[b]	2.44[c]
Moral obligation to consume less/no meat	5.38[a]	4.32[b]	2.21[c]
Social norm	2.21[a,b]	2.28[a]	1.93[b]
Meat consumption gives status	1.35[a]	1.52[a]	2.68[b]
Meat attachment questionnaire			
Hedonism	1.38[a]	2.76[b]	5.76[c]
Affinity	2.88[a]	4.78[b]	5.99[c]
Entitlement	2.10[a]	2.87[b]	5.22[c]
Dependence	1.29[a]	2.03[b]	4.68[c]
4N's			
Natural	2.10[a]	3.17[b]	5.15[c]
Necessary	1.65[a]	2.68[b]	4.93[c]
Normal	2.76[a]	3.17[b]	4.76[c]
Nice	1.41[a]	2.50[b]	5.52[c]

[a−c]Different superscripts across rows indicate significant different means.

"makes me feel good" are more important motives to reduce for meat abstainers, whereas affordability, weight control, familiarity, and convenience are less important motives to meat abstainers. Compared to avid meat eaters, animal friendliness, "makes me feel good," environmental friendliness, health, naturalness, food safety, and fair production are more important reasons to reduce for meat abstainers (Figure 3).

Food preferences and consumption

Characterization of meat abstainers

Meat abstainers consume 3-component meals (three separate components for proteins, starch, and vegetables, such as a sausage with potatoes and broccoli) without meat about 4 days a week. When consuming a 3-component meal, most of the abstainers replace meat with plant-based meat substitutes, eggs, pulses, or mushrooms. And 45% does not replace meat by another product. Meat abstainers also consume combined meals without meat (mixed ingredients, such as in a pasta dish, curry, or soup) about 4 days a week. When consuming a combined meal, plant-based meat substitutes are also the most used alternatives, followed by pulses and mushrooms, but also egg, cheese, tofu, and tempeh and nuts are used as replacers by about half of the meat abstainers and 44% does not use any meat replacer in combined meals.

In terms of appreciation of different types of protein-rich products, meat abstainers value mushrooms, cashews and vegetarian burgers most, followed by Dutch cheese and chickpeas. Meat products are less liked as protein sources by this group.

Comparing meat abstainers with committed meat reducers and avid meat eaters

Committed meat reducers consume 3-component meals without meat with the same frequency as meat abstainers (on average 4 days a week). Avid meat eaters consume such type of meals much less often (less than 1 day a week). Combined meals without meat are a little less frequently consumed by committed meat reducers (3 days a week) compared to meat abstainers (4 days a week). Avid meat eaters consume such types of meals much less frequently (less than 1 day a week).

The groups also differ in the type of protein source they consume in meatless meals (see Figure 4). Plant-based meat substitutes are consumed by a much larger proportion of meat avoiders, whereas fish is much more frequently consumed by

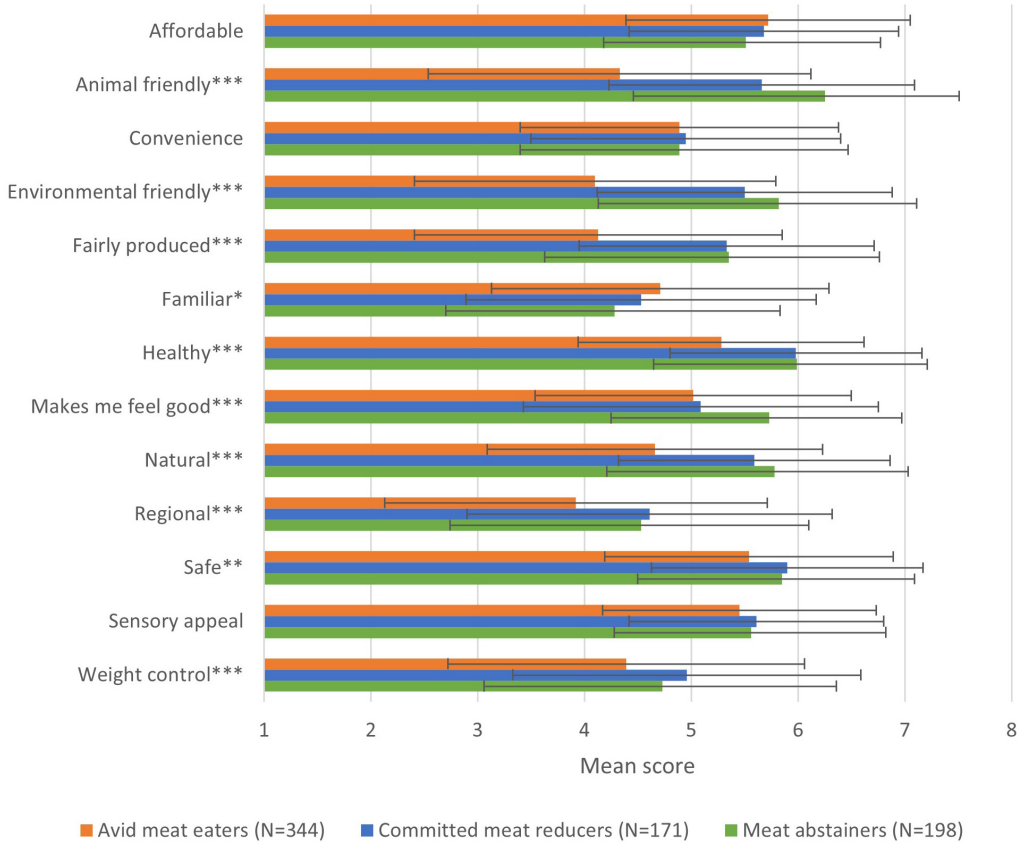


FIGURE 2
Mean scores of food choice motives per dietary consumer group (*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$).

committed reducers and avid meat eaters. This holds for both types of meals. The differences between avid meat eaters and meat abstainers are particularly large in the consumption of plant-based meat substitutes in 3-component meals (8% as opposed to 80%). Eggs and cheese products are also regularly used to replace meat in both types of meals, by an equal proportion of consumers in each group. Mushrooms and tofu or tempeh are more frequently used by meat abstainers than by the other groups, and nuts are equally often used by meat abstainers and committed meat reducers, but less frequently by avid meat eaters.

The groups differ greatly in their appreciation of different types of protein-rich products. Whereas the top three preferred products of meat abstainers are all plant-based products (mushrooms, cashew, vegetarian burgers), the two most liked products of committed meat reducers are animal-based products other them meat (eggs and cheese) and the three favorite products of committed meat eaters are meat products (steak, chicken filet, and meat balls). The contrast in appreciation of plant-based products is striking, scoring in the top favorite products of meat abstainers and in the bottom part of avid meat eaters. For meat products, the opposite is true (Table 3).

Discussion

Main findings

Differences and similarities in socio-demographic characteristics

This is the first Dutch study that not only characterizes meat abstainers (vegetarians and vegans) but compares them with committed meat reducers (consuming meat 1 or 2 days a week) and avid meat eaters (consuming meat 7 days a week) on a broad spectrum of variables: socio-demographics, attitudes, and norms, motivations and food preferences and consumption. The study aimed to explore what characterizes meat abstainers, and whether they are really a distinct subgroup of the population—as is sometimes implicitly or explicitly suggested.

Based on a large national representative sample of the Dutch adult population we confirm the stereotype of vegans and vegetarians as being mainly highly-educated females. This

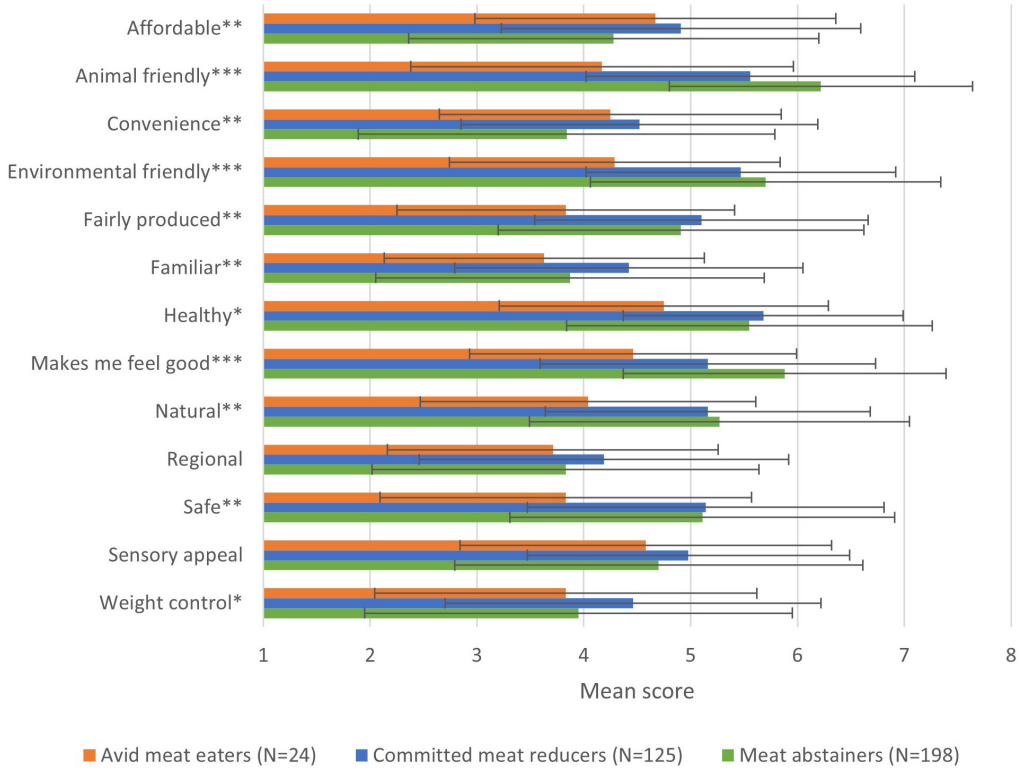


FIGURE 3
Mean scores of motives to limit meat consumption per dietary consumer group (*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$).

outcome engages with the extant literature (29, 33, 56, 57). Meat abstainers and meat reducers are quite similar in terms of their socio-demographic characteristics, though committed reducers are on average a bit older and live in smaller households. The difference is bigger with avid meat eaters, as they are mainly males, less often highly educated, living in larger household and less often single. Interestingly, the stereotype may be even stronger for committed meat reducers as most differences in terms of demographics exist between committed meat reducers and avid meat eaters. These results are largely in line with findings in Australia by Malek and Umberger (33) on differences between the groups in gender, age, household type and education level. Recent findings from New Zealand by Kemper et al. (58) on differences between three dietary groups of meat eaters and meat reducers also showed that more meat-reducing consumers were more likely to be female and higher educated while meat eaters were more likely to be male and less educated. Please note, however, that prior research found that the explanatory value of socio-demographics in explaining (sustainable) food consumption is limited as opposed to for example psychographic factors (59).

Pro-meat attitudes and norms

In terms of their attitudes and norms, large differences exist between the three groups in the expected direction, with meat abstainers being least pro-meat and avid meat eaters being most pro-meat. As expected, meat abstainers are not attached to meat in any aspect, are positive about meatless meals, and dislike the idea that meat comes from animals. This may be explained by personality aspects such as their greater openness and empathy as compared to omnivores (21). Moreover, meat abstainers attach high importance to ethical aspects related to meat, such as animal welfare and environmental impact, which is in accordance with previous literature (35, 60). Committed meat reducers differ from meat abstainers with regard to their attitudes and norms toward meat reduction, although the differences are generally small. It seems that committed meat reducers have a more nuanced opinion on meat consumption compared to meat abstainers. The most pronounced difference is in terms of affinity with eating meat, with committed meat reducers expressing much less feelings of repulsion.

The difference with avid meat eaters is much larger as they are much more attached to meat, are more positive about meat consumption, and favor meatless meals less. They attach less importance to ethical considerations and have no problem with animals being a source of consumption, possibly explained by their higher orientation toward social dominance (21). Interestingly, social norms are perceived to be low in all groups, and do not differ between meat abstainers and the other two groups. This is in line the work by Müssig et al. (35), who

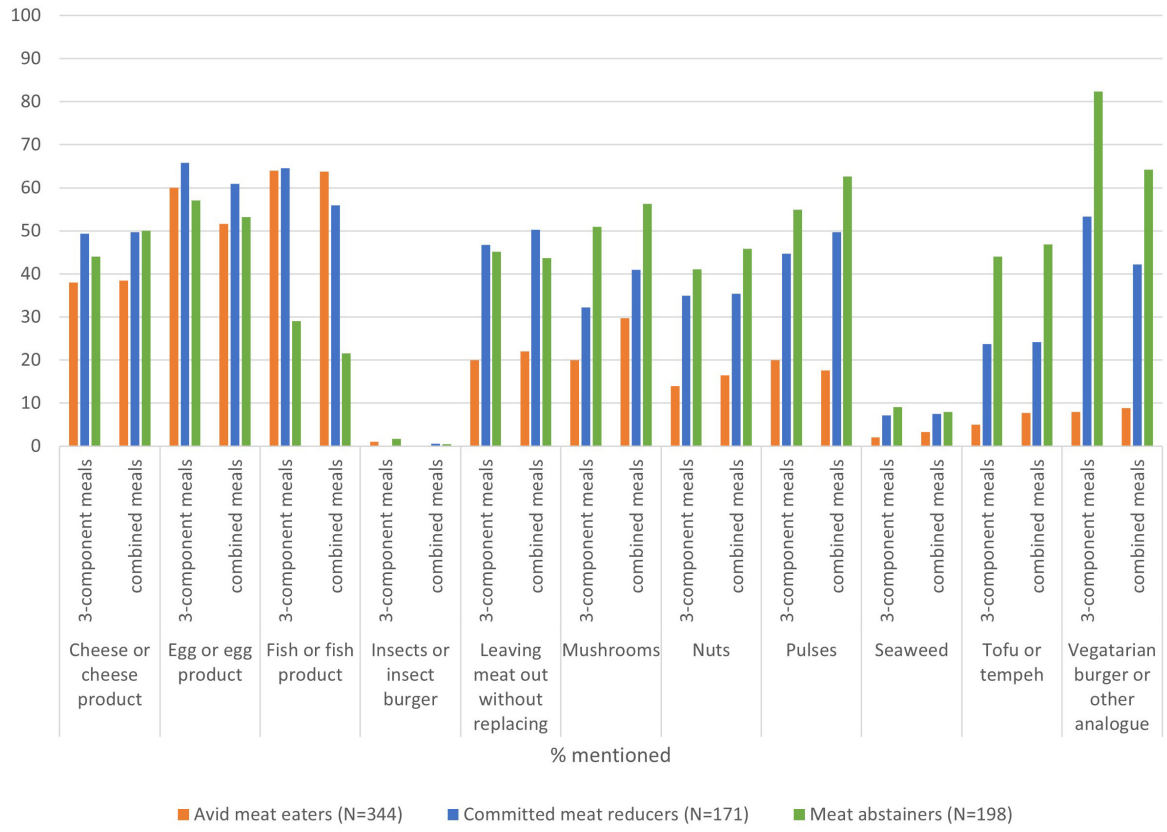


FIGURE 4
Meat replacers in 3-component meals and combined meals per dietary consumer group.

found that social norms were among the least important eating motives for both omnivores and meat abstainers.

Motives to reduce

Regarding their food choice motives, differences are again in the expected direction but provide some interesting insights. To meat abstainers, the most important food choice motives are motives related to sustainability and health aspects: animal welfare, healthiness, food safety, environmental welfare, and naturalness. Studies by Malek and Umberger (33) and North et al. (36) confirm that animal welfare is the most important motive for meat abstainers, and more specific for vegans (61), but contrary to our results, Malek and Umberger (33) show that for all dietary groups, price, and taste are among the five most important motives. Kemper et al. (58) found that taste is a main reason for meat consumption while price is an important motive for meat reduction. Price and taste are often mentioned as prerequisites to all population subgroups, but this is not reflected in our study. It might have to do with the trend that sustainability and health aspects are becoming more and more valued by consumers (62), and might start to dominate other egocentric motives, at least in certain subgroups. In comparing the dietary consumer groups, we found that the absolute scores on the food choice motives of meat abstainers do not differ from committed meat reducers, except for animal friendliness and "makes me feel good." This is in contrast with the findings by Malek and Umberger (33) that motives of unrestricted omnivores are similar to those of meat reducers but differ from those of vegetarians and vegans. This contrast with our study may have to do with the less strict definition of meat reducers in their sample. The finding that animal friendliness is discriminating between meat abstainers and the other groups is in line with other studies (27, 28, 33, 35, 63, 64). Animal welfare is not only the most important food choice motive to meat abstainers but is also the most important motive for them to have stopped consuming meat, followed by "makes me feel good," environmental welfare, health reasons and naturalness. This is mostly in agreement with previous studies that identify environmental, social, animal welfare, and health concerns as the main motivators of meat reduction (31, 35, 65, 66).

The finding that "makes me feel good" is the second most important reason to meat abstainers to have stopped eating meat is surprising. Müssig et al. (35) for example found that affect regulation (…to feel good) ranks in the bottom part of food choice motives. The high score on "feeling good" in our study may be explained by a recent qualitative research by Simons et al. (67), who found that meat avoidance is, next to ethical and health motivations, also unconsciously driven by aspects such

TABLE 3 Ranking of meat products and meat alternatives from most liked to least liked per dietary consumer group.

Meat abstainers		Committed meat reducers		Avid meat eaters	
Mushrooms	6.0	Eggs	6.2	Steak	5.6
Cashews	6.2	Dutch cheese	6.3	Chicken filet	5.7
Vegetarian burgers	6.3	Mushrooms	7.8	Meat balls	6.3
Dutch cheese	7.0	Cashews	7.8	Eggs	7.2
Chickpeas	7.2	Salmon steak	8.4	Dutch cheese	7.7
Eggs	7.3	Peanuts	9.1	Chop	7.8
Vegetarian minced meat	7.4	Vegetarian burger	9.4	Hamburger	7.9
Kidney beans	7.5	Kidney beans	9.4	Fried fish	8.8
Peanuts	8.1	Chickpeas	9.9	Frikandel	9.2
Tofu	8.6	Chicken filet	10.3	Salmon steak	9.9
Shiitakes	9.1	Fried fish	10.7	Mushrooms	10.1
Seaweed burger	10.1	Vegetarian minced meat	11.0	Peanuts	10.7
Salmon steak	12.7	Meat balls	11.9	Cashews	10.8
Fried fish	13.7	Tofu	12.4	Kidney beans	11.5
Insect burger	15.0	Shiitakes		Chick peas	14.9
Chicken filet	15.5	Steak	12.8	Shiitakes	15.0
Meat balls	15.6	Hamburger	13.3	Vegetarian minced meat	15.7
Hamburger	16.0	Seaweed burger	14.4	Vegetarian burger	15.8
Frikandel	16.8	Frikandel	15.1	Tofu	16.2
Steak	16.9	Chop	15.3	Seaweed burger	16.7
Chop	17.8	Insect burger	16.9	Insect burger	17.4

as empowerment, enrichment, autonomy, and superiority that make one feel good. This feeling-good is less pronounced for committed meat reducers. Surprisingly, the top three of most important motives to reduce meat consumption for committed meat reducers are all egoistic motives: health, food safety, and affordability. This also holds for avid meat eaters. In general, this group attaches much less importance to biospheric motives than the other groups, which is in accordance with findings of a systematic review of Holler et al. (21) that values of vegetarians are more based on universalism as opposed to omnivores.

Meat alternatives

Meat abstainers consume 3-component meals and combined meals without meat almost equally frequently. The products that meat abstainers use to replace meat in both types of meals are very similar, suggesting that the distinction in type of meal is less interesting than we expected (68), although the use of plant-based meat substitutes is particularly high in 3-component meals. Compared to the other two groups, meat abstainers less frequently use fish as a replacer for meat and pulses, mushrooms and nuts more frequently. Cheese and eggs are frequently used to replace meat in all groups. These findings largely agree with a study by Lehto et al. (56), based on a large-scale study in Finnish adults. The differences across the three groups are maybe most clear in their food preferences, with a much higher appreciation of plant-based protein sources among meat avoiders, a high appreciation of non-meat animal-based proteins across committed meat reducers and a high appreciation of meat products among avid meat eaters. This calls in mind Twigg's hierarchy of foods (51), in which meat is placed at the top, providing most status, followed by animal-sourced non-meat products such as fish, eggs and cheese, and plant-based foods are placed in the bottom of the hierarchy. This hierarchy is confirmed by avid meat eaters but turns around for meat abstainers. Our findings show that the hierarchy of preferences of Dutch meat-eating adults that was found earlier (20, 69), still holds. This suggests hardly any change. We add by showing that meat abstainers have a completely different preference, as they rank plant-based protein sources at the top.

Meating halfway

All in all, our results show that meat abstainers are more ethically motivated than both committed meat reducers and avid meat eaters, which has also been witnessed in studies by De Backer and Hudders (27), De Backer and Hudders (28), and Rosenfeld et al. (37). Rosenfeld et al. (37) concluded that for meat abstainers, their diet is a much more central component of their self-identity. This centrality might be something that meat abstainers have in common with avid meat eaters, since heavy meat consumption is often associated with identity-aspects such as masculinity and status (70, 71).

Committed meat reducers—who consume meat 1 or 2 days a week—take position between the two poles of meat-attached and meat-abstaining consumers in terms of their attitudes and norms. Their motives are similar to meat abstainers, but the fact that they not fully abstain from meat may result in that they are perceived as more progressive than the other two groups. This reasoning concurs with a study by Patel and Buckland (72) who showed that meat reducers are perceived

more positively than vegetarians and meat eaters. According to Patel and Buckland (72), social influence is strongest when groups are perceived as aspirational or positive and therefore the group of committed meat reducers may have potential to stimulate a shift toward more plant-based diets. Perhaps even more so than meat abstainers.

Implications

Masculinity and morality

This study provides leads for communication, policy measures and interventions targeted at the three included subgroups, in order to stimulate a further shift toward more plant-based diets. First of all, in terms of demographic profiles it is clear that there is much more work to do in targeting males compared to females. Meat consumption is deeply associated with masculinity in western cultures (73), which might be a huge barrier toward meat reduction among males (74). Messages that counteract this stereotype of meat-eating males could possibly help to overcome this barrier. Rosenfeld and Tomiyama (57) argue that it is helpful in this respect to distinguish several types of meat (such as beef vs. chicken), as these are differently associated to traditional gender roles. In addition, meat reduction seems specifically adopted by higher educated consumers. Communications on this topic should therefore also be targeted at lower educated subgroups of the population.

Second, the difference between meat abstainers on the one hand and committed meat reducers and avid meat eaters on the other are particularly striking in terms of animal welfare issues. Animal welfare seems the discriminating motive that makes meat abstainers so dedicated in translating their attitudes or intentions into actual behavior. This accords with findings by Hopwood et al. (31), that vegetarians are more motivated by animal rights than omnivores and may be explained by aversion, or even feelings of disgust toward consuming meat (75, 76). Although committed meat reducers also value animal welfare, their opinion is less pronounced. In addition, meat abstainers and committed meat reducers and avid meat eaters differ greatly in terms of their attachment to meat. Committed meat reducers and avid meat eaters express much less feelings of repulsion. In accordance with this, they much less dislike animals as source of meat. Altogether these insights suggests that animal welfare reasons are important to focus on. Although environmental concerns are often used as a reasoning behind the aim to shift diets, and are often found as motives for meat reduction, the importance of animal welfare is not to be underestimated. Piazza (77), therefore, suggests to develop interventions that make people connect animal products with their animal origin. This engages with other recent studies advocating to target meat eaters with animal welfare messages, for example by highlighting animal suffering, that appeal to (emotions related to) animal welfare in reducing meat consumption (78–82).

Emo and ego

Third, the aspect of feeling-good, that we found to be the second most important motive to meat abstainers for avoiding meat, is underresearched in current literature and warrants more emphasis on unconscious, affective aspects related to meat reduction, rather than conscious deliberations (83). Carfora et al. (84), for example, found that emotional messages caused a decrease in meat consumption, but informative messages did not. The relevance of emotions in intentions to consume alternatives to meat is also confirmed in a recent study by Onwezen et al. (85), who show that positive emotions are the most relevant driver for intentions (beyond motives) to consume five types of alternative protein sources to meat.

Fourth, given the high (relative) importance of egoistic motives to meat consuming groups [confirmed by Malek and Umberger (33)], interventions that address those groups should not neglect these egoistic motives. Affordability and sensory appeal are for example important motives, and this, together with the finding that avid meat eaters dislike meatless meals, implies that tasty, affordable alternatives for meat should become more available and accessible. Additionally, these alternatives should be perceived as healthy, as health is an important motive to all groups [which is, among others, confirmed by Hopwood et al. (31), Malek and Umberger (33), Hanras et al. (86), and North et al. (36)]. This is challenging and should be a focal point for producers of meat substitutes (87), and would also benefit meat abstainers, seen the high percentage that uses plant-based meat substitutes. Another motive that is important to consider is food safety, the only motive that appears in the top three motives of all three dietary groups. Such a finding is not confirmed by related and recent studies from other countries than the Netherlands by Kemper et al. (58) or Malek and Umberger (33).

Health issues

In the current study, we found that only meat abstainers perceive, to some extent, positive health effects of consuming less meat. The other groups do not. And avid meat eaters are even afraid that a meatless diet would result in nutritional deficiencies. This difference between meat eaters and abstainers in terms of perceived health effects coincides with Malek and Umberger (33), but in their sample, meat reducers are more positive about meatless diets in terms of health benefits. Regardless of that, they find that weaker beliefs in nutritional adequacy of meat-free diets gives a higher chance of being a reducer as opposed to an abstainer. In both studies, the (relative) importance of health as a motive to all population subgroups is shown. A study by Mullee et al. (30) showed that about 25% of omnivores agreed that consuming vegetarian meals often is unhealthy. Kemper et al. (58) found that meat eaters are less likely to agree that plant-based diets are healthy and processed meats are unhealthy than meat reducers. All in all, these findings suggest an important role for health perceptions in the transition

toward less meat-centered diets. This corresponds with Kwasny et al. (80), who recommended policy makers to inform about negative health effects of meat. Similarly, Grundy et al. (79) concluded that providing information on health consequences is promising in this respect. Future interventions could emphasize the possible health benefits of meat reduction more, and better inform the public about possible negative health effects of overconsumption of (red and processed) meat.

The impact of norms

Fifth, this study shows that social norms to reduce meat are low in all dietary groups. This is worrisome, as a recent review on acceptance of alternative protein sources concluded that social norms are an important driver of acceptance (83). This is in line with an Australian study, showing that social norms significantly impact attitudes to lower meat consumption (88). Additionally, a study conducted in the Netherlands showed that social norms positively predict meat curtailment behavior (59). In a study on acceptance of five types of alternative proteins, social norms even appeared to be the most relevant factor in explaining acceptance (89). And in a study among students, Schenk et al. (90) found that both injunctive and descriptive social norms (together with convenience) were the most important direct determinants of meat avoidance. This is in accordance with a modeling study by Eker et al. (91) who found social norms and self-efficacy to be the main drivers of shifting diets toward more sustainable levels. Moreover, a study by Lai et al. (92) confirmed the effect of both injunctive and descriptive social norms on meat purchases. Finally, a recent meta-review concludes that providing information on social norms appears promising to reduce the consumption of animal-based products (79). As social norms are low, and typically change slowly over time, the recent body of literature on dynamic norms may be of interest here. Dynamic norms provide information on how people's behavior is shifting and appears to be effective in triggering behavior change (93). As many consumers indicate to have lowered their meat consumption in the past year (14), this may be used as a dynamic norm in interventions.

Strategies to lower meat intake

Finally, our study implies that a distinction should be made between several types of meats and several types of meat alternatives, when developing strategies to encourage meat reduction. Our study shows that the dietary groups greatly differ in their relative appreciation of different types of protein sources. In general, meat abstainers prefer plant-based protein sources over animal-based sources. For them, the bottleneck is the appreciation and consumption of cheese, which has a high environmental impact (94). Informing them on this subject and enticing them toward plant-based alternatives may be an effective route. Committed meat reducers value non-meat animal-sourced foods the most. Informing them on the sustainability impact of animal-sourced foods and targeting them with environmental and animal welfare messages could be helpful [see for a related recent study (95)]. Alternatively, these heavy flexitarians could be motivated to replace meat by fish more often as a study by Broekema et al. (94) showed that fish consumption may rise in the Netherlands. This group appreciates fish and most of them use fish to replace meat. Avid meat eaters in turn prefer meat products over other protein sources and for these meat-attached food consumers it is difficult to move away from their meat-eating habits. Therefore, for this group it might be an interesting route to stimulate a shift from red and processed meat toward white meat such as chicken, with a much lower impact on the environment and health (94)—leaving detrimental impact on animal welfare of this "meat shift" aside. Also, from the perspective of traditional gender roles, it is important to consider differences between different types of meats (57). Alternatively, this group of avid meat eaters could be targeted with a strategy that de Boer and Aiking (68) described as mixed dishes, combining proteins from animal and plant origin, the strategy "less but better," which stands for smaller portions of animal-friendly produced meat (96) or "sustainability by stealth" [e.g., hybrid meats (97)].

Limitations and future research

As in every study, this study comes with several limitations that provide avenues for future research. Maybe the most important limitation lays in the fact that vegetarians and vegans were identified based on their self-reported identity as being a vegetarian or a vegan. We did not ask for their meat consumption frequency, which is a missed opportunity that could have been used as a check. Malek and Umberger (33) suggest that the size of this meat-abstaining groups would probably have been smaller based on food consumption frequencies. As stated by Malek and Umberger (33), future research is needed to explain these differences and to investigate effects of different classification methods.

In addition to the previous point, we measured meat consumption in number of days a week. We have no information on portion sizes. Portion size reduction can however be an effective strategy to decrease meat consumption (98, 99), particularly among subgroups that are attached to meat or find it difficult to prepare tasty low-to-non-meat meals. Future research should therefore assess the amounts of meat consumed.

Regardless of this probability of overrated numbers of meat abstainers—that possibly are not strictly abstaining from meat or animal-based products—the number of respondents that self-identified as a vegan was rather small to analyze as a separate group (see text footnote 1). Therefore, we combined vegetarians and vegans into one group of meat abstainers. Although this is common practice (35, 100), in the context of the urgently needed shift toward more plant-based diets this could be a missed opportunity. Strict vegans do not consume any animal-based foods and therefore do not need to shift their diets

in this respect, whereas vegetarians may use a lot of animal-sourced alternatives for meat (such as cheese and eggs) which is not particularly desirable with respect to environmental and animal welfare issues. Malek and Umberger (33) and Lund et al. (101) show interesting differences between vegetarians and vegans in their food choice motives and ethical and utilitarian positions. More specific, Malek and Umberger (33) show that environmental impact is second most important for vegans, but does not appear in the top five of vegetarians. It would be interesting to in-depth research this group of vegans to search for learnings that can be applied to achieve shifts in other dietary consumer groups, to research how vegetarians can be convinced to reduce their non-meat animal-based consumption and to investigate how vegans can be motivated to continue with their plant-based diet as veganism appears to be the least stable diet (34).

Related to the previous issue, future research should take a closer look at strategies to reduce the consumption of non-meat animal-based products such as dairy, eggs and fish. Our research was mainly focused on meat reduction, but a shift toward more plant-based diets entails a reduction in all types of animal-sourced foods. Meat reduction has gained a lot of attention in recent literature, but much less research has been conducted on how to reduce consumption of other animal-sourced foods. This study shows that meat is often replaced by other animal-sourced products such as fish, eggs and cheese, especially among those that do not fully abstain from eating meat. In terms of environmental impact, replacing meat with other animal-derived products is not always desirable. The CO_2 impact of cheese is for example higher than that of chicken (94, 102). The study by Malek and Umberger (33) showed that environmental impact is relatively more important to vegans than to vegetarians [MacInnis and Hodson (18) hint at a similar difference]. This suggests that attempts to reduce the consumption of non-meat animal-based products could benefit from stressing the environmental impact of the prevailing food system, and the role of animal-based products therein.

Another limitation relates to the way we questioned food choice motives. This has been done with short expressions to measure single food choice motives. Although this method has been validated (53), it is difficult to capture how respondents interpreted the concepts when rating them. Most items are obvious, but for example the item "makes me feel good" is ambiguous. The current research surprisingly showed that this motive is the second most important motive for abstainers to have stopped consuming meat. This could possibly be explained in different ways though. It may have something to do with what is known in literature as "warm glow," positive feelings that are elicited by doing the right thing (103). Alternatively, consumers may perceive positive effects of plant-based diets on their (physical) well-being (104), although this is an underexplored area of research (105). Further research is needed on this topic of "feeling good."

Moreover, the results are based on self-administered questionnaires. The cross-sectional design makes it impossible to draw conclusions on causality and therefore we cannot make any statements about shifts from one dietary group to another. Recent research by Milfont et al. (34) found that the probability of shifting from a meat-rich diet toward a vegetarian or vegan diet is low and previous work on flexitarianism suggests the same (14), but more research is needed on this topic. In addition, the lack of experimental elements in this study results in findings that could help to identify leads for interventions, but research is needed on how the insights from this manuscript can be turned into effective interventions that result in, preferably long-term, changes in dietary patterns of different consumer groups.

Furthermore, the data has been collected prior to the COVID-19 outbreak. It has been found that the impact of COVID-19 on dietary patterns was modest for most of the Dutch (106), although for per-capita meat consumption some reduction was observed (13). Such outcomes give reason to expect comparable results if we would repeat this study, but future research needs to confirm this presumption.

A final limitation has to do with cross-cultural validity. This study has been conducted in the Netherlands. The Dutch diet is characterized by a large proportion of so-called 3-component meals, consisting of three separate components for proteins (mostly meat), starch and vegetables. This type of main meal is not common practice in other cultures and therefore future research is needed in other countries to confirm our findings for other cultures. With respect to meat moderation and meat avoidance in other cultures it is also interesting to address whether and how religious beliefs play an influential role in animal-based food choices. In the current work religion was not explicitly taken into account. The Netherlands is a highly-secularized country though, but in other countries and regions religious reasons may be more important. Particularly in the field of vegetarianism it is not uncommon to pay some attention to religion (18, 35).

Conclusion

We conclude that meat abstainers differ from committed meat reducers and from avid meat eaters with respect to their socio-demographic characteristics, attitudes and norms, motives and food preferences and consumption. The results show that although differences across the groups are gradual and in the expected direction, interesting differences exist in motivations, particularly the valuation of animal welfare and "feeling good." Moreover, in terms of valuation of protein sources the three groups are very distinct, which makes it unlikely to expect big shifts from one group to another in the

short term. In view of the urgent need to move away from meat-heavy diets this is not entirely positive when it comes to expecting massive meat-reduced consumption behavior in the very near future.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

MV: conceptualization, methodology, formal analysis, and writing—original draft, review, and editing. HD: conceptualization, methodology, and writing—original draft, review, and editing. Both authors contributed to the article and approved the submitted version.

Funding

This work was performed under the research project "Sustainable protein consumption," financed by the Dutch Ministry of Agriculture, Nature and Food Quality.

Acknowledgments

We thank MSI-ACI Europe B.V. for collecting the data.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

1. Godfray HCJ, Aveyard P, Garnett T, Hall JW, Key TJ, Lorimer J, et al. Meat consumption, health, and the environment. *Science.* (2018) 361:eaam5324. doi: 10.1126/science.aam5324

2. Poore J, Nemecek T. Reducing food's environmental impacts through producers and consumers. *Science.* (2018) 360:987–92. doi: 10.1126/science.aaq0216

3. Springmann M, Clark M, Mason-D'Croz D, Wiebe K, Bodirsky BL, Lassaletta L, et al. Options for keeping the food system within environmental limits. *Nature.* (2018) 562:519–25. doi: 10.1038/s41586-018-0594-0

4. Tilman D, Clark M. Global diets link environmental sustainability and human health. *Nature.* (2014) 515:518–22. doi: 10.1038/nature13959

5. McMichael AJ, Powles JW, Butler CD, Uauy R. Food, livestock production, energy, climate change, and health. *Lancet.* (2007) 370:1253–63. doi: 10.1016/S0140-6736(07)61256-2

6. Willett W, Rockström J, Loken B, Springmann M, Lang T, Vermeulen S, et al. Food in the Anthropocene: the EAT–lancet commission on healthy diets from sustainable food systems. *Lancet.* (2019) 393:447–92. doi: 10.1016/S0140-6736(18)31788-4

7. Cocking C, Walton J, Kehoe L, Cashman KD, Flynn A. The role of meat in the European diet: current state of knowledge on dietary recommendations, intakes and contribution to energy and nutrient intakes and status. *Nutr Res Rev.* (2020) 33:181–9. doi: 10.1017/S0954422419000295

8. Organisation for Economic Co-operation and Development [OECD], Food and Agriculture Organization of the United Nations [FAO]. *OECD-FAO Agricultural Outlook 2022-2031*. Paris: OECD Publishing (2022). doi: 10.1787/f1b0b29c-en

9. Parlasca MC, Qaim M. Meat consumption and sustainability. *Annu Rev Resour Econ.* (2022) 14:17–41. doi: 10.1146/annurev-resource-111820-032340

10. Dagevos H. Finding flexitarians: current studies on meat eaters and meat reducers. *Trends Food Sci Technol.* (2021) 114:530–9. doi: 10.1016/j.tifs.2021.06.021

11. de Boer J, Aiking H. Do EU consumers think about meat reduction when considering to eat a healthy, sustainable diet and to have a role in food system change?. *Appetite.* (2022) 170:105880. doi: 10.1016/j.appet.2021.105880

12. Hartmann C, Siegrist M. Consumer perception and behaviour regarding sustainable protein consumption: a systematic review. *Trends Food Sci Technol.* (2017) 61:11–25. doi: 10.1016/j.tifs.2016.12.006

13. Dagevos H, Verbeke W. Meat consumption and flexitarianism in the Low Countries. *Meat Sci.* (2022) 192:108894. doi: 10.1016/j.meatsci.2022.108894

14. Verain MCD, Dagevos H, Jaspers P. Flexitarianism in the Netherlands in the 2010 decade: shifts, consumer segments and motives. *Food Qual Prefer.* (2022) 96:104445. doi: 10.1016/j.foodqual.2021.104445

15. Zaraska M. *Meathooked: The History and Science of Our 2.5-Million-Year Obsession with Meat*. New York, NY: Basic Books (2016).

16. Graça J, Calheiros MM, Oliveira A. Attached to meat?: (Un)Willingness and intentions to adopt a more plant-based diet. *Appetite.* (2015) 95:113–25. doi: 10.1016/j.appet.2015.06.024

17. Verdonk D-J. *Animals to Order: A Vegetarian History of the Netherlands*. Amsterdam: Boom (2009).

18. MacInnis CC, Hodson G. Tensions within and between vegans and vegetarians: meat-free motivations matter. *Appetite.* (2021) 164:105246. doi: 10.1016/j.appet.2021.105246

19. Dagevos H. Vegetarianism in the Dutch polder. In: De Backer CJ, Fisher ML, Dare J, Costello L editors. *To Eat or Not to Eat Meat: How Vegetarian Dietary Choices Influence Our Social Lives*. Lanham: Rowman & Littlefield (2019). p. 137–47.

20. Verain M, Dagevos H, Antonides G. Flexitarianism: a range of sustainable food styles. In: Reisch LA, Thøgersen J editors. *Handbook of Research On Sustainable Consumption*. Cheltenham: Edward Elgar Publishing (2015). p. 209–23. doi: 10.4337/9781783471270

21. Holler S, Cramer H, Liebscher D, Jeitler M, Schumann D, Murthy V, et al. Differences between omnivores and vegetarians in personality profiles, values, and empathy: a systematic review. *Front Psychol.* (2021) 12:579700. doi: 10.3389/fpsyg.2021.579700

22. Allen MW, Wilson M, Ng SH, Dunne M. Values and beliefs of vegetarians and omnivores. *J Soc Psychol.* (2000) 140:405–22. doi: 10.1080/00224540009600481

23. Janda S, Trocchia PJ. Vegetarianism: toward a greater understanding. *Psychol Mark.* (2001) 18:1205–40. doi: 10.1002/mar.1050

24. McEvoy CT, Temple N, Woodside JV. Vegetarian diets, low-meat diets and health: a review. *Public Health Nutr.* (2012) 15:2287–94. doi: 10.1017/S1368980012000936

25. Ruby MB. Vegetarianism. A blossoming field of study. *Appetite.* (2012) 58:141–50. doi: 10.1016/j.appet.2011.09.019

26. Rothgerber H. A comparison of attitudes toward meat and animals among strict and semi-vegetarians. *Appetite.* (2014) 72:98–105. doi: 10.1016/j.appet.2013.10.002

27. De Backer CJS, Hudders L. From meatless mondays to meatless sundays: motivations for meat reduction among vegetarians and semi-vegetarians who mildly or significantly reduce their meat intake. *Ecol Food Nutr.* (2014) 53:639–57. doi: 10.1080/03670244.2014.896797

28. De Backer CJS, Hudders L. Meat morals: relationship between meat consumption consumer attitudes towards human and animal welfare and moral behavior. *Meat Sci.* (2015) 99:68–74. doi: 10.1016/j.meatsci.2014.08.011

29. Allès B, Baudry J, Méjean C, Touvier M, Péneau S, Hercberg S, et al. Comparison of sociodemographic and nutritional characteristics between self-reported vegetarians, vegans, and meat-eaters from the NutriNet-Santé study. *Nutrients.* (2017) 9:1023. doi: 10.3390/nu9091023

30. Mullee A, Vermeire L, Vanaelst B, Mullie P, Deriemaeker P, Leenaert T, et al. Vegetarianism and meat consumption: a comparison of attitudes and beliefs between vegetarian, semi-vegetarian, and omnivorous subjects in Belgium. *Appetite.* (2017) 114:299–305. doi: 10.1016/j.appet.2017.03.052

31. Hopwood CJ, Rosenfeld D, Chen S, Bleidorn W. An investigation of plant-based dietary motives among vegetarians and omnivores. *Collabra Psychol.* (2021) 7:19010. doi: 10.1525/collabra.19010

32. Kováč Ľ, Halama P. How vegans, vegetarians and carnists differ in personality traits and attitudes towards animals. *Curr Issues Pers Psychol.* (2022) 10:147–52. doi: 10.5114/cipp.2021.107172

33. Malek L, Umberger WJ. Distinguishing meat reducers from unrestricted omnivores, vegetarians and vegans: a comprehensive comparison of Australian consumers. *Food Qual Prefer.* (2021) 88:104081. doi: 10.1016/j.foodqual.2020.104081

34. Milfont TL, Satherley N, Osborne D, Wilson MC, Sibley CG. To meat, or not to meat: a longitudinal investigation of transitioning to and from plant-based diets. *Appetite.* (2021) 166:105584. doi: 10.1016/j.appet.2021.105584

35. Müssig M, Pfeiler TM, Egloff B. Why they eat what they eat: comparing 18 eating motives among omnivores and veg* ns. *Front Nutr.* (2022) 9:780614. doi: 10.3389/fnut.2022.780614

36. North M, Klas A, Ling M, Kothe E. A qualitative examination of the motivations behind vegan, vegetarian, and omnivore diets in an Australian population. *Appetite.* (2021) 167:105614. doi: 10.1016/j.appet.2021.105614

37. Rosenfeld DL, Rothgerber H, Tomiyama AJ. From mostly vegetarian to fully vegetarian: meat avoidance and the expression of social identity. *Food Qual Prefer.* (2020) 85:103963. doi: 10.1016/j.foodqual.2020.103963

38. Rosenfeld DL, Rothgerber H, Tomiyama AJ. Mostly vegetarian, but flexible about it: investigating how meat-reducers express social identity around their diets. *Soc Psychol Pers Sci.* (2020) 11:406–15. doi: 10.1177/1948550619869619

39. Lea E, Worsley A. Influences on meat consumption in Australia. *Appetite.* (2001) 36:127–36. doi: 10.1006/appe.2000.0386

40. Roos G, Prättälä R, Koski K. Men, masculinity and food: interviews with Finnish carpenters and engineers. *Appetite.* (2001) 37:47–56. doi: 10.1006/appe.2001.0409

41. Steptoe A, Pollard TM, Wardle J. Development of a measure of the motives underlying the selection of food: the food choice questionnaire. *Appetite.* (1995) 25:267–84. doi: 10.1006/appe.1995.0061

42. de Boer J, Hoogland CT, Boersema JJ. Towards more sustainable food choices: value priorities and motivational orientations. *Food Qual Prefer.* (2007) 18:985–96. doi: 10.1016/j.foodqual.2007.04.002

43. Vanhonacker F, Verbeke W. Buying higher welfare poultry products? Profiling Flemish consumers who do and do not. *Poult Sci.* (2009) 88:2702–11. doi: 10.3382/ps.2009-00259

44. Lacroix K, Gifford R. Reducing meat consumption: identifying group-specific inhibitors using latent profile analysis. *Appetite.* (2019) 138:233–41. doi: 10.1016/j.appet.2019.04.002

45. Eertmans A, Victoir A, Notelaers G, Vansant G, Van den Bergh O. The food choice questionnaire: factorial invariant over western urban populations? *Food Qual Prefer.* (2006) 17:344–52. doi: 10.1016/j.foodqual.2005.03.016

46. Malek L, Umberger WJ, Goddard E. Committed vs. uncommitted meat eaters: understanding willingness to change protein consumption. *Appetite.* (2019) 138:115–26. doi: 10.1016/j.appet.2019.03.024

47. Bamberg S, Hunecke M, Blöbaum A. Social context, personal norms and the use of public transportation: two field studies. *J Environ Psychol.* (2007) 27:190–203. doi: 10.1016/j.jenvp.2007.04.001

48. Gärling T, Fujii S, Gärling A, Jakobsson C. Moderating effects of social value orientation on determinants of proenvironmental behavior intention. *J Environ Psychol.* (2003) 23:1–9. doi: 10.1016/S0272-4944(02)00081-6

49. Ajzen I. The theory of planned behavior. *Organ Behav Hum Decis Process.* (1991) 50:179–211. doi: 10.1016/0749-5978(91)90020-T

50. Minton AP, Rose RL. The effects of environmental concern on environmentally friendly consumer behavior: an exploratory study. *J Bus Res.* (1997) 40:37–48. doi: 10.1016/S0148-2963(96)00209-3

51. Twigg J. Vegetarianism and the meanings of meat. In: Murcott A editor. *The Sociology of Food and Eating*. Aldershot: Gower (1983). p. 18–30.

52. Piazza J, Ruby MB, Loughnan S, Luong M, Kulik J, Watkins HM, et al. Rationalizing meat consumption. The 4Ns. *Appetite.* (2015) 91:114–28. doi: 10.1016/j.appet.2015.04.011

53. Onwezen MC, Reinders MJ, Verain MCD, Snoek HM. The development of a single-item food choice questionnaire. *Food Qual Prefer.* (2019) 71:34–45. doi: 10.1016/j.foodqual.2018.05.005

54. Kerslake E, Kemper JA, Conroy D. What's your beef with meat substitutes? Exploring barriers and facilitators for meat substitutes in omnivores, vegetarians, and vegans. *Appetite* (2022) 170:105864. doi: 10.1016/j.appet.2021.105864

55. Field A. *Discovering statistics using SPSS*. 2nd ed. London: SAGE Publications (2005).

56. Lehto E, Kaartinen NE, Sääksjärvi K, Männistö S, Jallinoja P. Vegetarians and different types of meat eaters among the Finnish adult population from 2007 to 2017. *Br J Nutr.* (2022) 127:1060–72. doi: 10.1017/S0007114521001719

57. Rosenfeld DL, Tomiyama AJ. Gender differences in meat consumption and openness to vegetarianism. *Appetite.* (2021) 166:105475. doi: 10.1016/j.appet.2021.105475

58. Kemper JA, Benson-Rea M, Young J, Seifert M. Cutting down or eating up: examining meat consumption, reduction, and sustainable food beliefs, attitudes, and behaviors. *Food Qual Prefer.* (2023) 104:104718.

59. Verain MCD, Dagevos H, Antonides G. Sustainable food consumption. Product choice or curtailment?. *Appetite.* (2015) 91:375–84. doi: 10.1016/j.appet.2015.04.055

60. Graça J, Truninger M, Junqueira L, Schmidt L. Consumption orientations may support (or hinder) transitions to more plant-based diets. *Appetite.* (2019) 140:19–26. doi: 10.1016/j.appet.2019.04.027

61. Ghaffari M, Rodrigo PGK, Ekinci Y, Pino G. Consumers' motivations for adopting a vegan diet: a mixed-methods approach. *Int J Consum Stud.* (2021) 46:1193–208. doi: 10.1111/ijcs.12752

62. Onwezen MC, Galama J. *Impact COVID-19 op voedselgedrag van consumenten: Impact, verklaringen en aangrijpingspunten*. Wageningen: Wageningen University & Research (2021).

63. de Boer J, Schösler H, Aiking H. Towards a reduced meat diet: mindset and motivation of young vegetarians, low, medium and high meat-eaters. *Appetite.* (2017) 113:387–97. doi: 10.1016/j.appet.2017.03.007

64. Lentz G, Connelly S, Mirosa M, Jowett T. Gauging attitudes and behaviours: meat consumption and potential reduction. *Appetite.* (2018) 127:230–41. doi: 10.1016/j.appet.2018.04.015

65. de Boer J, Aiking H. How meat reduction differs from other personal climate actions: distinct concerns and cultural barriers among EU consumers. *Food Qual Prefer.* (2022) 101:104646. doi: 10.1016/j.foodqual.2022.104646

66. Miki AJ, Livingston KA, Karlsen MC, Folta SC, McKeown NM. Using evidence mapping to examine motivations for following plant-based diets. *Curr Dev Nutr.* (2020) 4:nzaa013. doi: 10.1093/cdn/nzaa013

67. Simons J, Vierboom C, Klink-Lehmann J, Härlen I, Hartmann M. Vegetarianism/veganism: a way to feel good. *Sustainability.* (2021) 13:3618. doi: 10.3390/su13073618

68. de Boer J, Aiking H. Strategies towards healthy and sustainable protein consumption: a transition framework at the levels of diets, dishes, and dish ingredients. *Food Qual Prefer.* (2019) 73:171–81. doi: 10.1016/j.foodqual.2018.11.012

69. Dagevos H, Voordouw J. Sustainability and meat consumption: is reduction realistic? *Sustain Sci Pract Policy.* (2013) 9:60–9. doi: 10.1080/15487733.2013.11908115

70. Rothgerber H. Real men don't eat (vegetable) quiche: masculinity and the justification of meat consumption. *Psychol Men Masc.* (2013) 14:363–75. doi: 10.1037/a0030379

71. Ruby MB, Heine SJ. Meat, morals, and masculinity. *Appetite.* (2011) 56:447–50. doi: 10.1016/j.appet.2011.01.018

72. Patel V, Buckland NJ. Perceptions about meat reducers: results from two UK studies exploring personality impressions and perceived group membership. *Food Qual Prefer.* (2021) 93:104289. doi: 10.1016/j.foodqual.2021.104289

73. Rosenfeld DL. Gender differences in vegetarian identity: how men and women construe meatless dieting. *Food Qual Prefer.* (2020) 81:103859. doi: 10.1016/j.foodqual.2019.103859

74. Schösler H, de Boer J, Boersema JJ, Aiking H. Meat and masculinity among young Chinese, Turkish and Dutch adults in the Netherlands. *Appetite.* (2015) 89:152–9. doi: 10.1016/j.appet.2015.02.013

75. Graça J, Oliveira A, Calheiros MM. Meat, beyond the plate. Data-driven hypotheses for understanding consumer willingness to adopt a more plant-based diet. *Appetite.* (2015) 90:80–90. doi: 10.1016/j.appet.2015.02.037

76. Rosenfeld DL. Why some choose the vegetarian option: are all ethical motivations the same? *Motiv Emot.* (2019) 43:400–11. doi: 10.1007/s11031-018-9747-6

77. Piazza J. Why people love animals yet continue to eat them. In: Dhont K, Hodson G editors. *Why We Love and Exploit Animals: Bridging Insights from Academia and Advocacy*. Oxford: Routledge (2019). p. 121–36.

78. Bryant C, Platt B, Vultaggio A, Dillard C. Testing social media advertisements for non-human animal advocacy. *OSF.* [Preprint]. (2021). doi: 10.31219/osf.io/xs5p7

79. Grundy EAC, Slattery P, Saeri AK, Watkins K, Houlden T, Farr N, et al. Interventions that influence animal-product consumption: a meta-review. *Future Foods.* (2022) 5:10011. doi: 10.1016/j.fufo.2021.100111

80. Kwasny T, Dobernig K, Riefler P. Towards reduced meat consumption: a systematic literature review of intervention effectiveness, 2001–2019. *Appetite.* (2022) 168:105739. doi: 10.1016/j.appet.2021.105739

81. Mathur MB, Peacock J, Reichling DB, Nadler J, Bain PA, Gardner CD, et al. Interventions to reduce meat consumption by appealing to animal welfare: meta-analysis and evidence-based recommendations. *Appetite.* (2021) 164:105277. doi: 10.1016/j.appet.2021.105277

82. Palomo-Vélez G, Tybur JM, van Vugt M. Unsustainable, unhealthy, or disgusting? Comparing different persuasive messages against meat consumption. *J Environ Psychol.* (2018) 58:63–71. doi: 10.1016/j.jenvp.2018.08.002

83. Onwezen MC, Bouwman EP, Reinders MJ, Dagevos H. A systematic review on consumer acceptance of alternative proteins: pulses, algae, insects, plant-based meat alternatives, and cultured meat. *Appetite.* (2021) 159:105058. doi: 10.1016/j.appet.2020.105058

84. Carfora V, Bertolotti M, Catellani P. Informational and emotional daily messages to reduce red and processed meat consumption. *Appetite.* (2019) 141:104331. doi: 10.1016/j.appet.2019.104331

85. Onwezen MC, Verain MCD, Dagevos H. Positive emotions explain increased intention to consume five types of alternative proteins. *Food Qual Prefer.* (2022) 96:104446. doi: 10.1016/j.foodqual.2021.104446

86. Hanras E, Mathieu S, Chevrier B, Boujut E, Dorard G. Vegans, strict vegetarians, partial vegetarians, omnivores: do they differ in food choice motives, coping, and quality of life? *La Press Med Open.* (2022) 3:100033.

87. Boukid F. Plant-based meat analogues: from niche to mainstream. *Eur Food Res Technol.* (2021) 247:297–08. doi: 10.1007/s00217-020-03630-9

88. Cheah I, Sadat Shimul A, Liang J, Phau I. Drivers and barriers toward reducing meat consumption. *Appetite.* (2020) 149:104636. doi: 10.1016/j.appet.2020.104636

89. Onwezen MC, Verain MCD, Dagevos H. Social norms support the protein transition: the relevance of social norms to explain increased acceptance of alternative protein burgers over 5 years. *Foods* (2022) 11:3413.

90. Schenk P, Rössel J, Scholz M. Motivations and constraints of meat avoidance. *Sustainability.* (2018) 10:3858. doi: 10.3390/su10113858

91. Eker S, Reese G, Obersteiner M. Modelling the drivers of a widespread shift to sustainable diets. *Nat Sustain.* (2019) 2:725–35. doi: 10.1038/s41893-019-0331-1

92. Lai AE, Tirotto FA, Pagliaro S, Fornara F. Two sides of the same coin: environmental and health concern pathways toward meat consumption. *Front Psychol.* (2020) 11:578582. doi: 10.3389/fpsyg.2020.578582

93. Sparkman G, Walton GM. Dynamic norms promote sustainable behavior, even if it is counternormative. *Psychol Sci.* (2017) 28:1663–74. doi: 10.1177/0956797617719950

94. Broekema R, Tyszler M, van't Veer P, Kok FJ, Martin A, Lluch A, et al. Future-proof and sustainable healthy diets based on current eating patterns in the Netherlands. *Am J Clin Nutr.* (2020) 112:1338–47. doi: 10.1093/ajcn/nqaa217

95. Noguerol AT, Pagán MJ, García-Segovia P, Varela P. Green or clean? Perception of clean label plant-based products by omnivorous, vegan, vegetarians and flexitarian consumers. *Food Res Int.* (2021) 149:110652. doi: 10.1016/j.foodres.2021.110652

96. de Boer J, Schösler H, Aiking H. "Meatless days" or "less but better"? Exploring strategies to adapt Western meat consumption to health and sustainability challenges. *Appetite.* (2014) 76:120–8. doi: 10.1016/j.appet.2014.02.002

97. de Bakker E, Dagevos H. Reducing meat consumption in today's consumer society: questioning the citizen-consumer gap. *J Agric Environ Ethics.* (2012) 25:877–94. doi: 10.1007/s10806-011-9345-z

98. Reinders MJ, Huitink M, Dijkstra SC, Maaskant AJ, Heijnen J. Menu-engineering in restaurants - adapting portion sizes on plates to enhance vegetable consumption: a real-life experiment. *Int J Behav Nutr Phys Act.* (2017) 14:41. doi: 10.1186/s12966-017-0496-9

99. van den Berg SW, van den Brink AC, Wagemakers A, den Broeder L. Reducing meat consumption: the influence of life course transitions, barriers and enablers, and effective strategies according to young Dutch adults. *Food Qual Prefer.* (2022) 100:104623. doi: 10.1016/j.foodqual.2022.104623

100. Rothgerber H. Underlying differences between conscientious omnivores and vegetarians in the evaluation of meat and animals. *Appetite.* (2015) 87:251–8. doi: 10.1016/j.appet.2014.12.206

101. Lund TB, McKeegan DE, Cribbin C, Sandøe P. Animal ethics profiling of vegetarians, vegans and meat-eaters. *Anthrozoös.* (2016) 29:89–106. doi: 10.1080/08927936.2015.1083192

102. Clune S, Crossin E, Verghese K. Systematic review of greenhouse gas emissions for different fresh food categories. *J Clean Prod.* (2017) 140:766–83. doi: 10.1016/j.jclepro.2016.04.082

103. Taufik D, Bolderdijk JW, Steg L. Acting green elicits a literal warm glow. *Nat Clim Change.* (2015) 5:37–40. doi: 10.1038/nclimate2449

104. Fehér A, Gazdecki M, Véha M, Szakály M, Szakály Z. A comprehensive review of the benefits of and the barriers to the switch to a plant-based diet. *Sustainability.* (2020) 12:4136. doi: 10.3390/su12104136

105. Medawar E, Huhn S, Villringer A, Veronica Witte A. The effects of plant-based diets on the body and the brain: a systematic review. *Transl Psychiatry.* (2019) 9:226. doi: 10.1038/s41398-019-0552-0

106. Poelman MP, Gillebaart M, Schlinkert C, Dijkstra SC, Derksen E, Mensink F, et al. Eating behavior and food purchases during the COVID-19 lockdown: a cross-sectional study among adults in the Netherlands. *Appetite.* (2021) 157:105002. doi: 10.1016/j.appet.2020.105002

frontiers | Frontiers in Psychology

TYPE Hypothesis and Theory
PUBLISHED 30 November 2022
DOI 10.3389/fpsyg.2022.996250

OPEN ACCESS

EDITED BY
Christopher J. Hopwood,
University of Zurich,
Switzerland

REVIEWED BY
Mohamad Motevalli,
University of Innsbruck,
Austria
Kate Sievert,
Deakin University,
Australia

*CORRESPONDENCE
Ben De Groeve
ben.de.groeve@gmail.com

SPECIALTY SECTION
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

RECEIVED 17 July 2022
ACCEPTED 27 October 2022
PUBLISHED 30 November 2022

CITATION
De Groeve B, Bleys B and Hudders L (2022) Ideological resistance to veg*n advocacy: An identity-based motivational account. *Front. Psychol.* 13:996250. doi: 10.3389/fpsyg.2022.996250

Ideological resistance to veg*n advocacy: An identity-based motivational account

Ben De Groeve[1]*, Brent Bleys[2] and Liselot Hudders[1,3]

[1]Center for Persuasive Communication, Department of Communication Sciences, Ghent University, Ghent, Belgium, [2]Department of Economics, Ghent University, Ghent, Belgium, [3]Department of Marketing, Innovation and Organisation, Ghent University, Ghent, Belgium

Animal-based diets in Western countries are increasingly regarded as unsustainable because of their impact on human health, environmental and animal welfare. Promoting shifts toward more plant-based diets seems an effective way to avoid these harms in practice. Nevertheless, claims against the consumption of animal products contradict the ideology of the omnivorous majority known as carnism. Carnism supports animal-product consumption as a cherished social habit that is harmless and unavoidable and invalidates minorities with plant-based diets: vegetarians and vegans (veg*ns). In this theoretical review, we integrate socio-psychological and empirical literature to provide an identity-based motivational account of ideological resistance to veg*n advocacy. Advocates who argue against the consumption of animal products often make claims that it is harmful, and avoidable by making dietary changes toward veg*n diets. In response, omnivores are likely to experience a simultaneous threat to their moral identity and their identity as consumer of animal products, which may arouse motivations to rationalize animal-product consumption and to obscure harms. If omnivores engage in such motivated reasoning and motivated ignorance, this may also inform negative stereotyping and stigmatization of veg*n advocates. These "pro-carnist" and "counter-veg*n" defenses can be linked with various personal and social motivations to eat animal products (e.g., meat attachment, gender, speciesism) and reinforce commitment to and ambivalence about eating animal products. This does not mean, however, that veg*n advocates cannot exert any influence. An apparent resistance may mask indirect and private acceptance of advocates' claims, priming commitment to change behavior toward veg*n diets often at a later point in time. Based on our theoretical account, we provide directions for future research.

KEYWORDS

animal-product consumption, identity and conflict, motivated cognitions, carnism, dietary change, veg*nism

Introduction

In Western countries, animal-based diets – i.e., diets centered around meat and other animal products (e.g., seafood, dairy, eggs) – are the norm and these diets are now spreading across the globe. This trend, however, is increasingly criticized by scientists (Graça, 2016; Ripple et al., 2017; Poore and Nemecek, 2018; Willett et al., 2019) and minorities with plant-based diets – i.e., diets centered around food derived from plants (e.g., vegetables, fruits, legumes, seeds, nuts) (Melina et al., 2016; Rosenfeld, 2018; Medawar et al., 2019). Although "plant-based diets" is an umbrella term that may include diets with fewer animal products (Hemler and Hu, 2019), the most prominent and norm-challenging plant-based diets are those of vegetarians (who eschew meat) and vegans (who eschew animal products in general; Rosenfeld, 2018).

Vegetarians and vegans (veg*ns) often oppose the consumption of animal products because of their impact on animal welfare, environmental sustainability and human health (Janssen et al., 2016; Rosenfeld, 2018; Hopwood et al., 2020). In the following sections, we discuss these three common "veg*n" motives as claims against animal-product consumption (§1.1). Next, we discuss resistance to veg*n dietary change among the omnivorous majority, including identity-based motivational resistance (§1.2). We then clarify the aim and structure of our article (§1.3).

Claims against animal-product consumption

Animal products and animal welfare

Because the animals farmed for food (chickens, pigs, ruminants, fish) are most probably sentient and able to suffer (Low, 2012; Fleischman, 2020), their mass production and instrumental use for consumption poses a pressing moral problem (Singer, 1975; Francione, 2020; Bruers, 2021). At any given moment, there are billions of vertebrate animals that are being farmed for food globally and most are raised in factory farms to maximize productivity (~74% of farmed land animals and virtually all farmed fish; Anthis & Anthis, 2019). Common sources of animal suffering include: intensive confinement in artificial conditions, unhygienic overcrowding, early mother-offspring separation and mutilating procedures (e.g., debeaking of chickens, tail docking of pigs, disbudding of cattle; Graça, 2016; Nordquist et al., 2017). Even "humane" slaughter typically involves stunning by a captive bolt, through electrocution or gas suffocation (Browning and Veit, 2020). To deny sentient beings bodily autonomy and care simply because they do not belong to the human species would be arbitrary species-based discrimination (i.e., speciesism; Bruers, 2021). Boycotting products for which animals were exploited and harmed by adopting a vegan lifestyle "as far as possible and practicable" seems to be a logically consistent approach to avoid speciesism and prevent suffering (Wrenn, 2018; Francione, 2020; Bruers, 2021). Likewise, avoiding the killing (i.e., vegetarianism) and exploitation of farmed animals (i.e., veganism) for consuming their flesh and byproducts as food is often a primary motive of veg*ns (Janssen et al., 2016; Rothgerber, 2017). Although animal rights arguments arguably provide the clearest challenge against animal-product consumption, the (over)consumption of animal products also poses environmental and health problems (Clark et al., 2019; Willett et al., 2019).

Animal products and environmental sustainability

Indeed, the widespread global consumption of animal products, particularly in Western countries, is a leading cause of urgent environmental problems, including the decimation of natural habitats and wildlife, nutrient pollution and global warming (Machovina et al., 2015; Springmann et al., 2016; Poore and Nemecek, 2018). While environmental impacts may vary considerably depending on the type of animal product and the producer (up to 50-fold for the same product; Poore and Nemecek, 2018), plant-based foods are generally less resource-intensive (excl. nuts, legumes) and polluting (Poore and Nemecek, 2018; Shepon et al., 2018), especially compared to red and ruminant meats (10–100 fold impact; Clark et al., 2019, 2022). Likewise, diets with less animal products (e.g., healthy meat-reduced, no ruminant meat, veg*n) offer substantial environmental benefits, with vegan diets being the most eco-friendly (Hallström et al., 2015; Chai et al., 2019). Although modern plant-based diets increasingly include highly processed animal-product alternatives (e.g., sausages, burgers), which are usually more impactful than minimally processed plant foods (MacDiarmid, 2021), actual animal products are overall still less environmentally sustainable than these alternatives (Bryant, 2022; Clark et al., 2022). Only in very rare cases a healthy diet with some meat (mainly local) is more sustainable than a veg*n diet (e.g., many processed foods from afar) (Chai et al., 2019). Directly allocating more plant crops for human consumption rather than feeding livestock would allow to reduce global food-feed competition and foster intra- and intergenerational equity while maintaining land to conserve biodiversity and regaining land to tackle climate change (Stoll-Kleemann and Schmidt, 2017; Poore and Nemecek, 2018).

Animal products and human health

Lastly, an excessive consumption of animal products that include high levels of saturated fat and cholesterol has been associated with chronic non-communicable diseases of welfare that lower life expectancies (Springmann et al., 2016; Wang et al., 2016; Clark et al., 2019; Barnard and Leroy, 2020). In particular, higher intakes of (un)processed red meat have been linked with cardiovascular disease (Wang et al., 2016), stroke (Kim et al., 2017), cancer (Wang et al., 2016), obesity (Rouhani et al., 2014) and type 2 diabetes (Neuenschwander et al., 2019). Nevertheless, the exact health effects of high meat consumption are difficult to disentangle because of potential confounding with (other) unhealthy behaviors (Boutron-Ruault et al., 2017). By contrast,

fish and seafood are typically associated with improved health (Clark et al., 2019, 2022), though the (over)exploitation of wild-caught sea-animals and aquaculture expansion also poses environmental and animal welfare problems (Lam, 2019). In addition, avoiding factory farmed animal products (esp. from chickens and pigs) may decrease the risk of spreading zoonotic infectious diseases (Karesh et al., 2012; UNEP, 2020; Hayek, 2022) and antibiotic-resistance related illness (Tang et al., 2017; Hayek, 2022).

A common motive among people to adopt veg*n diets is to prevent and treat diseases of welfare (e.g., obesity, type 2 diabetes, cardiovascular disease) (Radnitz et al., 2015; Cramer et al., 2017; Costa et al., 2019) and nutritional science indicates that well-planned veg*n diets may indeed serve this function (Melina et al., 2016; Medawar et al., 2019; Selinger et al., 2022). Nevertheless, it is important to note that plant-based diets can also be unhealthy if they include unhealthy ingredients (e.g., highly processed plant-based alternatives high in fat, sugar and salt) or exclude healthy plant-based foods (e.g., vegetables, fruits, whole grains, olive oil, nuts) (Clark et al., 2019; Barnard and Leroy, 2020; MacDiarmid, 2021). There is also weak evidence that a vegan diet increases the risk of bone fractures, which could be due to lower intakes of vitamin B-12, vitamin D, calcium and protein (Craig, 2009; Selinger et al., 2022). Vegan diets thus require a reliable source of these nutrients *via* fortified foods or supplements (other nutrients of potential concern are omega-3-fatty acids, taurine, iron and zinc) (McCarty, 2004; Craig, 2009). Another common health motive among veg*ns is the promotion of physical and mental fitness (e.g., lose weight and gain energy) (Radnitz et al., 2015; Cramer et al., 2017; Costa et al., 2019). Evidence as to whether veg*n diets improve or decrease mental health (e.g., depression) is, however, mixed and not robust (Rosenfeld, 2018; Selinger et al., 2022).

Although veg*n diets could in principle provide integrated solutions to avoid animal, environmental and health harms associated with animal-product consumption, veg*ns remain a minority and claims against animal-based diets are often resisted by members of the omnivorous majority (Morris et al., 2014; De Groeve and Rosenfeld, 2022). This resistance has sparked a lot of academic interest (Graça et al., 2019).

Resistance to veg*n dietary change

General barriers to veg*n dietary change

Over the past decades, a vast body of literature has emerged on the barriers and enablers to eat less animal products and to adopt veg*n diets (Corrin and Papadopoulos, 2017; Graça et al., 2019; Taufik et al., 2019), with important work on the history of meat-eating (Leroy and Praet, 2015; Chiles and Fitzgerald, 2018), reviews on the psychology of veg*nism (Ruby, 2012; Rosenfeld, 2018) and systematic reviews on interventions to reduce meat eating (Bianchi, Dorsel, et al., 2018a; Bianchi, Garnett, et al., 2018b; Harguess et al., 2020; Kwasny et al., 2022). Other reviews discussed meat reduction or plant-based diets/alternatives within the context of health promotion (Corrin and Papadopoulos, 2017; Bryant, 2022), pro-environmentalism (Hartmann and Siegrist, 2017; Bryant, 2022) and animal protection (Mathur et al., 2021). In addition, various theories have been applied to examine meat-eating (Povey et al., 2001; Graça et al., 2016; Grünhage and Reuter, 2021), including cognitive dissonance theory (Festinger, 1962) to gain insight in the meat paradox ("how can people care about animals, but also eat them?") (Loughnan et al., 2014; Lin-Schilstra and Fischer, 2020) and the psychology of meat-eating as a morally questionable and dissonance-arousing activity (Bastian and Loughnan, 2017; Rothgerber, 2020). This vast literature indicates that the promotion of meat reduction and veg*n dietary changes is held back by a complex and diverse set of barriers, involving both macro-level historical, economic, political, technological and societal barriers and micro-level psychological barriers concerning awareness and habitual behavior, conflicting goals and values, ambivalent feelings and moral disengagement (Graça, 2016; Graça et al., 2019; Harguess et al., 2020).

More in particular, vegetarian and especially vegan diets may be criticized for being a privilege that may not be achievable for everyone due to medical conditions (e.g., health disorders), increased vulnerability (e.g., childhood, pregnancy), restricted food access (e.g., food deserts, livestock dependency), a lack of nutrition literacy, time or money (Greenebaum, 2017; Leroy et al., 2020). Cooking with fresh plant foods may be time-consuming while highly processed plant-based convenience foods are less nutritious in comparison (MacDiarmid, 2021). In addition, besides veg*n dietary changes, "less but better" animal products (i.e., more healthy, eco- and animal-friendly) and production systems (e.g., agroecological, regenerative) could provide pragmatic solutions to improve the global food system and human, environmental and animal health (Sahlin and Trewern, 2022).

In response to these criticisms, one may argue that an insistence on 100% purity in vegan practice is counter-productive (*cf.* "as far as possible") (Leenaert, 2017) and that the ability to make healthy food choices in general is a luxury that requires nutrition literacy (Greenebaum, 2017). In addition, Bryant's (2022) meta-analysis indicates that plant-based convenience foods are generally more nutritious than the animal products they replace. However, nutritional profiles of plant-based alternatives are highly variable (see also Clark et al., 2022) and further improving their healthiness (e.g., reducing salt and increasing protein, iron, vitamin B-12 content), familiarity, price and sustainability is recommended. Lastly, the promotion of veg*n diets may be complemented with "less but better" strategies, although these strategies have been criticized for lacking clear implementation goals (Sahlin and Trewern, 2022), while veg*n diets provide clear goals that also challenge speciesism more strongly (Singer, 1975; Rosenfeld, 2019b). In either case, the extent with which animal-product consumption is avoidable in practice remains open for empirical

research. Although it is clear that omnivores may resist dietary change due to a wide variety of factors, our article elaborates on one potent motivational barrier: identity.

Identity-based motivated resistance to veg*n dietary change

More recently, there has been an increased attention on the influence of *social identity* on attitudes toward meat reduction and veg*nism, for example by considering the influence of political identity (Dhont and Hodson, 2014), gender (De Backer et al., 2020), species (Leite et al., 2019) and cultural identity (Ruby et al., 2016). Social identity refers to one's self-perception based on feelings of belonging to a particular social group (e.g., conservatives, females, humans) (Tajfel, 1972; Turner and Reynolds, 2010). According to social identity theory (Tajfel and Turner, 1979, 1986), people are able to flexibly construe themselves as individuals or group members across situations, depending on perceived similarities and differences in a social comparison context (Turner and Reynolds, 2010; Hogg, 2016). The theory postulates that people desire a positive and distinct identity which, through social comparison and identification, could explain why people are motivated to favor their own ingroup (i.e., ingroup favoritism) and discriminate against outgroups, even when they are categorized based on minimal criteria (e.g., preferring a painting of Klee vs. Kandinsky) (Abrams, 2001; Otten, 2016). Given that the mainstream ideology (called "carnism") legitimizes the consumption of animal products (e.g., as normal, natural, and necessary) (Joy, 2009, 2018) and delegitimizes veg*n minorities and veg*n practices (Joy, 2009, 2018), the omnivorous majority may resist changing their diet because they are motivated to protect their identity as consumers of animal products when confronted with an "outgroup" of veg*n advocates. What is currently missing in literature, however, is a comprehensive account of how ideological resistance to veg*n advocacy can be traced back to identity-based motivations.

Aim and structure of the present review

The aim of this theoretical review is to provide an identity-based motivational account to understand ideological resistance to veg*n advocacy (visualized in Figure 1). First, we discuss veg*n advocacy against animal-product consumption (§2.1): Veg*ns often internalize their diet in their moral identity (§2.1.1), which may motivate them to engage in veg*n advocacy and signal a moral identity by making claims that eating animal products is harmful and avoidable (§2.1.2). Next, we introduce the reader to the omnivorous majority, which may exhibit ideological (i.e., carnist) resistance to veg*n advocacy (§2.2.1). We theorize that this "carnist resistance" stems from a simultaneous threat to omnivores' moral identity and their identity as consumer of animal products (i.e., their carnist identity) (§2.2.2). To resolve moral/carnist identity threat, omnivores may rationalize their diet and obscure harms through motivated reasoning and motivated ignorance (i.e., pro-carnist defenses) (§2.2.3), which are theorized to inform negative stereotyping and stigmatization of veg*n advocates (i.e., counter-veg*n defenses), respectively (§2.2.4). We then discuss how these pro-carnist and counter-veg*n defenses are linked with different personal and social identity-based motivations (e.g., meat attachment, politics, gender) to maintain one's carnist identity (§2.2.5) and how these defenses ultimately allow to reject and ignore advocate claims, reinforcing commitment to and ambivalence about animal-product consumption (§2.2.6). Nevertheless, this does not mean that advocates cannot exert influence. Apparent resistance to advocates' claims may mask an indirect and private acceptance (i.e., conversion) and commitment to behavioral change (§2.3); this conversion can happen immediately (§2.3.1), but is often delayed (§2.3.2). Lastly, we provide directions for future research to test and qualify features of our account in the Discussion section (§3). One limitation we wish to disclose upfront, is that our work is mostly based on literature with WEIRD (i.e., Western, Educated, Industrialized, Rich, and Democratic) study samples and thus mainly representative for this study population.

Theoretical account

Veg*n advocacy against animal-product consumption

The veg*n minority and moral identity

As a minority (Martin et al., 2008), veg*ns are a numerically small group (about 2–10% in Western countries; Corrin & Papadopoulos, 2017) who typically hold moral, antinormative positions. Although veg*ns may have various motives for their diet – such as taste preference, religious or political beliefs, upbringing, influence of family and friends, and financial constraints (Ruby, 2012; Rosenfeld and Burrow, 2017), the three most common veg*n motives in Western countries include concerns about animal, environmental and health (see §1.1) (Janssen et al., 2016; Rosenfeld, 2018; Hopwood et al., 2020). These three motivations often co-occur (Janssen et al., 2016; Trethewey and Jackson, 2019) and may form a hierarchy with "more moral" motivations being viewed more positively (i.e., concerns about animals followed by environmental and then health concerns), especially among vegans (MacInnis and Hodson, 2021).

Because veg*ns often decide to consciously deviate from carnist norms based on strong moral motivations, they tend to strongly internalize their diet as an important aspect of who they are (Rosenfeld and Burrow, 2018; Rosenfeld, 2019b) and as a part of their *moral identity* (Chuck et al., 2016; Feinberg et al., 2019), i.e., their identity as a morally committed person and associated thoughts, feelings, and behaviors with regard to promoting or protecting the welfare of others (Aquino and Reed, 2002; De Groeve and Rosenfeld, 2022). The labels "vegetarian" and "vegan" may be a source of ingroup pride (Rosenfeld, 2018), facilitate cooperative group formation (Smaldino, 2019) and moral identity signaling (Aquino and Reed, 2002; Paxman, 2016), so that

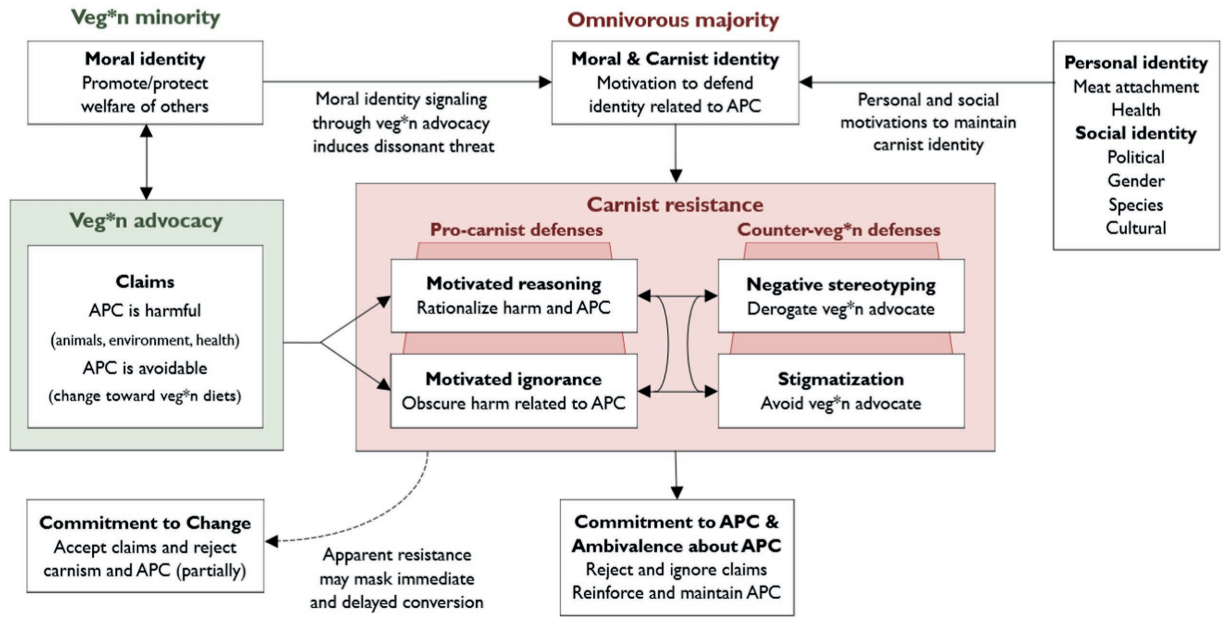


FIGURE 1
Identity-based Motivational Account of Carnist Resistance to Veg*n Advocacy. Veg*n minorities who engage in advocacy signal a moral identity by making claims that animal-product consumption (APC) is harmful and avoidable. This may evoke carnist resistance among the omnivirous majority, which may ultimately reinforce commitment to and ambivalence about APC. However, apparant resistance may mask immediate and delayed conversion (i.e., indirect and private acceptance of the advocates' claims), priming commitment to behavioral change. We assume veg*n advocates' primary claims consider the impact of APC on animal welfare, followed by concerns about environmental welfare and human health. Our account is explained in detail in the article.

omnivores may readily perceive veg*ns as morally committed advocates who attract attention for "their" cause (Markowski and Roxburgh, 2019; De Groeve et al., 2021).

Veg*n advocacy and moral identity signaling

Indeed, there are a lot of actions veg*ns may partake to promote their diet and moralized identity, such as sharing messages on social media, signing petitions, donating money to campaigns and/or protesting (Thomas et al., 2019). Veg*ns may participate in various education and community engagement – from cooking and sharing veg*n food with others, to writing books or articles, to engaging in outreach (e.g., giving lectures, advertising stalls) (Chuck et al., 2016; Paxman, 2016). Yet, there is a lot of heterogeneity in how veg*ns construe their identity and engage in different forms of advocacy (Chuck et al., 2016; Paxman, 2016; Thomas et al., 2019). While only a radical minority engages in illegal actions such as clandestine investigations and animal rescue operations in pursuit of social change (Thomas et al., 2019), many veg*ns may detach from the veg*n label in some circumstances, see it as a personal burden, and are reluctant to discuss their dietary preferences with others (Chuck et al., 2016; Paxman, 2016; Rosenfeld and Tomiyama, 2019).

Based literature on veg*ns' main motives and collective goals (MacInnis and Hodson, 2021; De Groeve and Rosenfeld, 2022), we presuppose that veg*n advocacy primarily involves claims that animal-product consumption harms animals, while claims about environmental and/or health harms are secondary. Stronger moral convictions, a stronger rejection of carnist and speciesist majority beliefs and a higher perceived inconsistency between moral vs. majority beliefs may motivate activism (Piazza et al., 2015; Harrington et al., 2022). In addition, Judge et al. (2022) showed that more principled convictions predict engagement in vegan advocacy *via* a stronger identification with other vegans and animals, perceived collective efficacy and moral outrage. Although pragmatic veg*n advocates may welcome incremental dietary changes (i.e., eating *less* meat/animal products rather than none) based on various motives, the desire to communicate a clear moral identity with consistent goals may cause veg*ns to dissociate from other self-identified veg*ns who do not share the same motives (e.g., categorizing health-motivated veg*ns as merely plant-based dieters) or calls for change (e.g., dismissing incremental changes as hypocritical) (Leenaert, 2017; MacInnis and Hodson, 2021; De Groeve and Rosenfeld, 2022). Advocates who clearly signal a moral identity are likely to evoke carnism-induced ideological resistance among members of the omnivorous majority (De Groeve and Rosenfeld, 2022; De Groeve et al., 2022).

Carnist resistance to veg*n advocacy

The omnivorous majority and carnist resistance

Although humans have gradually included meat in their diet over evolutionary history, the prevalent consumption of animal products only became the norm in Western countries over the last

century (Graça, 2016; Chiles and Fitzgerald, 2018). Joy (2009) introduced the term "carnism" to refer to the normative belief system that legitimizes animal-product consumption as a given rather than a choice, rendering associated harms "invisible." Indeed, many people nowadays are socialized to adopt a diet rich in animal products as a part of their identity, which is by default deemed appropriate and therefore unlabeled (Bastian and Loughnan, 2017; de Boer et al., 2017). Consequently, omnivores generally do not consider their diet as a central aspect of who they are or take pride in their diet (Piazza et al., 2015; Rosenfeld and Burrow, 2018). Although omnivores generally care about animal welfare and, to some extent, the environment (Trethewey & Jackson, 2019), they tend to dissociate these values from their dietary pattern (Lacroix and Gifford, 2019; Rothgerber, 2020) and do not report prosocial/moral motives to follow their diet (Rosenfeld and Burrow, 2018). The most common reasons for eating meat include taste, habit, upbringing, convenience (e.g., socially, practically, financially), and perceived health of eating meat (Povey et al., 2001; Mullee et al., 2017; Lacroix and Gifford, 2019). Compared to veg*ns, omnivores are moderately more likely to endorse conventional values that bind groups together, including power/authority, loyalty and purity (Graham et al., 2013; Grünhage and Reuter, 2021; Holler et al., 2021).

Because the omnivorous diet is conventional, majority norms exert a strong immediate influence on omnivores. One reason for majority's social power is that majority membership protects against social rejection (Martin et al., 2008): eating and sharing animal products is a way to facilitate social bonding and different animal foods may characterize different nations (e.g., Australian meat pies), celebrations (e.g., Thanksgiving Turkey) or (sub) cultures (Markowski and Roxburgh, 2019; Nguyen and Platow, 2021). For example, in Western countries many people love dogs and eat pigs (Joy, 2009), while eating dogs may be acceptable in some Asian countries (Podberscek, 2009) and eating pigs is forbidden by Islamic and Judaic scripture (Farouk et al., 2015). Majorities also exert a powerful influence because individuals may doubt their own convictions in the face of the majority (Martin et al., 2008; Bolderdijk and Jans, 2021; May and Kumar, 2022). Conforming to majority norms (e.g., eat what your peers eat) enables fast and frugal decision making, obviating the need for individuals to extensively deliberate on food choice (Henrich et al., 2001). Unsurprisingly then, one of the most persistent barriers to follow more plant-based diets are conformity pressures (Ruby, 2012; Leenaert, 2017; Lacroix and Gifford, 2019).

Conformity pressures may explain why meat reduction initiatives may evoke considerable resistance (Morris et al., 2014) and why omnivores often report having experienced conflict with veg*ns, who oppose the majority's carnist ideology (Guerin, 2014; Piazza et al., 2015; Markowski and Roxburgh, 2019). Conversely, veg*ns can be targets of anti-veg*n bias (Earle and Hodson, 2017) such as social stigma and negative stereotypes (Chin et al., 2002; Minson and Monin, 2012; MacInnis and Hodson, 2017; Markowski and Roxburgh, 2019; De Groeve and Rosenfeld, 2022). Joy (2018) distinguishes two sets of psychological defenses people use to maintain animal-product consumption and resist change, which we refer to as "carnist resistance": (1) defenses that legitimize the consumption of animal products (i.e., pro-carnist defenses) and (2) defenses that delegitimize veg*nism (i.e., counter-veg*n defenses). These two defenses resemble a tendency of people to selectively seek and process information that confirms one's identity or position (i.e., confirmation bias), while being disproportionally more critical of refuting information (i.e., disconfirmation bias; Taber and Lodge, 2012). At the same time, it is important to note that defensive and stigmatizing attitudes are dynamic and may vary considerable across individuals, cultures and contexts (Paxman, 2016; MacInnis and Hodson, 2017). Individual variation and the versatility of the human mind (e.g., identities, language) through time should prevent us from essentializing identity categories. As we analyze carnist resistance further, we will consider more variety among omnivores in how they might respond to veg*n advocacy.

Carnist resistance as a consequence of moral-carnist identity threat

Most research that examined carnist resistance until now has relied on cognitive dissonance theory (Festinger, 1962) to explain the maintenance of meat consumption as a morally-conflicting behavior (i.e., the meat paradox) (Bastian and Loughnan, 2017; Lin-Schilstra and Fischer, 2020; Rothgerber, 2020). Cognitive dissonance refers to a state of negative arousal that arises when someone holds two contradictory cognitions, typically involving a behavior versus an attitude (e.g., eating meat but caring for animals). Subsequently, individuals are motivated to resolve this perceived inconsistency either by changing one's behavior (e.g., refusing to eat meat) or by changing one's attitudes (i.e., defending meat consumption).

In our account of carnist resistance, we draw on revisions of cognitive dissonance theory that integrate the role of identity or the self-concept (Cooper, 2007). Self-based revisions of dissonance theory assert that perceived attitude-behavior inconsistencies do not just arouse dissonance due to a perception of inconsistency between two cognitions (Festinger, 1962), but that dissonance only occurs to the extent that it involves a threat to the self (Cooper, 2007): When a behavior is perceived as contradicting one's self-concept in Aronson's (1968) self-consistency account, or when it challenges one's self-integrity as a moral and competent person in Steele's (1988) self-affirmation account. These accounts are in line with the postulate that humans desire a positive and distinct identity (Hogg, 2016). Consequently, omnivores are likely to experience self-threat when veg*n advocates signal a moral identity by claiming that animal-product consumption entails avoidable harm. More specifically, such an exposure may readily threaten omnivores' own moral identity (Bastian and Loughnan, 2017; De Groeve and Rosenfeld, 2022). In addition, although omnivores generally view eating animal products as a given and not as central to their identity (Joy, 2009; Rosenfeld and Burrow, 2018), a confrontation with veg*n advocates may increase the salience of omnivores' *carnist identity* – their identity as consumers

of animal products (or non-veg*ns) and the thoughts, feelings and behaviors associated with it (De Groeve and Rosenfeld, 2022). Based on this theorizing, Minson and Monin (2012) their measure of anticipated moral reproach (e.g., "If they saw what I normally eat, most vegetarians would think I am extremely (im)moral.") can be construed as a proxy of moral/carnist identity threat and the meat paradox can be construed as an inconsistency between omnivores' moral and carnist identity, which omnivores are motivated to resolve in order to maintain a positive identity and avoid dissonant feelings of self-threat. Our theorizing is also consistent with the New Look model of dissonance, according to which individuals reduce dissonance to render consequences of behavior non-aversive (Cooper, 2007).

Based on research on the meat paradox, meat-related dissonance (e.g., Bastian and Loughnan, 2017; Rothgerber, 2020), moral disengagement (Graça et al., 2016) and research on identity-protective and motivated cognition (Kunda, 1990; Kahan, 2013; Williams, 2020; May and Kumar, 2022), a distinction can be made between two broad categories of pro-carnist defenses omnivores employ to resolve moral/carnist identity threat: (1) motivated reasoning and (2) motivated ignorance. Below, we will shortly discuss these motivated defenses and clarify their interrelationship with counter-veg*n defenses in the form of negative stereotyping and stigmatization. We note that our discussion is mainly focused on defenses against animal welfare claims because these embody the primary motive for veg*n advocacy (MacInnis and Hodson, 2021) and have been studied most extensively. In addition, environmental and especially health claims pro veg*nism may be less persuasive or arouse less dissonance (De Groeve and Rosenfeld, 2022; Silva Souza and O'Dwyer, 2022).

Pro-carnist defenses: Motivated reasoning and motivated ignorance

Motivated reasoning: Rationalize harm and animal-product consumption

When omnivores are exposed to veg*n advocates, we argue that they are likely to experience dissonance because their claims are difficult to ignore (De Groeve and Rosenfeld, 2022), subsequently arousing a motivation to actively defend their salient carnist identity by engaging in motivated reasoning (Rothgerber, 2020). *Motivated reasoning* involves arriving at a particular position one wants to arrive at (Kunda, 1990), which allows for reducing dissonance (Rothgerber, 2020), affirming one's identity (Kahan, 2013) and expressing loyalty to groups one depends on for material and social support (Kahan, 2013). Defense mechanisms relying on motivated reasoning justify eating animal-derived products as relatively harmless and/or as difficult or impossible to avoid, implying a denial of responsibility (Bastian and Loughnan, 2017). These dissonance-reducing defenses have also been described as unapologetic or direct/active defenses in literature on meat-related dissonance (Hartmann and Siegrist, 2020; Rothgerber, 2020) and distort evidence showing that eating animal products involves avoidable harm.

Omnivores may rationalize harm by denying the collateral damage associated with eating animals for the environment, public health and animal welfare (Rothgerber, 2013; Graça et al., 2016). Eating animal products may be rationalized as unavoidable (i.e., a requirement) by endorsing "the 4Ns" (Piazza et al., 2015, 2020; Hopwood et al., 2021a): the belief that consuming animal products is *Necessary* for one's health, too *Nice* or enjoyable to forego, a *Normal* practice that is socially desirable and something *Natural* to do. Omnivores may also feel morally licensed to eat animal products if they endorse speciesism and human supremacy over animals and the natural environment (Graça et al., 2016; Caviola et al., 2019), for example through hierarchical and fate justifications (e.g., humans are on the top of the food chain and meant to eat animals) and religious licensing (i.e., God intended for us to eat animals; Rothgerber, 2013). Furthermore, omnivores may deny or diffuse responsibility by expressing moral outrage and blaming third parties such as industries, society and government (Graça et al., 2016; Rothgerber, 2020; Silva Souza and O'Dwyer, 2022).

These defensive rationalizations are reminiscent of a fight-response to stress (Cannon, 1932) and Joy's (2009) characterization of carnism as a power-oriented ideology that supports a culture of violence. Various institutions are complicit by catering to omnivores' confirmation bias: Animal farming industry and stakeholder groups have a powerful interest to externalize production costs and reinforce a cheap, ubiquitous supply of animal products (Weis, 2013); existing laws and advertisements often convey the falsely reassuring message that farmed animals are treated humanely without needless suffering (Bastian and Loughnan, 2017; Francione, 2020; Clare et al., 2022), and media coverage of veganism tends to confirm the ideological preferences of their audience (Cole and Morgan, 2011).

Although omnivores who are more committed to their diet are more likely to engage in motivated reasoning (Rothgerber, 2013, 2020; Piazza et al., 2015; Graça et al., 2016), it is relevant to note that rationalizations in support of animal-product consumption are typically not strongly endorsed by omnivores (Rothgerber, 2013; Piazza et al., 2015; Monteiro et al., 2017). This may indicate that these defenses mainly serve to maintain a mostly habitual activity once ambivalent thoughts or feelings about eating animal products come to mind (Buttlar and Walther, 2018; Piazza, 2020). Omnivores may also vary considerably in how they respond to veg*n advocates. In between radical vegan activists and deliberate anti-veg*ns at two opposing ends of a putative dietarian-ideological continuum (De Groeve and Rosenfeld, 2022; Gregson et al., 2022; Verain et al., 2022), omnivores' attitudes may be less outspoken and more ambivalent (Povey et al., 2001; Berndsen and Van Der Pligt, 2004; Graça, Calheiros, et al., 2015a). For example, people who consciously eat less meat (i.e., flexitarians) may still belong to the omnivorous majority, but resemble veg*ns in that they deviate from carnist norms (Rosenfeld, 2018). Likewise, their attitudes toward meat and vegetarianism often fall in-between

those of conventional omnivores and veg*ns (Rosenfeld, 2018) and flexitarians are less likely to defend meat-eating through motivated reasoning (Rosenfeld, 2018; Rosenfeld et al., 2019; De Groeve et al., 2022).

As motivated reasoning involves defending oneself using reasons irrespective of their accuracy (Williams, 2020) and arriving at a particular position one wants to arrive at (Kunda, 1990), it is typically related with a motivation to avoid acquiring certain information contradicting this position: motivated ignorance (Williams, 2020), most clearly expressed in the form of denial (Piazza et al., 2015; Rothgerber, 2020). However, if people are more ambivalent about eating animal products, motivated ignorance may suffice as a defense mechanism on itself without actively defending one's carnist identity through motivated reasoning (Rothgerber, 2020).

Motivated ignorance: Obscuring harm related to animal-product consumption

Although motivated (or strategic) ignorance generally refers to an avoidance of acquiring available information that is perceived as potentially aversive, it may also involve the distortion or obfuscation of information (Onwezen and van der Weele, 2016; Golman et al., 2017), motivated forgetting, a refusal to acknowledge what one knows (willful ignorance), and self-deception (Golman et al., 2017). Identity-protective motivated ignorance may be socially adaptive, as it allows people to blend in with desirable groups and avoid social sanctions (Williams, 2020). Concerning animal-product consumption, defense mechanisms relying on motivated ignorance obscure evidence of harm related to animal-product consumption (Rothgerber, 2020). These defenses are also described as dissonance-preventing, indirect or apologetic defenses in literature on meat-related dissonance (Hartmann and Siegrist, 2020; Rothgerber, 2020), allowing omnivores to avoid carnist identity threat and comply with the omnivorous majority.

Motivated ignorance is evident in omnivores who avoid information about the sentient minds of farmed animals (Buttlar and Walther, 2018; Leach et al., 2022) and factory farming conditions (Cornish et al., 2016; Onwezen and van der Weele, 2016). Consumers may also dissociate vegan diets from animal rights philosophy (Lundahl, 2020) and animal products from their animal origins so that farmed animals and their suffering remain hidden (Benningstad and Kunst, 2020). Animal harms can also be obscured if consumers dichotomize animals in those who are farmed for food (i.e., treated as objects) and those who are kept as companion animals (i.e., treated as subjects) (Amiot et al., 2019; Rothgerber, 2020) or if harm is neutralized by claiming that meat is only rarely eaten or ethically sourced (Rothgerber, 2015, 2020; Dowsett et al., 2018). For example, a recent US survey found that, while consumers on average believed that 69% of animals are factory farmed, many reported thinking that animals are treated well (62%) and that they usually buy animal products from humanely raised animals (Reese, 2021). Evidence of a rising flexitarian self-identification combined with stable and high self-reported meat consumption levels has been reported for the Netherlands (Dagevos, 2021). Another recent study showed that consumers may willfully disregard solutions targeting factory farming to prevent future pandemics, especially if they are meat-committed (Dhont et al., 2021). Socially motivated ignorance and fear of ostracism could play a role in climate change skepticism in (conservative) groups where expressing concern about global warming is identity-inconsistent (Williams, 2020). Socially motivated ignorance may reinforce pluralistic ignorance, a situation where individuals privately reject a norm, but are swayed to comply with the majority position because they falsely assume that others privately endorse it (Delon, 2018). In this way, omnivores can (privately) identify as being animal-and eco-friendly (Trethewey and Jackson, 2019) or morally condemn conventional farming conditions when reading about it (Hartmann and Siegrist, 2020) without considering themselves responsible for its problems (Graça et al., 2016). A considerable amount of US consumers even favors banning factory farming (51%), slaughterhouses (45%) or all animal farming (36%) (Reese, 2021), while not adopting congruent dietary behavior that may reduce ambivalent feelings about eating meat (Povey et al., 2001).

Defenses relying on motivated ignorance are reminiscent of a flight-response to stress (Cannon, 1932) and Joy's (2009) characterization of carnism as an "invisible" ideology that supports a culture of silence where the implicit norm is to speak no harm, hear no harm and see no harm. How people produce, promote, prepare and talk about animal products obscures the link between the product and its animal origins (Benningstad and Kunst, 2020). For example, meat consumers may feel more apathy toward animals and feel less disgusted by eating meat if the killing of farmed animals is described as "harvesting," if the flesh of animals (pigs, cows) is described in culinary terms (pork, beef), or if the meat resembles the original animal less rather than more (Kunst and Hohle, 2016). Animal farming industry uses similar tactics as the tobacco and fossil industry to mystify harm, while encouraging ongoing consumption (Clare et al., 2022). Bastian and Loughnan (2017) elaborate on how information avoidance may spread and become embedded in minds and cultures and how habits, institutions and rituals may operate like a veil of ignorance. In what follows, we discuss how motivated cognitions (i.e., pro-carnist defenses) among omnivores may reinforce the negative stereotyping and stigmatization (i.e., counter-veg*n defenses) of veg*n advocates who pierce this veil of ignorance by challenging animal-product consumption (Rothgerber, 2020; De Groeve and Rosenfeld, 2022).

Counter-veg*n defenses: Negative stereotyping and stigmatization of veg*n advocates

Motivated reasoning informs negative stereotyping of veg*n advocates

According to self-categorization theory (Turner et al., 1987; Hogg, 2016), stereotypes are not just mental representations of a

social category (i.e., prototypes) that are widely shared among people, but also serve the social function to justify ingroup behavior (Hornsey, 2008; Turner and Reynolds, 2010). As such, negative stereotypes that derogate the veg*n outgroup can be connected with motivated reasoning to justify one's carnist identity and diet. Although the content of stereotypes typically revolves around a stable core (e.g., vegetarians do not eat meat), their expression may differ depending on the social comparison context (Hogg, 2016). For example, (negative) stereotyping may depend on how visible or voluntary one's veg*n identity is or on the extent that a veg*n identity is seen as socially disruptive or threatening (Greenebaum, 2012; Minson and Monin, 2012; Guerin, 2014; Rothgerber, 2014).

Although veg*ns may be appreciated for their perceived morality, commitment and their animal-loving, eco-friendly and healthy image (De Groeve et al., 2021), arguably the most salient negative stereotype associated with veg*n identities, is that they are moralistic (Markowski and Roxburgh, 2019; De Groeve et al., 2021; De Groeve and Rosenfeld, 2022). This moralistic stereotype reflects a social truth to some extent, because veg*ns may generally look down on omnivores more than omnivores look down on veg*ns (Rosenfeld and Burrow, 2018; Rosenfeld, 2019a), arguably because they are more likely to strongly identify as a group challenging (vs. defending) the status quo (Bäck and Lindholm, 2014) and view the consumption of animals for food as immoral and disgusting (Povey et al., 2001). Similarly, vegans may negatively judge vegetarians as hypocrites and akin to omnivores for still consuming dairy and eggs (thus supporting the exploitation of cows and chickens) (Povey et al., 2001; Ruby, 2012; Plante et al., 2019). Nonetheless, research also suggests that omnivores may overestimate the extent with which vegetarians look down on them and a stronger anticipated moral reproach predicts more negative stereotyping (Minson and Monin, 2012). Omnivores' moralistic perceptions of veg*ns may partly stem from defensively distorting moral commitment perceptions to resolve the meat paradox and carnist identity threat (De Groeve and Rosenfeld, 2022). Omnivores are more likely to stereotype vegans (vs. vegetarians) as moralistic (De Groeve et al., 2021), especially if vegans have animal ethics (vs. health) motivations and engage in public advocacy (De Groeve et al., 2022), and if veg*ns' communication is static and results-oriented rather than dynamic and process-oriented (Weiper and Vonk, 2021).

Although moralistic stereotypes appear to be the most pervasive, De Groeve and Rosenfeld (2022) argue that the rationalization that animal-product consumption is relatively harmless supports the stereotyping of veg*ns as overly sensitive and effeminate, while 4Ns endorsements that make animal-product consumption seem practically unavoidable may be reinforced by stereotyping veg*ns as opposing the Ns: weird, eccentric and unsociable (not normal), too boring (not nice), unnatural (not natural), hypocritical and unhealthy (by opposing the claimed nutritional necessity of animal products). Just like motivated reasoning can be seen as a manifestation of motivated ignorance, negative stereotyping is but one expression of stigmatization, and studies reveal that veg*n stigma and motivated ignorance about the harms related to animal products are interconnected (Markowski and Roxburgh, 2019; Rothgerber, 2020).

Motivated ignorance informs stigmatization of veg*n advocates

To stigmatize someone, is to identify them as deviant, label them and negatively stereotype them, which serves to otherize and discriminate individuals as outgroup members, resulting in a "spoiled" identity and status loss for the stigmatized (Link and Phelan, 2001; Major and O'Brien, 2005). Put differently, stigmatized individuals are socially marked as unaccepted and to be avoided (Kurzban and Leary, 2001). Arguably the most extensive study examining stigmatization of veg*ns was conducted by MacInnis and Hodson (2017), who showed that veg*ns, in particular vegans, were rated equivalently or significantly more negatively than other targets of prejudice (e.g., Black people). People were more likely to avoid veg*ns in general, as friends or as potential partners if they more strongly identified as meat-eaters. Conversely, 46% of vegetarians and 67% of vegans reported some level of discrimination in their lives and some vegans even reported decreased contact with friends (25%) and family (10%) after disclosing being vegan. Veg*ns often engage in stigma/impression management strategies to navigate and smoothen social interactions with omnivores and present their identity in a more positive light (Greenebaum, 2012; Paxman, 2016; Rosenfeld and Tomiyama, 2019), for example by selectively disclosing their identity and communicating strategically about their diet to avoid defensiveness or feelings of guilt among omnivores. Despite clear evidence of stigmatization, we reiterate that this is a dynamic context-dependent phenomenon. In general, views of veg*ns are often rather positive, yet mixed and more negative toward vegans (Corrin and Papadopoulos, 2017; De Groeve et al., 2021), resembling ambivalent feelings toward meat (van der Weele, 2013; Graça, Oliveira, et al., 2015b).

In the context of veg*n advocacy, stigmatization allows omnivores to resist and avoid advocate claims to maintain their carnist identity (Markowski and Roxburgh, 2019). Zane et al. (2016) directly demonstrated a link between stigmatization and motivated ignorance by showing that consumers who willfully ignored ethical product information derogated consumers who did inform themselves before purchasing products. Likewise, the derogation of veg*ns (Minson and Monin, 2012) can be traced back to motivated ignorance among omnivores about the moral implications of their diet (Rothgerber, 2020). By "shooting the (veg*n) messenger" (Joy, 2018) or "condemning the condemner" (Cole and Morgan, 2011; Rothgerber, 2020) omnivores may deflect attention from messages that morally condemn their dietary behavior and carnist identity (De Groeve and Rosenfeld, 2022). Likewise, Cole and Morgan (2011) interpreted evidence of vegan stigma in UK national newspapers as a reflection of motivated ignorance about the ethics of exploiting and killing animals. The link between stigmatization and motivated ignorance

is also vividly expressed by an omnivorous participant in Guerin's (2014) focus group study: *"I do not want people to get in my face and tell me the gory details of where meat comes from while I'm eating a burger. I mean, I've never been pressured to stop eating it or anything but I would probably just be put-off and ignore them."* (p. 16). By voicing concerns about people pushing against meat, omnivores may mark vegetarian advocates as ignorable. Conversely, focus group studies among veg*ns also provide vivid examples of the link between stigmatization and motivated ignorance (Greenebaum, 2012), as one vegetarian notes: *"I learned along the way that the majority of people have no idea how the animal gets to that plate. They are just completely ignorant about that. And when I start talking about it they just tell me to shut up."* (p. 315). Although actively derogating veg*ns by voicing negative stereotypes provide the clearest example of stigmatization, it can also be expressed as passive avoidance (e.g., decreased contact family and friends) (MacInnis and Hodson, 2017). Ultimately, we theorize that the stigmatization and negative stereotyping of veg*ns discussed above serve to protect personal and/or social motivations tied with one's carnist identity. Below, we discuss how pro-carnist and counter-veg*n defenses can be linked with some of the most potent personal and social identity-based motivations to maintain a carnist identity.

Pro-carnist and counter-veg*n defenses: Personal and social identity-based motivations

Personal identity

Meat attachment

Veg*n advocates may pose a threat to the self-interest in maintaining a carnist identity. Self-interest, which is often connoted with hedonistic attachment, forms an obvious barrier against moralizing animal-product consumption and making personal sacrifices for the common good (Feinberg et al., 2019). People who eat more meat and identify more strongly as a meat-eater tend to have a stronger personal attachment to eating meat, causing them to morally disengage from meat production harms (Graça et al., 2016) through motivated reasoning to justify meat (Piazza et al., 2015; Verain et al., 2022) and motivated ignorance of animal minds (Leach et al., 2022), dismissive reactions toward meat substitution (Graça et al., 2016) and stigmatizing attitudes toward veg*ns (Dhont and Hodson, 2014; Earle and Hodson, 2017; Vandermoere et al., 2019). Those who are less attached to meat and more willing to change their diet (e.g., flexitarians) are less likely to engage in motivated reasoning and negative stereotyping of veg*ns (Minson and Monin, 2012; De Groeve et al., 2022).

Health

Healthy eating may also be a personal motive to eat meat. Nevertheless, previous studies found that identifying oneself as a healthy eater does not predict self-reported meat consumption (Trethewey and Jackson, 2019) or intentions to eat (less) red meat (Carfora et al., 2017), but that it does predict fruit and vegetable intake (Carfora et al., 2016) and intentions to follow vegetarian or plant-based diets (Povey et al., 2001; Graça et al., 2019). Although veg*ns and plant-based foods are often perceived as healthy, veg*nism may be perceived as unhealthy to the extent that animal products are seen as more nutritionally adequate or necessary (De Groeve and Rosenfeld, 2022; Gregson et al., 2022). In addition, more processed foods are generally seen as less healthy, which poses a barrier for promoting (healthy) plant-based animal-product alternatives (Bryant, 2022; Hartmann et al., 2022).

Social identity

Political identity

Conservatives may be more socially motivated to maintain their carnist identity. People who identify as meat-eaters more strongly and eat more meat are more likely to endorse conservativism (Allen and Ng, 2003; Dhont and Hodson, 2014), typically characterized as two dispositional tendencies: (a) right-wing authoritarianism (RWA, i.e., a preference for tradition and punishment of non-conformists), which predicts a higher endorsement of conventional values (i.e., authority, loyalty, purity), and (b) social dominance orientation (SDO, i.e., a preference for hierarchical domination over lower-status groups), which predicts a lower endorsement of a postconventional, universal morality that prioritizes the welfare of individuals (i.e., harm avoidance, justice) (Federico et al., 2013; Dhont and Hodson, 2014; Kugler et al., 2014). Conservatives may partly identify as meat-eaters more strongly because veg*ns pose a threat to traditional ways of life *via* RWA (Dhont and Hodson, 2014; Judge and Wilson, 2019; Leite et al., 2019) and because meat – in particular red meat – symbolizes power, inequality, and human supremacy over nature and animals *via* SDO (Allen and Ng, 2003; Dhont and Hodson, 2014). Veg*ns' status as egalitarian norm-violators – reflected by stereotypes that they are liberal, hippies and pacifists (Sadalla and Burroughs, 1981; Minson and Monin, 2012; De Groeve et al., 2021) – may generate pushback against them to defend the dominant carnist ideology (Dhont and Hodson, 2014; MacInnis and Hodson, 2017; Monteiro et al., 2017). Given that conservatives often use moralistic stereotypes (e.g., social justice warrior, snowflake) as slurs against progressive ideas (Prażmo, 2019), conservatives may be more likely to view veg*ns as arrogant competitors overcommitted to change society (Dhont and Hodson, 2014; Judge and Wilson, 2019). Research among current and former vegetarians shows that those higher on conservativism are significantly more likely to have lapsed into meat-eating, mainly because of lower social justice motivations, but also because of a lack of social support (Hodson and Earle, 2018). Given that conservativism has also been analyzed as a motivated social cognition that varies situationally (not only dispositionally) to deal with uncertain, dangerous (*cf.* RWA) and competitive (*cf.* SDO) environments (Jost et al., 2003; Sibley and Duckitt, 2013) and that animal-product consumption remains widespread, liberals may resemble conservatives in their resistance

to advocacy and dietary change. Nevertheless, liberals generally feel less threatened by veg*ns (MacInnis and Hodson, 2017) and liberals and centrists who eat more meat may be more likely to exhibit motivated ignorance (avoidance, dissociation and dichotomization; Grünhage & Reuter, 2021). A lower meat consumption and veg*nism has been associated with a higher endorsement of universal values, empathy and openness (Keller and Siegrist, 2015; Holler et al., 2021), which oppose SDO and RWA (Sibley and Duckitt, 2013).

Gender identity

Veg*n advocates may also pose a threat to masculine identities. Across cultures, eating meat – in particular red meat – is linked with traditional notions of masculinity, which assert that "real" men are strong, virile and emotionally stoic (Rothgerber, 2013). Consequently, men may be socially motivated to show off their meat consumption to signal their masculinity in particular situations (Rothgerber, 2013; Rosenfeld, 2018). Omnivores, in particular omnivorous men, may rate vegetarian men more negatively than vegetarian women, arguably because vegetarianism is incongruent with traditional masculinity (MacInnis and Hodson, 2017; Rosenfeld, 2018). For instance, the link between meat and "masculine" values to be dominant and physically strong contrasts with the lower social status of veg*n minorities and their reputation as being physically weak and sentimental (Rothgerber, 2013; Corrin and Papadopoulos, 2017). Men, especially those who endorse traditional masculinity, rationalize meat-eating more (Hinrichs et al., 2022) and may derogate vegetarians to avoid appearing emasculated or feminine (Ruby and Heine, 2011; MacInnis and Hodson, 2017), though promoting plant-based eating does not necessarily increase defensiveness (Hinrichs et al., 2022). Traditional masculinity can be juxtaposed with new forms of masculinity characterized by valuing authenticity, holistic self-awareness and nurturing, and questioning male norms and privileges (De Backer et al., 2020). A stronger endorsement of new masculine values predicts a lower meat attachment and more positive attitudes toward vegetarians (De Backer et al., 2020). Compared to men, women are generally more willing to reduce their meat intake or be(come) veg*n (Ruby, 2012; Rosenfeld, 2018). Overall, women (vs. men) are more health-conscious (VanHeuvelen and VanHeuvelen, 2019), endorse universal values more strongly (Hayley et al., 2015; Rosenfeld, 2018) and are more likely to report that eating meat is unhealthy and harms the environment and animals (Mullee et al., 2017; Possidónio et al., 2019). Women are less likely to defend their diet through motivated reasoning (dissociation and avoidance are more common) (Rothgerber, 2013, 2020) and to stigmatize vegetarians (Vandermoere et al., 2019) and more likely to admire vegetarians (Ruby et al., 2016). Some studies, however, only found small or negligible gender differences in stereotyping (De Groeve et al., 2021, 2022).

Species identity

Veg*n advocates may also evoke resistance because their diets challenge speciesism and human supremacy, i.e., the belief that humans are distinct from and superior to non-human animals (Dhont & Hodson, 2014; Leite et al., 2019; Caviola et al., 2019, 2022). Meat-attached people are more likely to endorse human supremacy (Graça, Calheiros, et al., 2015a), which predicts a willingness to exploit animals and eat more meat (Dhont and Hodson, 2014). Monteiro et al.'s (2017) carnism measure, which seems to combine human supremacy beliefs ("carnistic dominance") and meat-eating justifications ("carnistic defense"), is strongly correlated with seeing vegetarianism as a cultural threat, suggesting that omnivores who strongly endorse human supremacy and speciesism are more likely to defend animal-product consumption through motivated reasoning (see also Piazza et al., 2015; Graça et al., 2016). While vegetarianism threat increases negative feelings about eating meat, human supremacy and 4N endorsement may alleviate such feelings (Amiot et al., 2019). Prejudiced attitudes toward animals and veg*ns can be explained by SDO (Dhont and Hodson, 2014), which is a common denominator of prejudices toward human outgroups (e.g., sexism, racism and other dehumanizing tendencies) (see the SD-HARM model; Dhont et al., 2016). In contrast, people who identify more strongly with animals are more likely to reject speciesism and justifications of animal use (Amiot and Bastian, 2017). Liberals (vs. conservatives), women (vs. men) and those who have more contact or affinity with animals (through pet ownership) are more likely to express positive affiliation with animals (Amiot and Bastian, 2017; Possidónio et al., 2019; Amiot et al., 2020; Rothgerber, 2020), which may have downstream positive effects on attitudes toward veg*ns (Earle et al., 2019; Leite et al., 2019; Hodson et al., 2020) with the caveat that derogating veg*ns would be more likely if omnivorous animal lovers feel that their moral self-concept is on the line (Minson and Monin, 2012).

Cultural identity

Lastly, eating animal foods may be an important part of one's cultural identity. Nevertheless, psychological research on the role of culture in shaping one's dietary identity, and attitudes toward animal products and veg*ns is scarce (Rosenfeld, 2018; Rothgerber, 2020). One study has shown, for example, that a higher national identification among Americans, Brits, and Australians predicted higher intentions to eat meat, and lower intentions to eat a vegetarian meal when eating meat is considered typical for one's nation (Nguyen and Platow, 2021). In addition, attitudes in favor of beef have been shown to systematically predict anti-vegetarian prejudice among college students in Argentina, Brazil, France and the US (Earle and Hodson, 2017), with varying attitudes between these countries (Ruby et al., 2016). Concerning the role of religion, Rothgerber (2013) found that meat consumption frequency modestly correlates with religious justifications (e.g., God intended for us to eat animals), which are in turn associated with hierarchical and fate justifications, the endorsement of masculine norms among men and denying animal suffering (Rothgerber,

2013). This suggests, in line with vegetarian ecofeminist theory (Gaard, 2002), that patriarchal dualist religions may tie conservative, masculine, and human supremacist identities together in opposing veg*n advocacy. On the other hand, though, religious viewpoints are likely to be diverse; religious people may also view veg*nism as a sign of devotion and spiritual purity (Wrenn, 2019), in line with the Garden-of-Eden ideal (Bekoff and Meaney, 1998). Notably, in India, vegetarianism is part of religious traditions (i.e., Jainism, Hinduism) and vegetarians are *more* likely to endorse conservative values than omnivores (Ruby et al., 2013).

In sum, despite the existence of favorable attitudes toward veg*ns, omnivores who are confronted with veg*ns may become personally and/or socially motivated to defend their salient carnist identity by engaging in pro-carnist and counter-veg*n defenses. These defenses reinforce commitment to and ambivalence about animal-product consumption as a result.

Commitment to and ambivalence about animal-product consumption

Omnivores who are already committed to their diet and have a stronger carnist identity (typically more meat-attached, conservative, traditional men, speciesist and/or proud of their cultural identity) are more likely to actively defend themselves through motivated reasoning and negative stereotyping of veg*ns, which reinforces the idea that eating (more) plant-based is difficult (Graça et al., 2016), pointless and "not for me" (Oyserman, 2015). By rejecting claims against the consumption of animal products, omnivores may strengthen their commitment to eating animal products and their aversion for veg*nism (Bastian and Loughnan, 2017; Rothgerber, 2020). This individual-level polarization may spur group-polarization in society at large if omnivores publicly rationalize their diet and derogate those who oppose it, because in doing so, they may potentially recruit others to share and reinforce the carnist majority position (Kahan, 2013; Bastian and Loughnan, 2017). Omnivores with a weaker carnist identity (more likely less meat-attached or flexitarian, more liberal, less masculine and more feminine, higher solidarity for animals and less attached to cultural norms) are less likely to actively defend their diet; motivated ignorance and passive forms of veg*n stigmatization (e.g., avoidance) may suffice. These indirect defenses allow omnivores to ignore veg*n advocates' claims, so that they remain ambivalent about the consumption of animal products (Rothgerber, 2020).

Overall, these findings are remarkably consistent with studies on minority influence (Moscovici, 1985; Mugny and Pérez, 1991; Martin et al., 2008; Levine and Tindale, 2014) showing that minority's calls for change often evoke immediate defensiveness or only ambivalence. As a result, the influence minorities exert on majority members is usually non-existent or even negative *at a direct, manifest level* (Moscovici, 1985; Mugny and Pérez, 1991; Wood et al., 1994). This does not mean, however, that minorities exert no influence at all (Mugny and Pérez, 1991; Wood et al., 1994). In Western countries, the market of plant-based alternatives is growing and majority norms are gradually shifting as flexitarianism is gaining popularity and veg*nism is increasingly accepted (Vranken et al., 2014; Lundahl, 2020; Verain et al., 2022). Consequently, it may become increasingly difficult to defend animal-product consumption and advocates may become more influential (De Groeve and Rosenfeld, 2022). Both research on minority influence and cognitive dissonance suggests that omnivores may resolve moral/carnist identity threat by adopting a third dissonance-reducing strategy: committing to behavioral change.

Commitment to behavioral change

A recurring pattern in studies that systematically compared minority versus majority influence is that minority (vs. majority) influence is characterized by changes that are private (rather than public) and indirectly (rather than directly) related to the position of the source (i.e., conversion), presumably because targets do not want to publicly align themselves with a stigmatized minority (Wood et al., 1994). This conversion can be immediate conversion, but is often delayed conversion.

Immediate conversion

Omnivores may (privately) accept claims that animal products entail avoidable harm (e.g., to animals, the environment) and might reduce dissonance by aligning their dietary behavior more with their moral identity and principles (Feinberg et al., 2019; Bouwman et al., 2022; De Groeve and Rosenfeld, 2022), thus rejecting animal-product consumption at least partially by making shifts toward veg*n diets (Rothgerber, 2020). One recent study (Silva Souza and O'Dwyer, 2022) found personal health arguments with a mixed recommendation (i.e., to reduce or eliminate animal products) could not persuade people to eat less animal products, but that arguments related to animal rights and environmental welfare were effective to increase omnivores' willingness to reduce (not cease) animal-product consumption *via* elevated dissonance. In addition, participants exposed to environmental arguments were more likely to disagree with *ceasing* animal-product consumption. Arguably, health arguments do not consistently favor veg*n dieting (i.e., omnivorous diets can also be healthy), while environmental arguments appear less stringent and animal rights favor veg*n diets most consistently.

A meta-analysis of minority influence research suggests that consistency is especially important for minorities to exert influence (Wood et al., 1994). Not only does consistency allow to capture attention of the majority (Wood et al., 1994), it also allows to signal that the majority behaves inconsistently (Wrenn, 2018), should rethink their position and change their behavior to the minority position (Mugny and Pérez, 1991; Wood et al., 1994). Given that veganism is a consistent anti-speciesist position (Bruers, 2021), this might explain why animal-welfare interventions with a "go vegan" recommendation may have larger effects on meat reduction than more modest recommendations ("go vegetarian" or "reduce your consumption") (Mathur et al.,

2021). Similarly, Dakin et al. (2021) found that prescribing vegetarian (vs. flexitarian) diets for a week based on animal welfare arguments led to larger sustained reductions in meat intake, which was partially mediated by reduced 4Ns rationalization and commitment to eat meat. It is important to note, however, that participants in the studies above were probably already more receptive to eating less meat. As differences in opinion increase, a more flexible (vs. uncompromising) style of negotiation becomes more important for a consistent minority to exert influence (Mugny, 1975; Mugny and Pérez, 1991; Leenaert, 2017; Weiper and Vonk, 2021).

Delayed conversion

Minority influence research further suggests that conversion to a minority position is often delayed (rather than immediate) and typically happens after a validation process where majority members actively thought about the minority's claims (Moscovici, 1980; Mugny and Pérez, 1991; Wood et al., 1994). Likewise, veg*ns typically report that they changed gradually in different stages (Chuck et al., 2016; Grassian, 2019; Bryant et al., 2022). Highlighting the role of motivated resistance, Bryant et al. (2022) provide an overview of psychosocial barriers to overcome in the journey to ethical veganism through five stages of change: precontemplation, contemplation, preparation, action, and maintenance. Consumers who reject rationalizations for eating animal products may become more ambivalent about eating meat and negative about conventional meat production systems (Berndsen and Van Der Pligt, 2004; Hartmann and Siegrist, 2020). Although they might initially be motivated to ignore claims against consuming animal products, they may be more open to eat meat alternatives (e.g., Quorn, tofu, seitan) (Hartmann and Siegrist, 2020) and change their diet after effortful information seeking if concerns about eating animal products can no longer be ignored (Rothgerber, 2020; Pauer et al., 2022). Based on interviews with veg*ns, this information may include a variety of sources, such as educational materials (e.g., documentaries, books, flyers, speeches), role models and emotionally intensive imagery related to animal cruelty (Chuck et al., 2016; Grassian, 2019).

Reducing carnist resistance seems crucial to promote dietary change among omnivores. As people reject carnism more, eat less meat, follow a flexitarian diet longer, and see avoiding meat as more self-defining, they are more likely to identify with vegetarians rather then meat-eaters (Rosenfeld et al., 2019) and less likely to negatively stereotype veg*ns as socially unattractive (Minson and Monin, 2012; De Groeve et al., 2022). A rejection of carnism is also strongly associated with more positive and less speciesist attitudes toward animals, feeling more guilty about eating animal products, and being more engaged in animal advocacy (Piazza et al., 2015; Monteiro et al., 2017; Rosenfeld, 2019b; Amiot et al., 2020). If moral reasons for veg*n diets are internalized, people are likely to develop disgust toward the idea of eating animal products (Rozin, 1996; Graça et al., 2016) and if eating veg*n diets feels identity-congruent, perceived difficulties in veg*n practice may be interpreted as worthwhile and meaningful (Oyserman, 2015). Nevertheless, important barriers for adopting veg*n diets (e.g., conformity, meat attachment, health concerns, practical convenience) may also cause a significant number of veg*ns to lapse or revert from veg*n diets temporarily or permanently (Rosenfeld, 2018; Salehi et al., 2020). Conversely, veg*ns are more likely to maintain their diet if they have social support, if they are motivated by animal ethics, if they have knowledge about veg*n nutrition and if it is practically feasible and affordable (Ruby, 2012; Salehi et al., 2020).

Discussion

Having explained our theoretical account of carnist resistance to veg*n advocacy, we will now discuss directions for future research to test and qualify its main features (§3.1) (for a summary, see Table S1 in the Supplementary material). We further consider the need to go beyond veg*n advocacy (§3.2) and conclude (§3.3).

Future research directions

Veg*n advocacy and moral identity

First, our account presupposes that veg*n advocacy is based on claims that animal-product consumption is harmful and avoidable. Future research could test to which extent veg*ns (vs. omnivores) perceive different non-veg*n diets and/or animal products as harmful (e.g., to animals, the environment, health) (e.g., Schein and Gray, 2015) and avoidable (e.g., by measuring "outcome efficacy"; Steg and de Groot, 2010). We expect that veg*ns are more likely to construe their diet as a part of their moral identity due to perceiving more avoidable animal harms, followed by environmental and health harms, respectively. More research is required to examine how veg*n dietary motivations (e.g., Hopwood et al., 2020, 2021b) contribute to moral identity internalization, as well as a desire to signal one's moral identity (Aquino and Reed, 2002) *via* veg*n advocacy (e.g., Thomas et al., 2019; Judge et al., 2022).

Moral and carnist identity

Our account suggests that moral identity signaling among advocates may threaten omnivores' moral and carnist identity simultaneously, and claims against animal-product consumption that are perceived as more harmful and avoidable are expected to arouse a stronger moral/carnist identity threat (e.g., by measuring "moral reproach"; Minson and Monin, 2012) and dissonant feelings (e.g., Silva Souza and O'Dwyer, 2022) among omnivores, especially among those with stronger moral and carnist identities. Future research could examine whether the strength of omnivores' moral and carnist identity moderates threat perceptions of advocacy (see De Groeve and Rosenfeld, 2022) and also consider environmental and health harms related to various animal products as potential causes of dissonance besides animal harms related to meat in particular (Rothgerber, 2020; De Groeve and

Rosenfeld, 2022; Silva Souza and O'Dwyer, 2022). Concerning moral identity, we acknowledge that people's conceptions of what is "moral" may vary considerably, depending on various cooperative relationships (Curry et al., 2019), the endorsement of conventional values (i.e., authority, loyalty, purity) (Graham et al., 2013) and divine authority (Simpson et al., 2016). Although some research suggests that moral identity (Dawson et al., 2021) and moral judgment processes can be largely attributed to concerns about (intentional, unjustified) harms (Schein and Gray, 2015, 2018; Sousa et al., 2021), different moral paradigms may affect how people respond to veg*n advocacy (e.g., Grünhage and Reuter, 2021). Similarly, omnivores may vary considerably in how they construe their carnist identity, depending on the individual, culture, and the particular context in which it is cued (Turner and Reynolds, 2010; Oyserman, 2015). Pursuing a more comprehensive, multifaceted understanding of carnist identity, for example by conducting segmentation studies (e.g., Lacroix and Gifford, 2019; Verain et al., 2022), is recommended. Carnist resistance (i.e., pro-carnist and counter-veg*n defensiveness) is relevant to consider in this regard (see Table S2 for existing measurement scales).

Carnist resistance: Pro-carnist and counter-veg*n defenses

Based on our account, we expect that a stronger carnist identity positively predicts motivated reasoning, negative stereotyping of advocates, and commitment to eat animal products. More research could test whether motivated reasoning negatively predicts perceived harms and the perceived efficacy of veg*n diets to avoid harms, and whether different rationalizations for eating animal products (e.g., the 4Ns) support different negative stereotypes (e.g., veg*ns seen as contradicting the 4Ns). Conversely, omnivores with a weaker carnist identity should be less likely to rationalize animal-product consumption or actively stigmatize veg*ns by expressing negative stereotypes (though still more likely than veg*ns), and mainly rely on motivated ignorance. Researchers may examine whether different forms of motivated ignorance (e.g., ignoring farmed animal suffering) inform different stigmatizing attitudes (e.g., avoiding contact with veg*ns). Although relevant scales to measure stigmatization exist (Table S2), future research is needed to examine whether passive forms of stigmatization can be distinguished from negative stereotyping. We also recommend more psychometric analysis to better understand the interrelationship between pro-carnist defenses: for example, our conceptualization of neutralization as a form of motivated ignorance is rather tentative and the status of dichotomization is also less clear (Hartmann and Siegrist, 2020; Rothgerber, 2020). In addition, future research could assess the relative importance and interrelationship between personal and social motivations linked with one's carnist identity related to individual meat attachment and healthy eating, politics (e.g., conservativism), gender (e.g., new/traditional masculinity), species (e.g., human supremacy) and culture (e.g., nation, religion) (see studies in §2.2.5 for measurement scales) and how these identities inform pro-carnist and counter-veg*n defenses. Lastly, research on how these defenses are associated with an ambivalence about or a commitment to animal-product consumption is recommended. For example, previous research has found both committed and ambivalent omnivores may be motivated to ignore/downplay the sentience of farmed animals (Buttlar and Walther, 2018; Leach et al., 2022), which might be due to differences in moral/carnist identity threat. Committed omnivores may ignore information due to indifference (i.e., low moral, high carnist identity threat), while ambivalent omnivores may want to avoid confrontation (i.e., higher moral identity threat) (Onwezen and van der Weele, 2016; Rothgerber, 2020), though this needs to be verified.

Commitment to behavioral change

Our account further suggests that an apparent resistance against veg*n advocacy may mask indirect, private influence, often at a later point in time. Therefore, future research on veg*n advocacy would benefit from integrating minority influence perspectives (Martin et al., 2008; Levine and Tindale, 2014), ideally using longitudinal designs to capture delayed influence across different stages of change (Bryant et al., 2022; De Groeve and Rosenfeld, 2022). More diverse quantitative and qualitative research approaches (e.g., field experiments, participant observation) are also recommended to demonstrate potential differences between publicly expressed and privately held beliefs (*cf.* pluralistic ignorance) (Bolderdijk and Cornelissen, 2022; De Groeve and Rosenfeld, 2022). In addition, our account suggests that the rejection of carnist beliefs is an important predictor of accepting commitments to dietary change (Rosenfeld et al., 2019; Trethewey and Jackson, 2019). Future research could thus develop interventions that target pro-carnist defenses, for example within an open, respectful dialogue (Buttlar et al., 2020). Although experimental studies have manipulated variables related to social norms and motivated ignorance such as dissociation and dichotomization (Mathur et al., 2021; Kwasny et al., 2022), experiments on how to tackle specific rationalizations (e.g., nice, natural, necessary, human supremacy, faith) and denial of harms are missing (Rothgerber, 2020; Kwasny et al., 2022). In addition, researchers could examine how to reduce negative stereotyping of vegan advocates, moralistic stereotyping in particular (for a review, see De Groeve and Rosenfeld, 2022).

Because our account suggests that promoting veg*n diets might increase polarization, we also recommend researchers to examine more pragmatic approaches to support change (De Groeve and Rosenfeld, 2022), for example by addressing the practical barriers (e.g., capacities, opportunities) that make changing one's mind costly (Graça et al., 2019; Williams, 2020). For committed omnivores, the promotion of small dietary changes within meat formats that are already familiar (e.g., meat substitution) seems promising (Lacroix and Gifford, 2020). Emphasizing similarities between omnivores and

veg*ns might also improve intergroup relations, trust and credibility (De Groeve and Rosenfeld, 2022), which could be examined using common and dual identity approaches (Gaertner et al., 1994; Dovidio et al., 2007). For example, to tackle human supremacy, advocates may emphasize commonalities (e.g., most people find factory farming problematic) and group differences (e.g., vegan diets minimize animal abuse) within a shared social identity (e.g., humans). To appeal to conservatives, veg*n advocates could argue that factory farming is untraditional and that environmental protection is patriotic (Rothgerber, 2020; Grünhage and Reuter, 2021). "Masculine" males may be motivated to challenge majority norms by emphasizing norms of responsibility, rebellion, and strength (Rothgerber, 2013). In addition, future research could examine the promotion of veg*n diets as a way to reclaim individuality: One does not have to identify with a particular group (veg*n or omnivore, male or female, liberal or conservative, etc.), in order to reflect on whether one's diet violates one's moral values (Bruers, 2021; Bouwman et al., 2022).

Although our account addresses resistance among omnivores against veg*n advocates, we also recommend future research to assess how motivated cognitions affect veg*ns' commitment to their diets. Like omnivores, veg*ns may too eagerly embrace or suppress information that strengthens or protects their (moral) identity, for example by believing that humans are "naturally" herbivores, that non-veg*ns cannot care about animals or by denying that omnivorous diets can be healthy (van der Weele, 2013). Conversely, veg*ns may also comply with carnist norms in social situations if they experience stigma (Rosenfeld and Tomiyama, 2019; Bolderdijk and Cornelissen, 2022), for example by framing their diet as a requirement (e.g., allergies) rather than a (moral) choice or identity (Paxman, 2016; Rosenfeld and Tomiyama, 2019).

Beyond veg*n advocacy

Lastly, given that there are many individual barriers for adopting plant-based diets, we also acknowledge the importance of institutional tactics to minimize harms of conventional animal-based diets, such as restructuring choice architecture (e.g., nudging, default-setting) (Bianchi, Garnett, et al., 2018b) and fiscal measures (i.e., taxes, subsidies) to dissuade animal-product consumption and promote the development of healthy, sustainable plant-based alternatives and cell-cultured meat, dairy and eggs (Grassian, 2019; Tubb and Seba, 2019; for a criticism of cell-cultured meat, see Chriki and Hocquette, 2020). "Less but better" animal products and production systems could also improve the global food system (Sahlin and Trewern, 2022), though "humane" narratives concealing inhumane treatment of animals to this day complicate the matter (Francione, 2020). While vegan principles may be reconcilable with regenerative, agroecological practices through veganic farming, it also remains questionable whether regenerative practices can function on any significant scale without functionalities of animals (e.g., manure) (see Weis & Ellis, 2021). In either case, we concur a radical rethinking of human-animal and environmental relationships is required (UNEP, 2020; Weis and Ellis, 2021) and momentum is growing to improve public and animal health systems (Cornish et al., 2016; UNEP, 2020), to urgently safeguard and restore terrestrial, marine and aerial wildlife habitats (Ripple et al., 2017; Stoll-Kleemann and Schmidt, 2017; Willett et al., 2019) and to legally recognize and protect farmed animals as sentient beings (Francione, 2020; Reese, 2020, 2021).

Conclusion

Attempts to promote shifts toward veg*n diets are often met with resistance due to a variety of individual, social and contextual barriers (Graça et al., 2019). The present article integrates sociopsychological theorizing and empirical research to provide an account for omnivores' ideological resistance to veg*n advocacy. We trace this "carnist resistance" back to a motivation among omnivores to avoid a salient threat to their moral and/or carnist identity. We theorized that pro-carnist defenses relying on motivated reasoning and ignorance inform negative stereotyping and stigmatization as counter-veg*n defenses. The maintenance of omnivores' carnist identity can be personally motivated (i.e., meat attachment), but also socially motivated because of political, gender, species, and cultural identities associated with eating animal products. Meat-attached individuals, conservatives, men endorsing traditional masculinity and human supremacists are more likely to actively defend the consumption of animal products and negatively stereotype veg*ns. More ambivalent individuals (e.g., flexitarians), liberals, women and those with more solidarity for animals are less likely to rationalize animal-product consumption and actively stigmatize veg*ns; motivated ignorance and passive forms of stigmatization may suffice as defenses. An ideological resistance to veg*n advocacy reinforces commitment to and ambivalence about animal-product consumption, though attitudes toward animal products and veg*ns may vary across cultures. At the same time, there are signs that the zeitgeist in Western countries is shifting in favor of veg*n diets (Vranken et al., 2014; Verain et al., 2022), so veg*n advocates may become increasingly influential in inducing gradual behavioral change (De Groeve and Rosenfeld, 2022) *via* immediate or delayed conversion. Our account may inform scientists in developing testable hypotheses to gain understanding on how to remediate ideological resistance and may inform veg*n advocates in developing effective interventions for positive social change.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

BDG developed the theoretical account and wrote the manuscript with BB and LH providing guidance and suggestions. All authors contributed to the article and approved the submitted version.

Funding

This article elaborates on unpublished work performed during the doctoral research of BDG, which was supported by a PhD grant fundamental research of the Research Foundation - Flanders (FWO) (grant number FWO.3F0.2017.0033.01), though no funding from this source was used to produce this article.

Acknowledgments

We acknowledge Charlotte De Backer, Verolien Cauberghe, Kristof Dhont and Johan Braeckman for feedback on preliminary writings of this article. We thank the editor and the reviewers for their thoughtful feedback.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.996250/full#supplementary-material

References

Abrams, D. (2001). "Psychology of Social Identity," in *International Encyclopedia of Social and Behavioral Sciences*. eds. N. J. Smelser and P. B. Baltes (Netherlands: Elsevier Science and Technology), 14306–14309.

Allen, M. W., and Ng, S. H. (2003). Human values, utilitarian benefits and identification: the case of meat. *Eur. J. Soc. Psychol.* 33, 37–56. doi: 10.1002/ejsp.128

Amiot, C. E., and Bastian, B. (2017). Solidarity with animals: assessing a relevant dimension of social identification with animals. *PLoS One* 12, 1–26. doi: 10.1371/journal.pone.0168184

Amiot, C. E., Lépine, O., and Zaky, J. (2019). Compartmentalization of animals: toward an understanding of how we create cognitive distinctions between animals and their implications. *Anal. Soc. Issues Public Policy* 19, 150–176. doi: 10.1111/asap.12177

Amiot, C. E., Sukhanova, K., and Bastian, B. (2020). Social identification with animals: unpacking our psychological connection with other animals. *J. Pers. Soc. Psychol.* 118, 991–1017. doi: 10.1037/pspi0000199

Anthis, K., and Anthis, J.R. (2019). Global farmed & factory farmed animals estimates. Available at: http://www.sentienceinstitute.org/global-animal-farming-estimates ().

Aquino, K., and Reed, A. (2002). The self-importance of moral identity. *J. Pers. Soc. Psychol.* 83, 1423–1440. doi: 10.1037/0022-3514.83.6.1423

Aronson, E. (1968). "Dissonance theory: Progress and problems" in *Theories of Cognitive Consistency: A Sourcebook*. eds. R. P. Abelson, E. Aronson, W. J. McGuire, T. M. Newcomb, M. J. Rosenberg and P. H. Tannenbaum (Chicago, IL: Rand McNally), 5–27.

Bäck, E. A., and Lindholm, T. (2014). Defending or challenging the status quo: position effects on biased intergroup perceptions. *J. Soc. Polit. Psychol.* 2, 77–97. doi: 10.5964/jspp.v2i1.158

De Backer, C., Erreygers, S., De Cort, C., Vandermoere, F., Dhoest, A., Vrinten, J., et al. (2020). Meat and masculinities. Can differences in masculinity predict meat consumption, intentions to reduce meat and attitudes towards vegetarians? *Appetite* 147:104559. doi: 10.1016/j.appet.2019.104559

Barnard, N. D., and Leroy, F. (2020). Children and adults should avoid consuming animal products to reduce the risk for chronic disease: debate consensus. *Am. J. Clin. Nutr.* 112, 937–940. doi: 10.1093/ajcn/nqaa237

Bastian, B., and Loughnan, S. (2017). Resolving the meat-paradox: a motivational account of morally troublesome behavior and its maintenance. *Personal. Soc. Psychol. Rev.* 21, 278–299. doi: 10.1177/1088868316647562

Bekoff, M., and Meaney, C.A. (1998). *Encyclopedia of Animal Rights and Animal Welfare*. Malden, Massachusetts, USA: Blackwell Publishers Inc.

Benningstad, C. G., and Kunst, J. R. (2020). Dissociating meat from its animal origins: a systematic literature review. *Appetite* 147:104554. doi: 10.1016/j.appet.2019.104554

Berndsen, M., and Van Der Pligt, J. (2004). Ambivalence towards meat. *Appetite* 42, 71–78. doi: 10.1016/S0195-6663(03)00119-3

Bianchi, F., Dorsel, C., Garnett, E., Aveyard, P., and Jebb, S. A. (2018a). Interventions targeting conscious determinants of human behaviour to reduce the demand for meat: a systematic review with qualitative comparative analysis. *Int. J. Behav. Nutr. Phys. Act.* 15, 102–125. doi: 10.1186/s12966-018-0729-6

Bianchi, F., Garnett, E., Dorsel, C., Aveyard, P., and Jebb, S. A. (2018b). Restructuring physical micro-environments to reduce the demand for meat: a systematic review and qualitative comparative analysis. *Lancet Planet. Heal.* 2, e384–e397. doi: 10.1016/S2542-5196(18)30188-8

de Boer, J., Schösler, H., and Aiking, H. (2017). Towards a reduced meat diet: mindset and motivation of young vegetarians, low, medium and high meat-eaters. *Appetite* 113, 387–397. doi: 10.1016/j.appet.2017.03.007

Bolderdijk, J. W., and Cornelissen, G. (2022). 'How do you know someone's vegan?' They won't always tell you. An empirical test of the do-gooder's dilemma. *Appetite* 168:105719. doi: 10.1016/j.appet.2021.105719

Bolderdijk, J. W., and Jans, L. (2021). Minority influence in climate change mitigation. *Curr. Opin. Psychol.* 42, 25–30. doi: 10.1016/j.copsyc.2021.02.005

Boutron-Ruault, M. C., Mesrine, S., and Pierre, F. (2017). "Meat consumption and health outcomes" in *Vegetarian and Plant-Based Diets in Health and Disease Prevention*. ed. F. Mariotti (Cambridge, MA: Academic Press).

Bouwman, E. P., Willem, J., Onwezen, M. C., and Taufik, D. (2022). 'Do you consider animal welfare to be important?' Activating cognitive dissonance via value activation can promote vegetarian choices. *J. Environ. Psychol.* 83:April:101871. doi: 10.1016/j.jenvp.2022.101871

Browning, H., and Veit, W. (2020). Is humane slaughter possible? *Animals* 10, 1–11. doi: 10.3390/ani10050799

Bruers, S. (2021). Speciesism, arbitrariness, and moral illusions. *Philosophia* 49, 957–975. doi: 10.1007/s11406-020-00282-7

Bryant, C. J. (2022). Plant-based animal product alternatives are healthier and more environmentally sustainable than animal products. *Futur. Foods*, 6:July 6:100174. doi: 10.1016/j.fufo.2022.100174

Bryant, C. J., Prosser, A. M. B., and Barnett, J. (2022). Going veggie: identifying and overcoming the social and psychological barriers to veganism. *Appetite* 169:105812. doi: 10.1016/j.appet.2021.105812

Buttlar, B., Rothe, A., Kleinert, S., Hahn, L., and Walther, E. (2020). Food for thought: investigating communication strategies to counteract moral disengagement regarding meat consumption. *Environ. Commun.* 15, 55–68. doi: 10.1080/17524032.2020.1791207

Buttlar, B., and Walther, E. (2018). Measuring the meat paradox: how ambivalence towards meat influences moral disengagement. *Appetite* 128, 152–158. doi: 10.1016/j.appet.2018.06.011

Cannon, W. (1932). *Wisdom of the body*. United States: W.W. Norton & Company, *184*, 864.

Carfora, V., Caso, D., and Conner, M. (2016). The role of self-identity in predicting fruit and vegetable intake. *Appetite* 106, 23–29. doi: 10.1016/j.appet.2015.12.020

Carfora, V., Caso, D., and Conner, M. (2017). Correlational study and randomised controlled trial for understanding and changing red meat consumption: the role of eating identities. *Soc. Sci. Med.* 175, 244–252. doi: 10.1016/j.socscimed.2017.01.005

Caviola, L., Everett, J. A. C., and Faber, N. S. (2019). The moral standing of animals: Towards a psychology of speciesism. *J. Pers. Soc. Psychol.* 116, 1011–1029. doi: 10.1037/pspp0000182

Caviola, L., Schubert, S., Kahane, G. and Faber, N. S. (2022). Humans first: Why people value animals less than humans. *Cognition* 225:105139. doi: 10.1016/j.cognition.2022.105139

Chai, B. C., van der Voort, J. R., Grofelnik, K., Eliasdottir, H. G., Klöss, I., and Perez-Cueto, F. J. A. (2019). Which diet has the least environmental impact on our planet? A systematic review of vegan, vegetarian and omnivorous diets. *Sustainability* 11:15. doi: 10.3390/su11154110

Chiles, R. M., and Fitzgerald, A. J. (2018). Why is meat so important in Western history and culture? A genealogical critique of biophysical and political-economic explanations. *Agric. Human Values* 35, 1–17. doi: 10.1007/s10460-017-9787-7

Chin, M. G., Fisak, B., and Sims, V. K. (2002). Development of the attitudes toward vegetarians scale. *Anthrozoös* 15, 332–342. doi: 10.2752/089279302786992441

Chriki, S., and Hocquette, J. F. (2020). The myth of cultured meat: a review. *Front. Nutr.* 7, 1–9. doi: 10.3389/fnut.2020.00007

Chuck, C., Fernandes, S. A., and Hyers, L. L. (2016). Awakening to the politics of food: politicized diet as social identity. *Appetite* 107, 425–436. doi: 10.1016/j.appet.2016.08.106

Clare, K., Maani, N., and Milner, J. (2022). Meat, money and messaging: how the environmental and health harms of red and processed meat consumption are framed by the meat industry. *Food Policy* 109:102234. doi: 10.1016/j.foodpol.2022.102234

Clark, M., Springmann, M., Rayner, M., Scarborough, P., Hill, J., Tilman, D., et al. (2022). Estimating the environmental impacts of 57, 000 food products. *Proc. Natl. Acad. Sci. U. S. A.* 119:e2120584119. doi: 10.1073/pnas.2120584119

Clark, M. A., Springmann, M., Hill, J., and Tilman, D. (2019). Multiple health and environmental impacts of foods. *Proc. Natl. Acad. Sci. U. S. A.* 116, 23357–23362. doi: 10.1073/pnas.1906908116

Cole, M., and Morgan, K. (2011). Vegaphobia: derogatory discourses of veganism and the reproduction of speciesism in UK national newspapers. *Br. J. Sociol.* 62, 134–153. doi: 10.1111/j.1468-4446.2010.01348.x

Cooper, J. (2007). "Cognitive dissonance: fifty years of a classic theory," in *Cognitive Dissonance: Fifty Years of a Classic Theory*. eds. M. Hogg and M. Carmichael (London: SAGE Publications Ltd), 1–197.

Cornish, A., Raubenheimer, D., and McGreevy, P. (2016). What we know about the public's level of concern for farm animal welfare in food production in developed countries. *Animals* 6, 1–15. doi: 10.3390/ani6110074

Corrin, T., and Papadopoulos, A. (2017). Understanding the attitudes and perceptions of vegetarian and plant-based diets to shape future health promotion programs. *Appetite* 109, 40–47. doi: 10.1016/j.appet.2016.11.018

Costa, I., Gill, P. R., Morda, R., and Ali, L. (2019). More than a diet: a qualitative investigation of young vegan Women's relationship to food. *Appetite* 143, 1–8 doi: 10.1016/j.appet.2019.104418

Craig, W. J. (2009). Health effects of vegan diets. *Am. J. Clin. Nutr.* 89, 1627S–1633S. doi: 10.3945/ajcn.2009.26736N

Cramer, H., Kessler, C. S., Sundberg, T., Leach, M. J., Schumann, D., Adams, J., et al. (2017). Characteristics of Americans choosing vegetarian and vegan diets for health reasons. *J. Nutr. Educ. Behav.* 49, 561–567.e1. doi: 10.1016/j.jneb.2017.04.011

Curry, O. S., Mullins, D. A., and Whitehouse, H. (2019). Is it good to cooperate?: testing the theory of morality-as-cooperation in 60 societies. *Curr. Anthropol.* 60, 47–69. doi: 10.1086/701478

Dagevos, H. (2021). Finding flexitarians: current studies on meat eaters and meat reducers. *Trends Food Sci. Technol.* 114, 530–539. doi: 10.1016/j.tifs.2021.06.021

Dakin, B. C., Ching, A. E., Teperman, E., Klebl, C., Moshel, M., and Bastian, B. (2021). Prescribing vegetarian or flexitarian diets leads to sustained reduction in meat intake. *Appetite* 164:April:105285. doi: 10.1016/j.appet.2021.105285

Dawson, K. J., Han, H., and Choi, Y. E. R. (2021). How are moral foundations associated with empathic traits and moral identity? *Curr. Psychol.*, 1–13. doi: 10.1007/s12144-021-02372-5 [Epub ahead of print]

De Groeve, B., Hudders, L., and Bleys, B. (2021). Moral rebels and dietary deviants: how moral minority stereotypes predict the social attractiveness of veg*ns. *Appetite* 164:105284. doi: 10.1016/j.appet.2021.105284

De Groeve, B., and Rosenfeld, D. L. (2022). Morally admirable or moralistically deplorable? A theoretical framework for understanding character judgments of vegan advocates. *Appetite* 168:105693. doi: 10.1016/j.appet.2021.105693

De Groeve, B., Rosenfeld, D. L., Bleys, B., and Hudders, L. (2022). Moralistic stereotyping of vegans: the role of dietary motivation and advocacy status. *Appetite* 174:106006. doi: 10.1016/j.appet.2022.106006

Delon, N. (2018). Social norms and farm animal protection. *Palgrave Commun.* 4:1. doi: 10.1057/s41599-018-0194-5

Dhont, K., and Hodson, G. (2014). Why do right-wing adherents engage in more animal exploitation and meat consumption? *Pers. Individ. Dif.* 64, 12–17. doi: 10.1016/j.paid.2014.02.002

Dhont, K., Hodson, G., and Leite, A. C. (2016). Common ideological roots of speciesism and generalized ethnic prejudice: the social dominance human–animal relations model (SD–HARM). *Eur. J. Personal.* 30, 507–522. doi: 10.1002/per.2069

Dhont, K., Piazza, J., and Hodson, G. (2021). The role of meat appetite in willfully disregarding factory farming as a pandemic catalyst risk. *Appetite* 164:105279. doi: 10.1016/j.appet.2021.105279

Dovidio, J. F., Gaertner, S. L., and Saguy, T. (2007). Another view of 'we': majority and minority group perspectives on a common ingroup identity. *Eur. Rev. Soc. Psychol.* 18, 296–330. doi: 10.1080/10463280701726132

Dowsett, E., Semmler, C., Bray, H., Ankeny, R. A., and Chur-Hansen, A. (2018). Neutralising the meat paradox: cognitive dissonance, gender, and eating animals. *Appetite* 123, 280–288. doi: 10.1016/j.appet.2018.01.005

Earle, M., and Hodson, G. (2017). What's your beef with vegetarians? Predicting anti-vegetarian prejudice from pro-beef attitudes across cultures. *Pers. Individ. Dif.* 119, 52–55. doi: 10.1016/j.paid.2017.06.034

Earle, M., Hodson, G., Dhont, K., and MacInnis, C. (2019). Eating with our eyes (closed): effects of visually associating animals with meat on antivegan/vegetarian attitudes and meat consumption willingness. *Gr. Process. Intergr. Relat.* 22, 818–835. doi: 10.1177/1368430219861848

Farouk, M. M., Regenstein, J. M., Pirie, M. R., Najm, R., Bekhit, A. E. D., and Knowles, S. O. (2015). Spiritual aspects of meat and nutritional security: perspectives and responsibilities of the Abrahamic faiths. *Food Res. Int.* 76, 882–895. doi: 10.1016/j.foodres.2015.05.028

Federico, C. M., Weber, C. R., Ergun, D., and Hunt, C. (2013). Mapping the connections between politics and morality: the multiple sociopolitical orientations involved in moral intuition. *Polit. Psychol.* 34, 589–610. doi: 10.1111/pops.12006

Feinberg, M., Kovacheff, C., Teper, R., and Inbar, Y. (2019). Understanding the process of moralization: how eating meat becomes a moral issue. *J. Pers. Soc. Psychol.* 117, 50–72. doi: 10.1037/pspa0000149

Festinger, L. (1962). *A theory of cognitive dissonance*, vol. *2*. Redwood City, CA: Stanford University Press.

Fleischman, D. S. (2020). "Animal ethics and evolutionary psychology" in *The SAGE Handbook of Evolutionary Psychology*. ed. T. K. Shackelford (Cambridge: SAGE Publications Ltd), 144–162.

Francione, G. L. (2020). Some brief comments on animal rights. *Anim. Front.* 10, 29–33. doi: 10.1093/af/vfz050

Gaard, G. (2002). Vegetarian ecofeminism: a review essay. *Front. A J. Women Stud.* 23, 117–146. doi: 10.1353/fro.2003.0006

Gaertner, S. L., Rust, M. C., Dovidio, J. F., Bachman, B. A., and Anastasio, P. A. (1994). The contact hypothesis: the role of a common ingroup identity on reducing intergroup bias. *Small Gr. Res.* 25, 224–249. doi: 10.1177/1046496494252005

Golman, R., Hagmann, D., and Loewenstein, G. (2017). Information avoidance. *J. Econ. Lit.* 55, 96–135. doi: 10.1257/jel.20151245

Graça, J. (2016). Towards an integrated approach to food behaviour: meat consumption and substitution, from context to consumers. *Psychol. Community Heal.* 5, 152–169. doi: 10.5964/pch.v5i2.169

Graça, J., Calheiros, M. M., and Oliveira, A. (2015a). Attached to meat? (un) willingness and intentions to adopt a more plant-based diet. *Appetite* 95, 113–125. doi: 10.1016/j.appet.2015.06.024

Graça, J., Godinho, C. A., and Truninger, M. (2019). Reducing meat consumption and following plant-based diets: current evidence and future directions to inform integrated transitions. *Trends Food Sci. Technol.* 91, 380–390. doi: 10.1016/j.tifs.2019.07.046

Graça, J., Manuela, M., and Oliveira, A. (2016). Situating moral disengagement: motivated reasoning in meat consumption and substitution. *Pers. Individ. Dif.* 90, 353–364. doi: 10.1016/j.paid.2015.11.042

Graça, J., Oliveira, A., and Calheiros, M. M. (2015b). Meat, beyond the plate. Data-driven hypotheses for understanding consumer willingness to adopt a more plant-based diet. *Appetite* 90, 80–90. doi: 10.1016/j.appet.2015.02.037

Graham, J., Haidt, J., Koleva, S., Motyl, M., Iyer, R., Wojcik, S. P., et al. (2013). "Chapter two - moral foundations theory: the pragmatic validity of moral pluralism" in *Advances in Experimental Social Psychology. 1st Edn*. eds. P. Devine and A. Plant (San Diego, CA: Academic Press), 55–130.

Grassian, T. (2019). A new way of eating: Creating meat reducers, vegetarians, and vegans. PhD Dissertation, Canterbury: University of Kent.

Greenebaum, J. B. (2012). Managing impressions: 'face-saving' strategies of vegetarians and vegans. *Humanity Soc.* 36, 309–325. doi: 10.1177/0160597612458898

Greenebaum, J. B. (2017). Questioning the concept of vegan privilege. *Humanity Soc.* 41, 355–372. doi: 10.1177/0160597616640308

Gregson, R., Piazza, J., and Boyd, R. L. (2022). Against the cult of veganism': unpacking the social psychology and ideology of anti-vegans. *Appetite* 178:106143. doi: 10.1016/j.appet.2022.106143

Grünhage, T., and Reuter, M. (2021). What makes diets political? Moral foundations and the left-wing-vegan connection. *Soc. Justice Res* 34, 18–52. doi: 10.1007/s11211-020-00361-w

Guerin, K. (2014). Where's the beef? (with vegans): A qualitative study of vegan-omnivore conflict. Undergraduate Honor's Thesis, Boulder, CO: University of Colo.

Hallström, E., Carlsson-Kanyama, A., and Börjesson, P. (2015). Environmental impact of dietary change: a systematic review. *J. Clean. Prod.* 91, 1–11. doi: 10.1016/j.jclepro.2014.12.008

Harguess, J. M., Crespo, N. C., and Hong, M. Y. (2020). Strategies to reduce meat consumption: a systematic literature review of experimental studies. *Appetite*, 144:October 2018 144:104478. doi: 10.1016/j.appet.2019.104478

Harrington, R., Nugier, A., Khamzina, K., Guimond, S., Monceau, S., and Streith, M. (2022). Understanding individual and collective response to climate change: the role of a self-other mismatch. *Front. Psychol.* 13:935209. doi: 10.3389/fpsyg.2022.935209

Hartmann, C., Furtwaengler, P., and Siegrist, M. (2022). Consumers' evaluation of the environmental friendliness, healthiness and naturalness of meat, meat substitutes, and other protein-rich foods. *Food Qual. Prefer.* 97:104486. doi: 10.1016/j.foodqual.2021.104486

Hartmann, C., and Siegrist, M. (2017). Consumer perception and behaviour regarding sustainable protein consumption: a systematic review. *Trends Food Sci. Technol.* 61, 11–25. doi: 10.1016/j.tifs.2016.12.006

Hartmann, C., and Siegrist, M. (2020). Our daily meat: justification, moral evaluation and willingness to substitute. *Food Qual. Prefer.*., 80:January 2019 80:103799. doi: 10.1016/j.foodqual.2019.103799

Hayek, M. N. (2022). The infectious disease risks of intensifying animal agriculture. *Sci. Adv.* 8, 1–8. doi: 10.1126/sciadv.add6681

Hayley, A., Zinkiewicz, L., and Hardiman, K. (2015). Values, attitudes, and frequency of meat consumption. Predicting meat-reduced diet in Australians. *Appetite* 84, 98–106. doi: 10.1016/j.appet.2014.10.002

Hemler, E. C., and Hu, F. B. (2019). Plant-based diets for personal, population, and planetary health. *Adv. Nutr.* 10, S275–S283. doi: 10.1093/advances/nmy117

Henrich, J., Albers, W., Boyd, R., Gigerenzer, G., McCabe, K. A., Ockenfels, A., et al. (2001). "Group report: what is the role of culture in bounded rationality?" in *Bounded Rationality: The Adaptive Toolbox*. eds. G. Gigerenzer and R. Selten (Cambridge, MA: MIT Press), 343–359.

Hinrichs, K., Hoeks, J., Campos, L., Guedes, D., Godinho, C., and Matos, M. (2022). Why so defensive? Negative affect and gender differences in defensiveness toward plant-based diets. *Food Qual. Prefer.* 102:104662. doi: 10.1016/j.foodqual.2022.104662

Hodson, G., Dhont, K., and Earle, M. (2020). "Devaluing animals, 'animalistic' humans, and people who protect animals" in *Why We Love and Exploit Animals: Bridging Insights from Academia and Advocacy*. eds. K. Dhont and G. Hodson (Abingdon: Routledge), 67–89.

Hodson, G., and Earle, M. (2018). Conservatism predicts lapses from vegetarian/vegan diets to meat consumption (through lower social justice concerns and social support). *Appetite* 120, 75–81. doi: 10.1016/j.appet.2017.08.027

Hogg, M. A. (2016). "Social identity theory" in *Understanding Peace and Conflict through Social Identity Theory: Contemporary Global Perspectives*. eds. S. McKeown, R. Haji and N. Ferguson (Switzerland: Springer), 3–27.

Holler, S., Cramer, H., Liebscher, D., Jeitler, M., Schumann, D., Murthy, V., et al. (2021). Differences between omnivores and vegetarians in personality profiles, values, and empathy: a systematic review. *Front. Psychol.* 12:579700. doi: 10.3389/fpsyg.2021.579700

Hopwood, C. J., Piazza, J., Chen, S., and Bleidorn, W. (2021a). Development and validation of the motivations to eat meat inventory. *Appetite* 163:105210. doi: 10.1016/j.appet.2021.105210

Hopwood, C. J., Rosenfeld, D., Chen, S., and Bleidorn, W. (2021b). An investigation of plant-based dietary motives among vegetarians and omnivores. *Collabra Psychol.* 7, 1–9. doi: 10.1525/collabra.19010

Hopwood, C. J., Bleidorn, W., Schwaba, T., and Chen, S. (2020). Health, environmental, and animal rights motives for vegetarian eating. *PLoS One* 15:e0230609. doi: 10.1371/journal.pone.0230609

Hornsey, M. J. (2008). Social identity theory and self-categorization theory: a historical review. *Soc. Personal. Psychol. Compass* 2, 204–222. doi: 10.1111/j.1751-9004.2007.00066.x

Janssen, M., Busch, C., Rödiger, M., Hamm, U., Janssen, M., Busch, C., et al. (2016). Motives of consumers following a vegan diet and their attitudes towards animal agriculture. *Appetite* 105, 643–651. doi: 10.1016/j.appet.2016.06.039

Jost, J. T., Glaser, J., Kruglanski, A. W., and Sulloway, F. J. (2003). Political conservatism as motivated social cognition. *Psychol. Bull.* 129, 339–375. doi: 10.1037/0033-2909.129.3.339

Joy, M. (2009). *Why we love dogs, eat pigs and wear cows: An introduction to carnism*. San Francisco, CA: Conari Press.

Joy, M. (2018). *Beyond beliefs: A guide to improving relationships and communication for vegans, vegetarians, and meat eaters*. Brooklyn, NY: Lantern Books.

Judge, M., Fernando, J. W., and Begeny, C. T. (2022). Dietary behaviour as a form of collective action: a social identity model of vegan activism. *Appetite* 168:105730. doi: 10.1016/j.appet.2021.105730

Judge, M., and Wilson, M. S. (2019). A dual-process motivational model of attitudes towards vegetarians and vegans. *Eur. J. Soc. Psychol.* 49, 169–178. doi: 10.1002/ejsp.2386

Kahan, D. M. (2013). Ideology, motivated reasoning, and cognitive reflection. *Judgm. Decis. Mak.* 8, 407–424. doi: 10.2139/ssrn.2182588

Karesh, W. B., Dobson, A., Lloyd-Smith, J. O., Lubroth, J., Dixon, M. A., Bennett, M., et al. (2012). Ecology of zoonoses: natural and unnatural histories. *Lancet* 380, 1936–1945. doi: 10.1016/S0140-6736(12)61678-X

Keller, C., and Siegrist, M. (2015). Does personality influence eating styles and food choices? Direct and indirect effects. *Appetite* 84, 128–138. doi: 10.1016/j.appet.2014.10.003

Kim, K., Hyeon, J., Lee, S. A., Kwon, S. O., Lee, H., Keum, N. N., et al. (2017). Role of total, red, processed, and white meat consumption in stroke incidence and mortality: a systematic review and meta-analysis of prospective cohort studies. *J. Am. Heart Assoc.* 6:9. doi: 10.1161/JAHA.117.005983

Kugler, M., Jost, J. T., and Noorbaloochi, S. (2014). Another look at moral foundations theory: do authoritarianism and social dominance orientation explain liberal-conservative differences in 'moral' intuitions? *Soc. Justice Res* 27, 413–431. doi: 10.1007/s11211-014-0223-5

Kunda, Z. (1990). The case for motivated reasoning. *Psychol. Bull.* 108, 480–498. doi: 10.1037/0033-2909.108.3.480

Kunst, J. R., and Hohle, S. M. (2016). Meat eaters by dissociation: how we present, prepare and talk about meat increases willingness to eat meat by reducing empathy and disgust. *Appetite* 105, 758–774. doi: 10.1016/j.appet.2016.07.009

Kurzban, R., and Leary, M. R. (2001). Evolutionary origins of stigmatization: the functions of social exclusion. *Psychol. Bull.* 127, 187–208. doi: 10.1037/0033-2909.127.2.187

Kwasny, T., Dobernig, K., and Riefler, P. (2022). Towards reduced meat consumption: a systematic literature review of intervention effectiveness, 2001–2019. *Appetite* 168:105739. doi: 10.1016/j.appet.2021.105739

Lacroix, K., and Gifford, R. (2019). Reducing meat consumption: identifying group-specific inhibitors using latent profile analysis. *Appetite* 138:March, 233–241. doi: 10.1016/j.appet.2019.04.002

Lacroix, K., and Gifford, R. (2020). Targeting interventions to distinct meat-eating groups reduces meat consumption. *Food Qual. Prefer.* 86:103997. doi: 10.1016/j.foodqual.2020.103997

Lam, M. E. (2019). "Seafood ethics: reconciling human well-being with fish welfare" in *The Routledge Handbook of Animal Ethics*. ed. B. Fisher (New York: Routledge), 177–197.

Leach, S., Piazza, J., Loughnan, S., Sutton, R. M., Kapantai, I., Dhont, K., et al. (2022). Unpalatable truths: commitment to eating meat is associated with strategic

ignorance of food-animal minds. *Appetite* 171:105935. doi: 10.1016/j.appet.2022.105935

Leenaert, T. (2017). *How to create a vegan world: A pragmatic approach*. New York, NY: Lantern Books.

Leite, A. C., Dhont, K., and Hodson, G. (2019). Longitudinal effects of human supremacy beliefs and vegetarianism threat on moral exclusion (vs. inclusion) of animals. *Eur. J. Soc. Psychol.* 49, 179–189. doi: 10.1002/ejsp.2497

Leroy, F., Hite, A. H., and Gregorini, P. (2020). Livestock in Evolving Foodscapes and Thoughtscapes. *Front. Sustain. Food Syst.* 4, 1–15. doi: 10.3389/fsufs.2020.00105

Leroy, F., and Praet, I. (2015). Meat traditions. The co-evolution of humans and meat. *Appetite* 90, 200–211. doi: 10.1016/j.appet.2015.03.014

Levine, J. M., and Tindale, R. S. (2014). "Social influence in groups" in *APA Handbook of Personality and Social Psychology*. eds. M. Mikulincer, P. R. Shaver, J. F. Dovidio and J. A. Simpson, vol. *2* (Washington, DC: American Psychological Association), 3–34.

Lin-Schilstra, L., and Fischer, A. R. H. (2020). Consumer moral dilemma in the choice of animal-friendly meat products. *Sustainability* 12:4844. doi: 10.3390/SU12124844

Link, B. G., and Phelan, J. C. (2001). Conceptualizing stigma. *Annu. Rev. Sociol.* 27, 363–385. doi: 10.1146/annurev.soc.27.1.363

Loughnan, S., Bastian, B., and Haslam, N. (2014). The psychology of eating animals. *Curr. Dir. Psychol. Sci.* 23, 104–108. doi: 10.1177/0963721414525781

Low, P. (2012). The Cambridge declaration on consciousness access. Available at: http://fcmconference.org/img/CambridgeDeclarationOnConsciousness.pdf. (Accessed November 3, 2022).

Lundahl, O. (2020). Dynamics of positive deviance in destigmatisation: celebrities and the media in the rise of veganism. *Consum. Mark. Cult.* 23, 241–271. doi: 10.1080/10253866.2018.1512492

MacDiarmid, J. I. (2021). The food system and climate change: are plant-based diets becoming unhealthy and less environmentally sustainable? *Proc. Nutr. Soc.* 81, 162–167. doi: 10.1017/S0029665121003712

Machovina, B., Feeley, K. J., and Ripple, W. J. (2015). Biodiversity conservation: the key is reducing meat consumption. *Sci. Total Environ.* 536, 419–431. doi: 10.1016/j.scitotenv.2015.07.022

MacInnis, C. C., and Hodson, G. (2017). It ain't easy eating greens: evidence of bias toward vegetarians and vegans from both source and target. *Gr. Process. Intergr. Relations* 20, 721–744. doi: 10.1177/1368430215618253

MacInnis, C. C., and Hodson, G. (2021). Tensions within and between vegans and vegetarians: meat-free motivations matter. *Appetite* 164:105246. doi: 10.1016/j.appet.2021.105246

Major, B., and O'Brien, L. T. (2005). The social psychology of stigma. *Annu. Rev. Psychol.* 56, 393–421. doi: 10.1146/annurev.psych.56.091103.070137

Markowski, K. L., and Roxburgh, S. (2019). 'If I became a vegan, my family and friends would hate me:' anticipating vegan stigma as a barrier to plant-based diets. *Appetite* 135, 1–9. doi: 10.1016/J.APPET.2018.12.040

Martin, R., Hewstone, M., Martin, P. Y., and Gardikiotis, A. (2008). "Chapter 16: persuasion from majority and minority groups" in *Attitudes Attitude Change*. eds. W. Crano and P. Radmila. *1st* ed (New York: Psychology Press), 189–212.

Mathur, M. B., Peacock, J., Reichling, D. B., Nadler, J., Bain, P. A., Gardner, C. D., et al. (2021). Interventions to reduce meat consumption by appealing to animal welfare: meta-analysis and evidence-based recommendations. *Appetite* 164:105277. doi: 10.1016/j.appet.2021.105277

May, J., and Kumar, V. (2022). Harnessing moral psychology to reduce meat consumption. *J. Am. Philos. Assoc.* 1–21, 1–21. doi: 10.1017/apa.2022.2

McCarty, M. F. (2004). Sub-optimal taurine status may promote platelet hyperaggregability in vegetarians. *Med. Hypotheses* 63, 426–433. doi: 10.1016/j.mehy.2002.11.007

Medawar, E., Huhn, S., Villringer, A., and Veronica Witte, A. (2019). The effects of plant-based diets on the body and the brain: a systematic review. *Transl. Psychiatry* 9:226. doi: 10.1038/s41398-019-0552-0

Melina, V., Craig, W., and Levin, S. (2016). Position of the academy of nutrition and dietetics: vegetarian diets. *J. Acad. Nutr. Diet.* 116, 1970–1980. doi: 10.1016/J.JAND.2016.09.025

Minson, J. A., and Monin, B. (2012). Do-gooder derogation: disparaging morally motivated minorities to defuse anticipated reproach. *Soc. Psychol. Personal. Sci.* 3, 200–207. doi: 10.1177/1948550611415695

Monteiro, C. A., Pfeiler, T. M., Patterson, M. D., and Milburn, M. A. (2017). The Carnism inventory: measuring the ideology of eating animals. *Appetite* 113, 51–62. doi: 10.1016/j.appet.2017.02.011

Morris, C., Kirwan, J., and Lally, R. (2014). Less meat initiatives: an initial exploration of a diet-focused social innovation in transitions to a more sustainable regime of meat provisioning. *Int. J. Sociol. Agric. Food* 21, 189–208. doi: 10.48416/ijsaf.v21i2.148

Moscovici, S. (1980). "Toward a theory of conversion behavior" in *Advances in Experimental Social Psychology*. ed. L. Berkowitz (New York: Academic Press)

Moscovici, S. (1985). "Social influence and conformity" in *Handbook of Social Psychology*. eds. G. Lindze and E. Aronson. *3rd* ed (New York: Random House)

Mugny, G. (1975). Negotiations, image of the other and the process of minority influence. *Eur. J. Soc. Psychol.* 5, 209–228. doi: 10.1002/ejsp.2420050206

Mugny, G., and Pérez, J.A. (1991). *The Social Psychology of Minority Influence*. Cambridge: Cambridge University Press.

Mullee, A., Vermeire, L., Vanaelst, B., Mullie, P., Deriemaeker, P., Leenaert, T., et al. (2017). Vegetarianism and meat consumption: a comparison of attitudes and beliefs between vegetarian, semi-vegetarian, and omnivorous subjects in Belgium. *Appetite* 114, 299–305. doi: 10.1016/j.appet.2017.03.052

Neuenschwander, M., Ballon, A., Weber, K. S., Norat, T., Aune, D., Schwingshackl, L., et al. (2019). Role of diet in type 2 diabetes incidence: umbrella review of meta-analyses of prospective observational studies. *BMJ* 366:l2368. doi: 10.1136/bmj.l2368

Nguyen, A., and Platow, M. J. (2021). 'I'll eat meat because that's what we do': the role of national norms and national social identification on meat eating. *Appetite* 164:March:105287. doi: 10.1016/j.appet.2021.105287

Nordquist, R. E., van der Staay, F. J., van Eerdenburg, F. J. C. M., Velkers, F. C., Fijn, L., and Arndt, S. S. (2017). Mutilating procedures, management practices, and housing conditions that may affect the welfare of farm animals: implications for welfare research. *Animals* 7:2. doi: 10.3390/ani7020012

Onwezen, M. C., and van der Weele, C. N. (2016). When indifference is ambivalence: strategic ignorance about meat consumption. *Food Qual. Prefer.* 52, 96–105. doi: 10.1016/j.foodqual.2016.04.001

Otten, S. (2016). The minimal group paradigm and its maximal impact in research on social categorization. *Curr. Opin. Psychol.* 11, 85–89. doi: 10.1016/j.copsyc.2016.06.010

Oyserman, D. (2015). "Identity-based motivation" in *Emerging Trends in the Behavioral and Social Sciences*. eds. S. Scott and R. Kosslyn (Hoboken, NJ: John Wiley & Sons), 1–11.

Pauer, S., Rutjens, B. T., Ruby, M. B., and Perino, G. (2022). Meating conflict: toward a model of ambivalence-motivated reduction of meat consumption. *Foods* 11:921. doi: 10.3390/foods11070921

Paxman, C. G. (2016). *Vegan voices: Communicatively negotiating a food-based identity*. PhD Dissertation, Iowa City, US: University of Iowa.

Piazza, J. (2020). "Why people eat animals" in *Why people eat animal*. eds. K. Dhont and G. Hodson (Abingdon: Routledge), 121–136.

Piazza, J., Ruby, M. B., Loughnan, S., Luong, M., Kulik, J., Watkins, H. M., et al. (2015). Rationalizing meat consumption. The 4Ns. *Appetite* 91, 114–128. doi: 10.1016/j.appet.2015.04.011

Piazza, J. R., Cooper, L., and Slater-Johnson, S. (2020). Rationalizing the many uses of animals: application of the 4N justifications beyond meat. *Human Animal Interact. Bull.* 2020, 1–22. doi: 10.1079/hai.2020.0004

Plante, C. N., Rosenfeld, D. L., Plante, M., and Reysen, S. (2019). The role of social identity motivation in dietary attitudes and behaviors among vegetarians. *Appetite* 141:104307. doi: 10.1016/j.appet.2019.05.038

Podberscek, A. L. (2009). Good to pet and eat: the keeping and consuming of dogs and cats in South Korea. *J. Soc. Issues* 65, 615–632. doi: 10.1111/j.1540-4560.2009.01616.x

Poore, J., and Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science* 360, 987–992. doi: 10.1126/science.aaq0216

Possidónio, C., Graça, J., Piazza, J., and Prada, M. (2019). Animal images database: validation of 120 images for human-animal studies. *Animals* 9:475. doi: 10.3390/ani9080475

Povey, R., Wellens, B., and Conner, M. (2001). Attitudes towards following meat, vegetarian and vegan diets: an examination of the role of ambivalence. *Appetite* 37, 15–26. doi: 10.1006/appe.2001.0406

Prażmo, E. M. (2019). 'Leftie snowflakes' and other metaphtonymies in the British political discourse. *J. Lang. Polit.* 18, 371–392. doi: 10.1075/jlp.17073.pra

Radnitz, C., Beezhold, B., and DiMatteo, J. (2015). Investigation of lifestyle choices of individuals following a vegan diet for health and ethical reasons. *Appetite* 90, 31–36. doi: 10.1016/j.appet.2015.02.026

Reese, J. (2020). Institutional change and the limitations of consumer activism. *Palgrave Commun.* 6, 1–8. doi: 10.1057/s41599-020-0405-8

Reese, J. (2021). Animals, food, and technology (AFT) survey: 2020 update. Available at: http://www.sentienceinstitute.org/animal-farming-attitudes-survey-2017 (accessed June 6, 2021).

Ripple, W. J., Wolf, C., Newsome, T. M., Galetti, M., Alamgir, M., Crist, E., et al. (2017). World scientists' warning to humanity: A second notice. *BioScience* 67, 1026–1028. doi: 10.1093/biosci/bix125

Rosenfeld, D. L. (2018). The psychology of vegetarianism: recent advances and future directions. *Appetite* 131:September, 125–138. doi: 10.1016/j.appet.2018.09.011

Rosenfeld, D. L. (2019a). A comparison of dietarian identity profiles between vegetarians and vegans. *Food Qual. Prefer.* 72, 40–44. doi: 10.1016/j.foodqual.2018.09.008

Rosenfeld, D. L. (2019b). Ethical motivation and vegetarian dieting: the underlying role of anti-speciesist attitude. *Anthrozoös* 32, 785–796. doi: 10.1080/08927936.2019.1673048

Rosenfeld, D. L., and Burrow, A. L. (2017). The unified model of vegetarian identity: a conceptual framework for understanding plant-based food choices. *Appetite* 112, 78–95. doi: 10.1016/j.appet.2017.01.017

Rosenfeld, D. L., and Burrow, A. L. (2018). Development and validation of the dietarian identity questionnaire: assessing self-perceptions of animal-product consumption. *Appetite* 127, 182–194. doi: 10.1016/j.appet.2018.05.003

Rosenfeld, D. L., Rothgerber, H., and Tomiyama, A. J. (2019). Mostly vegetarian, but flexible about it: investigating how meat-reducers express social identity around their diets. *Soc. Psychol. Personal. Sci.* 11, 406–415. doi: 10.1177/1948550619869619

Rosenfeld, D. L., and Tomiyama, A. J. (2019). When vegetarians eat meat: why vegetarians violate their diets and how they feel about doing so. *Appetite* 143:104417. doi: 10.1016/j.appet.2019.104417

Rothgerber, H. (2013). Real men don't eat (vegetable) quiche: masculinity and the justification of meat consumption. *Psychol. Men Masculinity* 14, 363–375. doi: 10.1037/a0030379

Rothgerber, H. (2014). Efforts to overcome vegetarian-induced dissonance among meat eaters. *Appetite* 79, 32–41. doi: 10.1016/j.appet.2014.04.003

Rothgerber, H. (2015). Can you have your meat and eat it too? Conscientious omnivores, vegetarians, and adherence to diet. *Appetite* 84, 196–203. doi: 10.1016/j.appet.2014.10.012

Rothgerber, H. (2017). "Attitudes toward meat and plants in vegetarians," in *Vegetarian and Plant-Based Diets in Health and Disease Prevention*. ed. F. Mariotti (Cambridge, MA: Academic Press), 11–35.

Rothgerber, H. (2020). Meat-related cognitive dissonance: a conceptual framework for understanding how meat eaters reduce negative arousal from eating animals. *Appetite* 146:May 2019:104511. doi: 10.1016/j.appet.2019.104511

Rouhani, M. H., Salehi-Abargouei, A., Surkan, P. J., and Azadbakht, L. (2014). Is there a relationship between red or processed meat intake and obesity? A systematic review and meta-analysis of observational studies. *Obes. Rev.* 15, 740–748. doi: 10.1111/obr.12172

Rozin, P. (1996). Towards a psychology of food and eating: from motivation to module to model to marker, morality, meaning, and metaphor. *Curr. Dir. Psychol. Sci.* 5, 18–24. doi: 10.1111/1467-8721.ep10772690

Ruby, M. B. (2012). Vegetarianism. A blossoming field of study. *Appetite* 58, 141–150. doi: 10.1016/j.appet.2011.09.019

Ruby, M. B., Alvarenga, M. S., Rozin, P., Kirby, T. A., Richer, E., and Rutsztein, G. (2016). Attitudes toward beef and vegetarians in Argentina, Brazil, France, and the USA. *Appetite* 96, 546–554. doi: 10.1016/j.appet.2015.10.018

Ruby, M. B., and Heine, S. J. (2011). Meat, morals, and masculinity. *Appetite* 56, 447–450. doi: 10.1016/j.appet.2011.01.018

Ruby, M. B., Heine, S. J., Kamble, S., Cheng, T. K., and Waddar, M. (2013). Compassion and contamination. Cultural differences in vegetarianism. *Appetite* 71, 340–3348. doi: 10.1016/j.appet.2013.09.004

Sadalla, E., and Burroughs, J. (1981). Profiles on eating: sexy vegetarians and other diet-based stereotypes. *Psychol. Today* 15, 51–57.

Sahlin, K. R., and Trewern, J. (2022). A systematic review of the definitions and interpretations in scientific literature of 'less but better' meat in high-income settings. *Nat. Food* 3, 454–460. doi: 10.1038/s43016-022-00536-5

Salehi, G., Carmona, E. D., and Redondo, R. (2020). "Consumers' switching to vegan, vegetarian, and plant-based (veg*n) diets: a systematic review of literature" in *19th International Congress on Public and Nonprofit Marketing Sustainability: New Challenges for Marketing and Socioeconomic Development*. Spain

Schein, C., and Gray, K. (2015). The unifying moral dyad: liberals and conservatives share the same harm-based moral template. *Personal. Soc. Psychol. Bull.* 41, 1147–1163. doi: 10.1177/0146167215591501

Schein, C., and Gray, K. (2018). The theory of dyadic morality: reinventing moral judgment by redefining harm. *Personal. Soc. Psychol. Rev.* 22, 32–70. doi: 10.1177/1088868317698288

Selinger, E., Neuenschwander, M., Koller, A., Gojda, J., Kühn, T., Schwingshackl, L., et al. (2022). Evidence of a vegan diet for health benefits and risks–an umbrella review of meta-analyses of observational and clinical studies. *Crit. Rev. Food Sci. Nutr.* 0, 1–11. doi: 10.1080/10408398.2022.2075311

Shepon, A., Eshel, G., Noor, E., and Milo, R. (2018). The opportunity cost of animal based diets exceeds all food losses. *Proc. Natl. Acad. Sci. U. S. A.* 115, 3804–3809. doi: 10.1073/pnas.1713820115

Sibley, C. G., and Duckitt, J. (2013). The dual process model of ideology and prejudice: a longitudinal test during a global recession. *J. Soc. Psychol.* 153, 448–466. doi: 10.1080/00224545.2012.757544

Silva Souza, G. L., and O'Dwyer, E. (2022). Animal rights, environment, or health? Effects of argument type and dissonance on the attitudes toward the consumption of animals. *Appetite* 176:June:106129. doi: 10.1016/j.appet.2022.106129

Simpson, A., Piazza, J., and Rios, K. (2016). Belief in divine moral authority: validation of a shortened scale with implications for social attitudes and moral cognition. *Pers. Individ. Dif.* 94, 256–265. doi: 10.1016/j.paid.2016.01.032

Singer, P. (1975). Animal liberation: a new ethics for our treatment of animals. The New York Review.

Smaldino, P. E. (2019). Social identity and cooperation in cultural evolution. *Behav. Process.* 161, 108–116. doi: 10.1016/j.beproc.2017.11.015

Sousa, P., Allard, A., Piazza, J., and Goodwin, G. P. (2021). Folk moral objectivism: the case of harmful actions. *Front. Psychol.* 12:638515. doi: 10.3389/fpsyg.2021.638515

Springmann, M., Godfray, H. C. J., Rayner, M., and Scarborough, P. (2016). Analysis and valuation of the health and climate change cobenefits of dietary change. *Proc. Natl. Acad. Sci. U. S. A.* 113, 4146–4151. doi: 10.1073/pnas.1523119113

Steele, C. M. (1988). "The psychology of self-affirmation: sustaining the integrity of the self" in *Advances in Experimental Social Psychology*. ed. L. Berkowitz (San Diego, CA: Academic Press), 261–302.

Steg, L., and de Groot, J. (2010). Explaining prosocial intentions: testing causal relationships in the norm activation model. *Br. J. Soc. Psychol.* 49, 725–743. doi: 10.1348/014466609X477745

Stoll-Kleemann, S., and Schmidt, U. J. (2017). Reducing meat consumption in developed and transition countries to counter climate change and biodiversity loss: a review of influence factors. *Reg. Environ. Chang.* 17, 1261–1277. doi: 10.1007/s10113-016-1057-5

Taber, C. S., and Lodge, M. (2012). Motivated skepticism in the evaluation of political beliefs (2006). *Crit. Rev.* 24, 157–184. doi: 10.1080/08913811.2012.711019

Tajfel, H. (1972). "Social categorization" in *Introduction à la psychologie sociale*. ed. S. Moscovici (Paris: Larouse)

Tajfel, H., and Turner, J. C. (1979). "An integrative theory of intergroup conflict" in *The Social Psychology of Intergroup Relations*. eds. S. Worchel and W. G. Austin (Monterey, CA: Brooks/Cole), 33–47.

Tajfel, H., and Turner, J. C. (1986). "The social identity theory of intergroup behaviour" in *The Psychology of Intergroup Relations*. eds. S. Worchel and W. G. Austin (Chicago, IL: Nelson-Hall), 7–24.

Tang, K. L., Caffrey, N. P., Nóbrega, D. B., Cork, S. C., Ronksley, P. E., Barkema, H. W., et al. (2017). Restricting the use of antibiotics in food-producing animals and its associations with antibiotic resistance in food-producing animals and human beings: a systematic review and meta-analysis. *Lancet Planet. Heal.* 1, e316–e327. doi: 10.1016/S2542-5196(17)30141-9

Taufik, D., Verain, M. C. D., Bouwman, E. P., and Reinders, M. J. (2019). Determinants of real-life behavioural interventions to stimulate more plant-based and less animal-based diets: a systematic review. *Trends Food Sci. Technol.* 93, 281–303. doi: 10.1016/j.tifs.2019.09.019

Thomas, E. F., Bury, S. M., Louis, W. R., Amiot, C. E., Molenberghs, P., Crane, M. F., et al. (2019). Vegetarian, vegan, activist, radical: using latent profile analysis to examine different forms of support for animal welfare. *Gr. Process. Intergr. Relations* 22, 836–857. doi: 10.1177/1368430218824407

Trethewey, E., and Jackson, M. (2019). Values and cognitive mechanisms: comparing the predictive factors of Australian meat intake. *Appetite* 142:104386. doi: 10.1016/j.appet.2019.104386

Tubb, C., and Seba, T. (2019). Rethinking food and agriculture 2020–2030: The second domestication of plants and animals, the disruption of the cow, and the collapse of industrial livestock farming. *Ind. Biotechnol.* 17. 57–72. doi: 10.1089/ind.2021.29240.ctu

Turner, J.C., Hogg, M.A., Oakes, P.J., Reicher, S.D., and Wetherell, M.S. (1987). *Rediscovering the Social Group: A Self-Categorization Theory*. Oxford and New York: Basil Blackwell.

Turner, J. C., and Reynolds, K. J. (2010). "The story of social identity," in *Rediscovering Social Identity: Key Readings*. eds. T. Postmes and N. R. Branscombe (New York: Psychology Press, Taylor & Francis), 13–32.

UNEP (2020). *Preventing the next pandemic: Zoonotic diseases and how to break the chain of transmission*. Available at: https://unsdg.un.org/resources/preventing-next-pandemic-zoonotic-diseases-and-how-break-chain-transmission (Accessed November 3, 2022).

Vandermoere, F., Geerts, R., De Backer, C., Erreygers, S., and Van Doorslaer, E. (2019). Meat consumption and vegaphobia: an exploration of the characteristics of meat eaters, vegaphobes, and their social environment. *Sustainability* 11:3936. doi: 10.3390/su11143936

VanHeuvelen, T., and VanHeuvelen, J. S. (2019). The (economic) development of healthy eating habits. *Sociol. Dev.* 5, 91–113. doi: 10.1525/sod.2019.5.1.91

Verain, M. C. D., Dagevos, H., and Jaspers, P. (2022). Flexitarianism in the Netherlands in the 2010 decade: shifts, consumer segments and motives. *Food Qual. Prefer.* 96:104445. doi: 10.1016/j.foodqual.2021.104445

Vranken, L., Avermaete, T., Petalios, D., and Mathijs, E. (2014). Curbing global meat consumption: emerging evidence of a second nutrition transition. *Environ. Sci. Pol.* 39, 95–106. doi: 10.1016/j.envsci.2014.02.009

Wang, X., Lin, X., Ouyang, Y. Y., Liu, J., Zhao, G., Pan, A., et al. (2016). Red and processed meat consumption and mortality: dose-response meta-analysis of prospective cohort studies. *Public Health Nutr.* 19, 893–905. doi: 10.1017/S1368980015002062

van der Weele, C. N. (2013). "Meat and the benefits of ambivalence" in *The Ethics of Consumption*. eds. H. Röcklinsberg and P. Sandin (Wageningen: Wageningen Academic Publishers), 290–295.

Weiper, M. L. V., and Vonk, R. (2021). A communicational approach to enhance open-mindedness towards meat-refusers. *Appetite* 167:August 2020:105602. doi: 10.1016/j.appet.2021.105602

Weis, T. (2013). *The Ecological Hoofprint: The Global Burden of Industrial Livestock*. (London, New York: Zed Books Ltd.).

Weis, T., and Ellis, R. A. (2021). "Animal functionality and interspecies relations in regenerative agriculture: considering necessity and the possibilities of non-violence," in *Routledge Handbook of Sustainable and Regenerative Food Systems*. eds. J. Duncan, M. Carolan and J. S. C. Wiskerke (London: Routledge), 141–153.

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., et al. (2019). Food in the Anthropocene: the EAT–lancet commission on healthy diets from sustainable food systems. *Lancet* 393, 447–492. doi: 10.1016/S0140-6736(18)31788-4

Williams, D. (2020). Motivated ignorance, rationality, and democratic politics. *Synthese* 198, 7807–7827. doi: 10.1007/s11229-020-02549-8

Wood, W., Lundgren, S., Ouellette, J. A., Busceme, S., and Blackstone, T. (1994). Minority influence: a meta-analytic review of social influence processes. *Psychol. Bull.* 115, 323–345. doi: 10.1037/0033-2909.115.3.323

Wrenn, C. (2019). Atheism in the American animal rights movement: an invisible majority. *Environ. Values* 28, 715–739. doi: 10.3197/096327119X15579936382509

Wrenn, C. L. (2018). Free-riders in the nonprofit industrial complex: the problem of flexitarianism. *Soc. Anim.* 28, 567–591. doi: 10.1163/15685306-12341544

Zane, D. M., Irwin, J. R., and Reczek, R. W. (2016). Do less ethical consumers denigrate more ethical consumers? The effect of willful ignorance on judgments of others. *J. Consum. Psychol.* 26, 337–349. doi: 10.1016/j.jcps.2015.10.002

frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 21 December 2022
DOI 10.3389/fpsyg.2022.1019714

OPEN ACCESS

EDITED BY
Christopher J. Hopwood,
University of Zurich,
Switzerland

REVIEWED BY
Meike Morren,
VU Amsterdam,
Netherlands
Derrick Tanous,
University of Innsbruck,
Austria

*CORRESPONDENCE
Marina Milyavskaya
marina.milyavskaya@carleton.ca

SPECIALTY SECTION
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

RECEIVED 15 August 2022
ACCEPTED 27 October 2022
PUBLISHED 21 December 2022

CITATION
Kolbuszewska M, Anderson J and Milyavskaya M (2022) Autonomous motivation, goal-facilitating behaviours, and dietary goal progress in individuals transitioning to a veg*n diet: A longitudinal study.
Front. Psychol. 13:1019714.
doi: 10.3389/fpsyg.2022.1019714

Autonomous motivation, goal-facilitating behaviours, and dietary goal progress in individuals transitioning to a veg*n diet: A longitudinal study

Marta Kolbuszewska[1,2], Jo Anderson[3] and Marina Milyavskaya[2]*

[1]Department of Psychology, University of British Columbia, Vancouver, BC, Canada, [2]Department of Psychology, Carleton University, Ottawa, ON, Canada, [3]Faunalytics, Olympia, WA, United States

Previous studies have consistently shown that autonomous motivation – pursuing goals because one *wants to*, rather than *has to* – is associated with greater behaviour maintenance in the context of healthy eating, exercise, and diet maintenance. The present study used a 7-wave longitudinal design to examine how autonomous motivation is related to dietary goal progress in individuals (N=222) transitioning to a veg*n (i.e., vegetarian or vegan) diet. We hypothesized that when people reported more autonomous motivation (compared to their own average) they would be more successful in reaching their dietary goals. We also explored the role of goal-facilitating behaviours in this process. We found no directional effects of relative autonomous motivation on goal progress or goal-facilitating behaviours, although the concurrent relations were significant. There were also no within-person effects of behaviours on progress. These findings shed light onto the relationship between autonomous motivation, behaviours, and goal progress both at the same time and over time, and highlight the importance of examining within-person fluctuations over time.

KEYWORDS

vegan, vegetarian, self-determination, autonomy, behaviour change

Introduction

Plant-based diets (whether in the form of reduced meat consumption or complete elimination of animal products) have received increased media coverage and popular interest in recent years (Phua et al., 2020; Van Loo et al., 2020). Campaigns to reduce meat consumption like Veganuary have seen growing success; in 2022, 629,000 people participated in Veganuary, up from 3,000 in 2014 (Veganuary, 2022), and meat alternatives are now mainstream, available at fast-food chains and grocery stores (Van Loo et al., 2020). Indeed, reducing meat consumption provides significant opportunities to mitigate climate

change and reduce greenhouse gas emissions (Shukla et al., 2019), protect animal welfare (Westhoek et al., 2014), and reduce the burden of chronic illness linked to cardiovascular disease (Kahleova et al., 2018; Siapco and Sabaté, 2019), colorectal cancers (Bouvard et al., 2015), and type 2 diabetes (Kahleova et al., 2011). Nevertheless, global meat consumption is increasing (Godfray et al., 2018) and despite considerable interest in vegetarian or vegan (henceforth referred to as veg*n) diets, only a small proportion of individuals who try a veg*n diet stick with it long-term (Faunalytics, 2016). In the United States, there are more than five times as many former veg*ns (i.e., people who tried a veg*n diet and then abandoned it) as current veg*ns; that is, over 80% of vegetarians/vegans abandon their diet (Faunalytics, 2016). Given the low success rate, what can help people stick to a veg*n diet?

Autonomous motivation

A large body of research has explored the environmental and psychological factors that influence individuals' uptake and maintenance of health behaviours (Sallis et al., 2015). Motivation is a psychological factor that is especially relevant to promoting goal attainment (Sheldon et al., 2004). Although past research has examined different motives or reasons for transitioning to a veg*n diet (Fox and Ward, 2008; Faunalytics, 2014; Grassian, 2020; North et al., 2021; Ghaffari et al., 2022), it has not considered the *quality* of motivation. Self-Determination Theory (Deci and Ryan, 2000) suggests that motivation exists on a continuum from autonomous (because one *wants to*) to controlled (because one *has to;* Ryan and Connell, 1989). Autonomous motivation entails enacting a behaviour for the enjoyment or challenge inherent to that action, because it is integral to their identity (e.g., a person avoids meat because it aligns with their beliefs), or because they believe their goal to be important (e.g., a person reduces milk consumption because they do not support the dairy industry, even though they really like cheese). Controlled motivation, on the other hand, is characterized by external pressures and demands. Individuals might pursue a goal because of feelings of guilt, shame, or social pressure (e.g., a vegetarian gives up eggs and dairy because they fear the negative reactions of their vegan peers if they continue eating animal products), or in order to meet external incentives or to satisfy an external demand (e.g., a person eats vegetarian because they will win a gift certificate if they do so).

Past studies have found that more autonomous motivation is associated with greater goal progress (Sheldon and Elliot, 1999; Koestner et al., 2002; Sheldon et al., 2004; Werner et al., 2016), and behaviour maintenance (of multiple behaviours; Ryan and Connell, 1989; Silva et al., 2011; Hagger et al., 2014; Nurmi et al., 2016; Vancampfort et al., 2016; Voi and Sainsbury, 2019), compared to controlled motivation. Although some of this research has examined the role of autonomous and controlled motivation in diet maintenance, it has predominantly focused on dieting for weight loss, which entails caloric restriction (Wadden et al., 1994; Wing et al., 2006) and implicates physiological processes related to metabolic adaptation that may interfere with weight loss maintenance (Ohsiek and Williams, 2011; Anastasiou et al., 2015). Transitioning to, and maintaining, a veg*n diet can thus differ from pursuing diets for weight control. Additionally, autonomous as opposed to controlled motivation is associated with using more adaptive strategies (Koestner et al., 2008), experiencing fewer temptations (Milyavskaya et al., 2015) and reporting greater subject ease (Werner et al., 2016) during general goal pursuit. We thus expect that relatively more autonomous motivation will similarly relate to more successful transition to a veg*n diet, including engagement in more goal-facilitating behaviours.

Goal-facilitating behaviours

What are some ways that people can stick to their goal of eating fewer animal products? Engaging in certain activities, like planning meals in advance, or avoiding situations with tempting dietary options, can help people succeed at meeting their goals (Williamson and Wilkowski, 2020). For veg*ns, some activities may be more influential than others at helping people reach their dietary goals. Faunalytics (2014) and Grassian (2020) found that veg*ns and former veg*ns list six general factors that influence veg*n diet maintenance, including cravings, convenience, motivation, cost, health concerns, and social support.

Strategies for dealing with cravings

One way to promote goal-consistent choices is by using strategies to actively manage oneself and one's environment and avoid temptations that may hinder goal progress (Duckworth et al., 2014; Duckworth et al., 2016). Prior research on self-control strategies finds that they are generally effective in preventing indulgence in the moment, and that using more strategies is more effective (Milyavskaya et al., 2020). In the context of transitioning to a veg*n diet, individuals may use strategies when faced with tempting situations (e.g., planning a strategy to use if a craving occurs) in order to help achieve their goals.

Convenience

Goal-consistent behaviours that increase convenience may also play an important role in supporting individuals' transition and maintenance of veg*n diets. For example, *situation selection*, choosing situations that help one stick to their goals and avoiding situations where self-control will be needed, helps people stick to their various goals more broadly (Duckworth et al., 2016). Similarly, choosing in advance generally encourages more self-controlled decisions (Laibson, 1997). Consequently, behaviours that increase convenience (e.g., going to a vegetarian restaurant instead of a steakhouse) may be particularly relevant to those following a veg*n diet.

Information seeking

Veg*ns cite various reasons for eliminating animal products from their diet, with animal welfare, environmental,

and health concerns often topping the list (Dyett et al., 2013; Kerschke-Risch, 2015; Radnitz et al., 2015; Izmirli and Phillips, 2011, see Janssen et al., 2016). However, some reasons are more effective than others at influencing long-term behaviour change; for example, many veg*ns cite learning about the harms of livestock agriculture as an important factor in transitioning to a veg*n diet (Faunalytics, 2014). We thus examined whether learning about the benefits of a veg*n diet (or the potential detriments of a non-veg*n diet) promotes dietary change.

Health

Another set of behaviours that are particularly relevant to the veg*n context are health-related behaviours (e.g., getting blood work done to check one's iron or B12 levels). Monitoring nutritional needs is especially important for maintaining health and may thereby help people stick to their diet (Herrmann and Geisel, 2002). Regular monitoring of serum B12 and iron levels has been recommended for children and pregnant/lactating women (Lemale et al., 2019), as well as adults (Herrmann and Geisel, 2002; Pawlak et al., 2014) following a plant-based diet, and current veg*ns are much more likely to have had these values checked than those who abandon a veg*n diet (Faunalytics, 2014). Additionally, nutritional concerns and deficits are cited as one of the top reasons for abandoning a veg*n diet (Faunalytics, 2014). As such, proactively monitoring health and nutrition may help individuals successfully transition to a veg*n diet.

Cost

For individuals pursuing a healthy diet, food choice is influenced by personal economic conditions: Eating a healthy, and environmentally friendly, diet often incurs financial costs (Cade et al., 1999) while financial constraints lead to less healthy eating (Drewnowski and Darmon, 2005; Barosh et al., 2014). Examining the affordability of health food items, Barosh et al. (2014) found that a low-income household would need to spend 40 to 48% of their weekly income to afford a healthy food basket, whereas a high-income household would only need to spend between 8 and 9% of their salary to afford the same food. Although veg*n and reduced-meat diets do not necessarily need to be expensive (Wilson et al., 2013), many individuals transitioning to a veg*n diet find cost to be a factor when planning their diet (Faunalytics, 2014; Van Den Berg et al., 2022). Strategies to reduce costs may therefore play a role in successfully transitioning to and maintaining a veg*n diet.

Social

Social support from various sources (e.g., family, healthcare professionals, friends) can positively influence goal attainment, including health outcomes (Jakubiak and Feeney, 2016). Social support is implicated in healthier food choices (Kubik et al., 2005; Stanton et al., 2007) and adherence to dietary changes (Sorensen et al., 1998; Wilson et al., 2013). Just as diet-related social support helps individuals pursue healthy eating behaviours, social support plays an important role in maintaining a veg*n diet (Jabs et al., 1998; Hielkema and Lund, 2021), with veg*ns often seeking out veg*n social groups (Chuter, 2018; Séré de Lanauze and Sirieix, 2022) and romantic partners (Twine, 2014). Similarly, a lack of social support can present a barrier to individuals maintaining a veg*n diet (Hodson and Earle, 2018; Markowski and Roxburgh, 2019).

Fluctuations over time and the present research

There is evidence that goal intentions (Conner et al., 2000; Conroy et al., 2011) and behaviours implicated in goal pursuit (Inauen et al., 2016) naturally fluctuate over time. That is, people's intentions (e.g., to exercise) and behaviours (e.g., snacking) vary on the short- to medium- term (i.e., on the weekly and monthly scale; Conroy et al., 2011; Reuter et al., 2009; Scholz et al., 2008). Previous research found that the greatest reported drop-off in diet adherence was within the first few months of a veg*n diet (34% within 3 months, another 19% within the first year; Asher et al., 2014); we thus chose one-month follow-ups, for 6 months, to try and strike a reasonable balance between frequency in those early months and not overburdening participants. Our research addresses a critical gap in the literature by addressing how goal progress may vary for a single individual over time, examining prospective effects of within-person deviations from trait levels. More concretely, we examine whether relative autonomous motivation will lead to engaging in more behaviours that facilitate goal pursuit, and whether this will lead to greater dietary goal progress among individuals transitioning to a veg*n diet - that is, whether more relative autonomous motivation in a given month compared to *your own average* will lead to greater goal progress).

The current study

In the present research, we examined whether feeling greater relative autonomous motivation and engaging in more behaviours that facilitate goal pursuit predict dietary goal progress among individuals transitioning to a veg*n diet. Specifically, we were interested in assessing whether goal-facilitating behaviours mediate the relationship between motivation and progress. We hypothesized that: (A) When individuals have higher relative autonomous motivation than usual, they will experience a subsequent increase in dietary goal progress. (B) When individuals engage in more behaviours that facilitate goal progress than usual, they will experience a subsequent increase in dietary goal progress. (C) Individuals who have higher relative autonomous motivation than usual will engage in more behaviours that facilitate goal progress than usual; this will in turn lead to an increase in dietary goal progress. (D) There will be an indirect effect of relative

autonomous motivation on goal progress *via* behaviours that facilitate goal progress at the within-person level.[1]

Materials and methods

Participants and procedure

Participants were 222 individuals transitioning to a vegetarian or vegan diet (67.6% women, M_{age} = 31.4, 40.5% had attempted a veg*n diet before, average time since beginning the current veg*n diet = 3.52 weeks) recruited from a variety of North American online sources (e.g., Facebook groups for health, plant-based recipes). Participants were surveyed once a month for 6 months, starting with a baseline survey at sign-up. At each follow-up, participants were emailed to ask if they were still pursuing the diet. If they were not pursuing their diet anymore, they were directed to a separate survey regarding diet abandonment. If they were still pursuing the diet, they filled out a longer survey.[2] Therefore, participants completed up to seven surveys in total. All survey questionnaires are available at https://osf.io/bhksj/. Sample size was determined by *a-priori* power analyses, with a sample of 200 participants required to detect a small-to-medium effect (f^2 = 0.08) with 90% power at α = 0.05 level of significance (although we did initially plan to recruit 400 participants to account for drop-out; see https://osf.io/z5vef/ for the original recruitment plan). Our final sample consisted of 222 participants. Exclusion criteria were pre-registered, however due to an influx of scammers during initial stages of data collection, exclusion criteria were revised prior to analysis to remove fraudulent responses. Full details of the revised exclusion criteria can be found online at https://osf.io/bhksj/. The data were collected as part of a collaboration with Faunalytics (a non-profit organization), which has published two reports stemming from the full dataset (Anderson et al., 2021; Anderson and Milyavskaya, 2021).

Measures

Relative autonomous motivation

A 12-item adapted version of the Treatment Self-Regulation Questionnaire (TSRQ; Ryan and Connell, 1989) was used to measure relative autonomous motivation for maintaining a veg*n diet. This scale consists of 12 items that ask participants to rate six statements representing autonomous motivation (e.g., "Because I personally believe it is the best thing to do") and six statements representing controlled motivation (e.g., "Because I would feel guilty or ashamed of myself if I did not follow this diet") on a 5-point Likert Scale ranging from 1 = strongly disagree, to 5 = strongly agree. For the purposes of the present study, relative autonomous motivation was computed as a composite score of the TSRQ, by subtracting the score for controlled motivation from autonomous motivation. Reliability for both the controlled motivation (α = 0.75–0.88) and autonomous motivation (α = 0.86–0.92) subscales was high.

Behaviours that facilitate goal progress

To assess behaviours that facilitate goal progress, participants were provided a list of 44 items, divided into six subsections: social (7 items; e.g., "Tried to meet new people with diets similar to yours"), convenience (8 items; e.g., "Switched to a restaurant, dining hall, etc., with better options for your diet"), cost (4 items; e.g., "Looked for cheaper restaurants"), health (5 items; e.g., "Taken vitamins or nutritional supplements"), information (9 items; e.g., "Learned more about the environmental impact of eating meat"), and cravings (11 items, e.g., "Planned a strategy for dealing with temptation if it occurs"). The total of 44 items included one open-ended item in each subsection. All variables were binary, scored 1 = "Yes," 0 = "No," that participants engaged in over the past month. The open-ended item was a string entry and was recoded as "yes" if answered (and answer did not duplicate prior answers), "no" if unanswered. A total score for behaviours was obtained by summing total items checked for each month.[3]

Dietary goal progress

We assessed dietary goal progress using two measures: subjective dietary goal progress and objective dietary goal progress.[4]

Subjective dietary goal progress

Dietary goal progress was assessed using a measure of perceived (subjective) goal progress. Participants were asked to rate how much progress they had made toward their dietary goal using a scale from 0% (not at all successful) to 100% (completely successful).

Objective dietary goal progress

Objective goal progress was calculated as a difference between the *goal diet* at the initial time point and the *actual diet* at the given time point, both assessed using a Food Frequency Questionnaire,

1 We had also preregistered hypotheses on between-person effects, to be tested using cross-lagged panel models (CLMP). However, given the general criticisms of these models (e.g., Lucas, 2022) and the poor fit of these models to our data, on the editor's recommendation we decided to report the results of these models in an online supplement only: https://osf.io/ez3wx, https://osf.io/bs3qr

2 Only our variables of interest are reported in this paper. For a full list of variables included in the questionnaires, see https://osf.io/bhksj/

3 Note that all behaviour categories were combined, as examining each type of behaviour separately was outside the scope of this paper.

4 Data on subjective and objective progress (and their relation) are used in another manuscript focusing on the correspondence between behavioural and self-report measures of goal progress (Smyth et al., under review).

a type of structured recall instrument often used in epidemiology research (e.g., Fred Hutch Cancer Center, 2022; National Cancer Institute, 2022) and more recently in psychology (e.g., Asher and Peters, 2020; Sparkman et al., 2021). At baseline, before all participants had started working towards their goal, objective goal progress was calculated as a difference between their goal diet and their actual diet at the same time point. The instructions for reporting *dietary goals* were as follows: "Once you achieve your new goal, how often do you expect to eat each of the following foods (including in other dishes or baked goods)?" Participants were provided with 5 food groups (dairy, poultry, fish/seafood, red meat, eggs) and asked to rate each item on a 5-point scale ranging from 1 = daily to 5 = not at all.

The instructions for reporting *actual diet* were as follows: "In the past month, how often have you eaten each of the following foods (including in other dishes or baked goods)?" Participants were provided with 5 food groups (dairy, poultry, fish/seafood, red meat, eggs) and asked to rate each item on a 5-point scale ranging from 1 = daily to 5 = not at all. A composite score was calculated by taking a difference between goal and actual diet for each food category and then averaging the scores for each participant. All participants who 'exceeded' their dietary goals (i.e., those that ate *less* meat, fish, etc. than they cited as their goal) were calculated as having no difference between their goal and actual diet progress. Therefore, the range of possible scores is 0 to 4, with 4 representing the most progress.

Analyses

All hypotheses as well as the analytical plan were pre-registered after data was collected but before data cleaning or analysis took place.[5] Analyses were conducted in R version 4.0.2 (R Core Team, 2020) Hypotheses A, B, C, and D were tested using the RI-CLPM model specified in Figure 1. Since both behaviours and progress were assessed with respect to the past month, we tested effects of behaviours on progress reported at the same time point (rather than cross-lagged), since it would not have made sense for behaviours in 1 month to predict progress in the following month (for example, behaviours in January should predict progress in January, not in February). Three random intercepts account for stable trait-like differences between persons in relative autonomous motivation, behaviours, and goal progress and separate out between-person variance, allowing the lagged relationships to account for within-person variance. These random intercepts, with all factor loadings constrained to 1, are represented by RI-AM, RI-Beh, and RI-GP in Figure 1. Observed measures for goal progress, behaviours, and relative autonomous motivation were regressed onto their respective latent, within-person centered variables. As such, cross-lags and autoregressive lags between latent variables indicated how changes in one construct (from an individual's average) influenced changes in other constructs (from an individual's average). Intervals between waves had the same length, and so cross-wave equality constraints were placed on autoregressive and cross-lagged effects (Hamaker et al., 2015; Orth et al., 2020). Hypothesis D was tested by requesting indirect effects of motivation on progress *via* behaviour with bootstrapped confidence intervals.

As per the preregistration, we tested correlations between objective and subjective progress over time in order to determine whether an indicator variable would be created to measure goal progress. Shapiro–Wilk's test was conducted to assess normality of data, and Spearman's rho was used to calculate correlations due to the skewed nature of variable distributions. Correlations between objective and subjective progress ranged between $r = 0.51$ and $r = 0.64$ (see online supplement for correlations at each time point), under our pre-registered cut-off of $r = 0.7$. Consequently, we fit two models to the data, one with each measure of progress.

In both models, longitudinal associations between relative autonomous motivation, goal-consistent behaviours, and goal progress (either objective or subjective) across seven time points were modeled using lavaan in R.[6] Although the original preregistration stated that all autoregressive, cross-lagged, and correlational paths would be constrained to be equal, at baseline (T0) many participants had not started working towards their goal and so instead we allowed the paths from goal progress at baseline to vary freely and constrained the paths across remaining time points. Model results with all paths constrained according to the original preregistration can be found in the online supplement.

In all analyses, full information maximum likelihood (FIML) estimates were used to deal with missing data (Enders and Bandalos, 2001). We assessed model fit using Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), and Chi square statistics. Because significance levels of the Chi-square statistic depend on sample size, model fit was evaluated using CFI, RMSEA, and SRMR. CFI values greater than 0.90 were considered to indicate acceptable fit, greater than 0.95 good fit. RMSEA values less than 0.08 indicated good fit, and SRMR values less than 0.06 indicated good fit (Hu and Bentler, 1999). For all analyses, standardized results are reported in text; unstandardized results can be found in the online supplement.[7]

Results

Preliminary analyses

Descriptive statistics of the variables of interests are presented in Table 1, and correlations are presented in Table 2.

5 https://osf.io/us9bx

6 https://osf.io/zx4sf/?view_only=f96dfaabf5ca43b5bc1ec6e1c93eaf96

7 https://osf.io/qckva

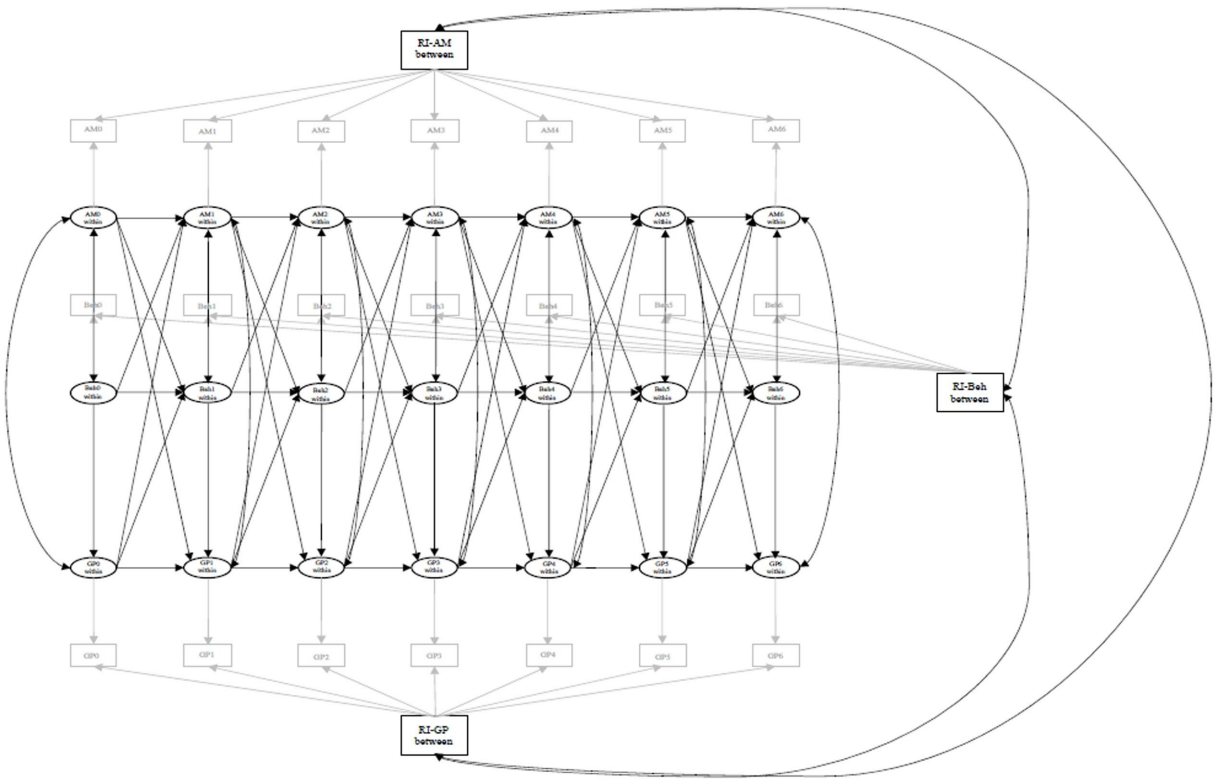


FIGURE 1
Random intercept cross-lagged panel model used to test hypotheses A to D.

TABLE 1 Means, standard deviations, and ICC of variables of interest at times T0-T6.

	Time							
	T0	T1	T2	T3	T4	T5	T6	
Variable (range)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	ICC
AM [−5–5]	1.95 (0.92)	1.81 (0.95)	1.80 (0.95)	1.69 (0.92)	1.52 (0.93)	1.53 (1.09)	1.57 (1.04)	0.57
GFB [0–44]	16.45 (6.99)	16.48 (6.86)	16.02 (7.25)	16.14 (7.68)	16.17 (8.18)	15.97 (8.96)	16.77 (9.05)	0.74
GPO [0–4]	2.70 (0.76)	3.61 (0.49)	3.68 (0.42)	3.70 (0.38)	3.73 (0.35)	3.76 (0.26)	3.78 (0.31)	0.30
GPS [0–100]	76.01 (21.19)	76.49 (2.73)	80.59 (17.90)	83.24 (17.23)	85.29 (15.70)	86.13 (15.60)	88.63 (14.18)	0.55

AM = Relative Autonomous Motivation; GFB = Behaviours; GPO = Objective Goal Progress; GPS = Subjective Goal Progress; ICC = Intraclass correlation.

Objective progress

The RI-CLPM model examining within-person relative autonomous motivation, behaviours, and objective goal progress showed adequate model fit (χ^2 (202) = 406.76, $p < 0.001$, CFI = 0.91, RMSEA = 0.07, 90% CI (0.06, 0.08), although the SRMR = 0.13 was poor). Autoregressive paths for within-person relative autonomous motivation and behaviours were significant and moderate (see Table 3 for standardized parameters and online supplement for unstandardized parameters). The relationship between goal progress at baseline (before participants had started working towards their goal) and time 1 was negative ($\beta = -0.24$, $p = 0.023$) – unsurprisingly, participants who had already made more progress at baseline made smaller additional gains at the first follow-up. Autoregressive effects were larger than other reported effects, suggesting that relative autonomous motivation and engagement in goal-consistent behaviours over the past month are best predicted by the same constructs at the previous time point. No cross-lagged effects were significant. Indirect effects of motivation on goal progress *via* behaviours were not significant ($\beta = -0.000$, $p = 0.996$, 95%CI [−0.002, 0.002]).[8] At the

8 In the tested models, variance of goal-facilitating behaviours was much higher than the variances of the other variables due to the operationalization in which scores were measured on different scales, resulting in a warning in R. We ran additional analyses with scaled variables. Standardized results remained the same (see online supplement).

TABLE 2 Correlation matrix of all variables at times T0-T6.

Variable	Time	Objective Goal Progress							Subjective Goal Progress							Autonomous Motivation							Goal-Facilitating Behaviours						
		0	1	2	3	4	5	6	0	1	2	3	4	5	6	0	1	2	3	4	5	6	0	1	2	3	4	5	6
Objective Goal Progress	0	1																											
	1	0.19*	1																										
	2	0.21*	0.76***	1																									
	3	0.20*	0.74***	0.68***	1																								
	4	0.20*	0.77***	0.72***	0.83***	1																							
	5	0.04	0.51***	0.51***	0.61***	0.68***	1																						
	6	0.14	0.60***	0.59***	0.66***	0.63***	0.63***	1																					
Subjective Goal Progress	0	−0.12	0.36***	0.28**	0.29**	0.21*	0.29**	0.24*	1																				
	1	−0.08	0.50***	0.38***	0.34***	0.33***	0.35***	0.31**	0.56***	1																			
	2	−0.07	0.44***	0.52***	0.41***	0.35***	0.26*	0.25*	0.51***	0.67***	1																		
	3	−0.01	0.39***	0.43***	0.53***	0.48***	0.49***	0.32**	0.44***	0.50***	0.56***	1																	
	4	0.00	0.33***	0.34***	0.44***	0.56***	0.47***	0.23*	0.41***	0.48***	0.64***	0.71***	1																
	5	−0.11	0.38***	0.27**	0.47***	0.42***	0.53***	0.35***	0.43***	0.50***	0.57***	0.66***	0.71***	1															
	6	−0.03	0.31**	0.37***	0.38***	0.37***	0.34***	0.45***	0.33***	0.38***	0.42***	0.44***	0.47***	0.49***	1														
Autonomous Motivation	0	−0.08	0.16	0.14	0.10	0.14	−0.04	0.07	0.16*	0.08	0.07	0.09	0.14	0.21*	0.18	1													
	1	−0.03	0.17*	0.08	0.07	0.12	−0.05	−0.01	0.06	0.08	0.12	0.03	0.19	0.24*	0.05	0.52***	1												
	2	0.00	−0.04	0.03	−0.12	−0.08	−0.29**	−0.14	−0.07	0.02	0.09	−0.04	0.04	0.14	0.03	0.39***	0.50***	1											
	3	0.05	0.16	0.07	0.14	0.18	−0.08	0.01	0.04	0.11	0.15	0.17	0.19	0.15	0.01	0.45***	0.60***	0.56***	1										
	4	−0.12	0.04	0.01	0.03	0.11	−0.10	−0.10	0.04	0.04	0.10	0.18	0.22	0.15	−0.01	0.52***	0.58***	0.47***	0.67***	1									
	5	−0.18	−0.08	−0.19	−0.14	−0.04	−0.15	−0.22*	−0.09	−0.07	0.11	0.00	0.14	0.17	−0.04	0.46***	0.60***	0.60***	0.65***	0.73***	1								
	6	−0.16	−0.03	0.03	−0.03	0.05	−0.19	−0.09	−0.06	−0.02	0.18	0.11	0.18	0.18	0.11	0.40***	0.61***	0.56***	0.64***	0.74***	0.76***	1							
Goal-Facilitating Behaviours	0	−0.03	0.21*	0.28**	0.21*	0.12	0.23*	0.18	0.07	0.07	0.05	0.04	−0.06	−0.04	0.05	0.02	−0.13	−0.09	−0.14	−0.31**	−0.36***	−0.30**	1						
	1	−0.03	0.16	0.24*	0.13	0.13	0.22*	0.26*	0.19*	0.11	0.08	0.04	0.05	0.06	0.06	0.09	−0.08	−0.07	−0.11	−0.27*	−0.38***	−0.21*	0.69***	1					
	2	0.01	0.17	0.21*	0.15	0.08	0.20	0.22	0.03	−0.01	0.05	−0.05	−0.07	0.02	−0.02	−0.06	−0.15	−0.03	−0.08	−0.38***	−0.31**	−0.21	0.70***	0.78***	1				
	3	0.05	0.13	0.14	0.06	0.06	0.10	0.23*	0.03	0.06	−0.04	−0.08	−0.04	−0.05	−0.02	−0.03	−0.14	−0.05	−0.13	−0.34***	−0.32**	−0.24*	0.60***	0.75***	0.78***	1			
	4	0.06	0.14	0.19	0.10	0.08	0.09	0.19	0.13	0.08	−0.02	−0.09	0.00	−0.06	−0.01	−0.02	−0.25**	−0.20	−0.21*	−0.32***	−0.41***	−0.36***	0.62***	0.81***	0.83***	0.84***	1		
	5	0.10	0.10	0.15	0.12	0.05	0.13	0.12	0.10	0.01	−0.06	−0.04	0.03	0.02	0.04	−0.07	−0.29**	−0.13	−0.26*	−0.34***	−0.38***	−0.30**	0.60***	0.79***	0.80***	0.83***	0.90***	1	
	6	0.22*	0.21*	0.21*	0.17	0.02	0.06	0.21*	0.08	0.05	−0.08	−0.05	−0.13	−0.02	0.05	−0.03	−0.27**	−0.12	−0.24*	−0.38***	−0.42***	−0.30**	0.53***	0.73***	0.74***	0.77***	0.81***	0.87***	1

All p values corrected for multiple testing using FDR (Benjamini-Hochburg procedure).
*Denotes $p < 0.05$ level of significance.
**Denotes $p < 0.01$ level of significance.
***Denotes $p < 0.001$ level of significance.

10.3389/fpsyg.2022.1019714

TABLE 3 Standardized RI-CLPM parameter estimates for Objective Progress Model.

Autoregressive paths (constrained T1-T6)	β	p-value	Cross-lagged paths (constrained T1-T6)	β	p-value	Covariances (constrained T1-T6)	β	p-value
$AM_{t-1} \rightarrow AM_t$ (a1)	0.161	0.002**	$GFB_{t-1} \rightarrow AM_t$ (c1)	−0.058	0.305	$AM_0 \leftrightarrow GFB_0$	0.006	0.948
$GFB_{t-1} \rightarrow GFB_t$ (a2)	0.356	< 0.001***	$GPO_0 \rightarrow AM_1$	−0.083	0.389	AM ↔ GFB	−0.080	0.062
$GPO_{t-1} \rightarrow GPO_t$ (a3)	0.218	< 0.001***	$GPO_{t-1} \rightarrow AM_t$ (c2)	0.018	0.731	$AM_0 \leftrightarrow GPO_0$	−0.073	0.376
$GPO_0 \rightarrow GPO_1$	−0.237	0.023*	$AM_{t-1} \rightarrow GFB_t$ (c3)	0.001	0.990	AM ↔ GPO	0.108	0.011**
			$GPO_0 \rightarrow GFB_1$	−0.127	0.164			
			$GPO_{t-1} \rightarrow GFB_t$ (c4)	−0.055	0.269			
			$AM_{t-1} \rightarrow GPO_t$ (c5)	0.017	0.677			
			$GFB_t \rightarrow GPO_t$ (c6)	−0.036	0.406			

AM = Autonomous Motivation; GFB = Goal-Facilitating Behaviours; GPO = Objective Goal Progress.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

TABLE 4 Standardized RI-CLPM parameter estimates for Subjective Progress Model.

Autoregressive paths (constrained T1-T6)	β	p-value	Cross-lagged paths (constrained T1-T6)	β	p-value	Covariances (constrained T1-T6)	β	p-value
$AM_{t-1} \rightarrow AM_t$ (a1)	0.155	0.004**	$GFB_{t-1} \rightarrow AM_t$ (c1)	−0.066	0.246	$AM_0 \leftrightarrow GFB_0$	−0.007	0.937
$GFB_{t-1} \rightarrow GFB_t$ (a2)	0.377	< 0.001***	$GPS_0 \rightarrow AM_1$	0.028	0.759	AM ↔ GFB	−0.074	0.085
$GPS_{t-1} \rightarrow GPS_t$ (a3)	0.248	< 0.001***	$GPS_{t-1} \rightarrow AM_t$ (c2)	0.153	0.006**	$AM_0 \leftrightarrow GPS_0$	0.200	0.023*
$GPS_0 \rightarrow GPS_1$	0.231	0.016*	$AM_{t-1} \rightarrow GFB_t$ (c3)	0.001	0.979	AM ↔ GPS	0.102	0.018*
			$GPS_0 \rightarrow GFB_1$	0.076	0.407			
			$GPS_{t-1} \rightarrow GFB_t$ (c4)	−0.064	0.233			
			$AM_{t-1} \rightarrow GPS_t$ (c5)	0.018	0.666			
			$GFB_t \rightarrow GPS_t$ (c6)	0.081	0.067			

AM = Autonomous Motivation; GFB = Goal-Facilitating Behaviours; GPS = Subjective Goal Progress.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

between-person level, the random intercept factor of relative autonomous motivation was uncorrelated with behaviours and goal progress suggesting that individuals who reported greater motivation did not necessarily report more behaviours or goal progress. The random intercept factors of behaviours and goal progress were positively correlated ($\beta = 0.23$, $p = 0.008$), such that those individuals who reported engaging in more behaviours overall also made more overall progress,

Subjective progress

The RI-CLPM model examining relative autonomous motivation, goal-consistent behaviours, and subjective goal progress showed adequate model fit (χ^2 (202) = 349.99, $p < 0.001$, CFI = 0.927, RMSEA = 0.057, 90% CI (0.047, 0.067), although SRMR was poor at 0.11). Autoregressive paths were all significant (see Table 4 for standardized parameters and online supplement for unstandardized parameters). Standardized autoregressive paths for within-person relative autonomous motivation ($\beta = 0.16$, $p = 0.004$), behaviours ($\beta = 0.38$, $p < 0.001$), and subjective goal progress ($\beta_{T0} = 0.23$, $p = 0.016$; $\beta_{T1\text{-}T6} = 0.25$, $p < 0.001$) were significant and low to moderate in size. Autoregressive effects were larger than other reported effects, suggesting that relative autonomous motivation and engagement in goal-consistent behaviours over the past month are best predicted by the same construct at the previous time point.

Effects for subjective goal progress on motivation were significant ($\beta = 0.15$, $p = 0.006$), suggesting a small positive relationship between subjective goal progress and motivation (i.e., when individuals reported that they were more successful in attaining their goal compared to their own average, they reported more relative autonomous motivation compared to their own average at the following time). Covariances between relative autonomous motivation and goal progress at the same time point were significant across waves ($\beta_{T0} = 0.20$, $p = 0.023$; $\beta_{T1\text{-}T6} = 0.10$, $p = 0.018$). At the between-person level, the random intercept factors of relative autonomous motivation, behaviours, and goal progress had no significant correlations, suggesting that individuals who reported greater motivation did not necessarily report more behaviours or goal progress. Indirect effects of motivation on goal progress *via* behaviours were not significant ($\beta = 0.002$, $p = 0.979$, 95%CI [−0.122, 0.125]).

Discussion

The primary aim of this study was to test the reciprocal associations between relative autonomous motivation, goal-facilitating behaviours, and dietary goal progress in individuals transitioning to a veg*n diet. Most of our hypotheses were not supported. At the within person level, contrary to hypothesis A, when individuals had higher relative autonomous motivation than usual, they did not report a subsequent increase in dietary goal progress (although motivation and progress were again positively correlated at the follow-ups). Contrary to hypothesis B, when individuals engaged in more behaviours that facilitate goal progress than usual, they did not report greater subjective or objective dietary goal progress. Inconsistent with hypothesis C, individuals who had higher relative autonomous motivation than usual did not report engaging in more behaviours that facilitate goal progress than usual. Lastly, contrary to hypothesis D, there was no significant indirect effect of relative autonomous motivation on goal progress *via* behaviours that facilitate goal progress at the within-person level.

Theoretical and practical implications

Our findings add to a growing literature on veg*n diet transition that examines the role of motivations and behaviour in increasing veg*n diet maintenance (Faunalytics, 2016; Rosenfeld and Tomiyama, 2019a,b; Grassian, 2020). Furthermore, our results offer some support for past research examining the relationship between goal-consistent behaviours, goal-pursuit, and motivation (Judge et al., 2005; Koestner et al., 2008; Milyavskaya et al., 2015). The present research also provides a novel examination of both objective and subjective veg*n goal progress. This is particularly important in the context of a veg*n diet given that people's claimed identity (e.g., vegan/vegetarian) does not always align with what they eat (e.g., 17% of vegetarians report regularly eating fish and 51% of vegetarians report having eaten meat since becoming vegetarian; Rosenfeld and Tomiyama, 2019a,b). Specifically, our study used an objective indicator of goal progress that took into account individuals' idiosyncratic, specific goals. By considering the difference between people's goals and actual diets, we were able to assess how much progress individuals had made related to *their own* goals (i.e., if two individuals stopped eating meat and ate only eggs, but one individual had a goal of eliminating only meat while the other individual had a goal of eliminating meat and eggs, our measure of goal progress accounted for these idiosyncrasies).

Autonomous motivation

Our findings are partially inconsistent with empirical and theoretical work that identifies autonomous motivation as an important predictor of goal progress (e.g., Koestner et al., 2008; see Ryan and Deci, 2017 for an overview). As can be expected, the two constructs were positively related at each time point. This means that participants who experienced greater relative autonomy also reported more goal progress, and also in months where autonomy was higher, participants reported greater progress. However, relative autonomous motivation did not predict greater progress in the following month. This may be due to autonomous motivation being relatively stable (57% of variability was between-person) and high; perhaps it is only when motivation becomes relatively less autonomous that subsequent goal pursuit is affected. It is also likely that the goal of transitioning to a veg*n diet differs from other goals (e.g., veg*ns face social stigma for their choices; Markowski and Roxburgh, 2019), so the processes linking motivation to progress may differ, or may be moderated by factors we did not examine.

We did, however, find that goal progress was positively related to subsequent reports of relative autonomous motivation. This aligns with research by Sheldon and Houser-Marko (2001), who found that greater attainment of personal goals was linked to more self-concordance (i.e., within-person relative autonomous motivation) the following semester. It may also be that dietary goal progress might indicate competence, with individuals reporting greater goal progress feeling more competent, thus leading to more relative autonomous motivation. Indeed, goal progress has been linked to greater satisfaction of basic psychological needs, which is associated with greater autonomous motivation (Milyavskaya et al., 2014).

In the present study, autonomous and controlled motivation were combined into one index measure of relative autonomy. This is a common practice, and in line with self-determination theory's theoretical view that these forms of motivation are opposite ends of a continuum (Ryan and Deci, 2017). Past research, however, has shown that autonomous and controlled motivation can have different effects on goal pursuit (e.g., Koestner et al., 2008; Milyavskaya et al., 2015; Leduc-Cummings et al., 2022): autonomous motivation is related to more successful goal pursuit and experiencing fewer obstacles. Controlled motivation, on the other hand, is unrelated to goal progress, and setting up and perceiving more obstacles, and greater effort to overcome them. For the present study, we had decided to combine autonomous and controlled motivation into an index of relative autonomy in order to keep model complexity manageable. Perhaps looking at autonomous and controlled motivation separately would have yielded different or more nuanced results. Current investigation examined if introverts and extraverts benefit differentially from specific positive psychology interventions.

Goal-facilitating behaviours

In examining the effects of goal-facilitating behaviours on goal progress, we found no within-person effects of behaviours on progress. That is, even in those months that individuals used

goal-facilitating behaviours, they did not report more progress than their own average. This may be reflective of an inconsistent link between behaviour monitoring and goal progress and attainment more broadly (Harkin et al., 2016). In a meta-analysis examining goal interventions, Harkin et al. (2016) found that monitoring behaviours led to greater behaviour progress, but not necessarily goal progress. In the context of a veg*n diet, this could mean that as a response to engaging in goal-consistent behaviours (e.g., finding vegetarian-friendly restaurants), individuals may dine at vegetarian restaurants more often, but not necessarily maintain a vegetarian diet overall. As such, participants may have perceived themselves to be successful in following their goal diet (e.g., because they dined at a vegetarian restaurant), but may have still eaten animal products on other days and thus did not report objective progress. Additionally, the goal-facilitating behaviours measured in this study were diverse, and included activities such as getting bloodwork done, planning strategies for if a craving occurs, and seeking out veg*n social groups. It may be that engaging in *more* goal-facilitating behaviours than one's usual was not necessarily better than engaging in *relevant* goal-facilitating behaviours might be.

Additionally, fit between behaviours and a person's goals might be an important factor in the effectiveness of behaviours for meeting one's goals. People respond differentially to behavioural interventions based on their personality (Schueller, 2012), and a similar pattern may hold for engaging dietary goal-facilitating behaviours. Outside the context of dietary goals, individuals have been found to favour different strategies, with idiosyncratic personal strategies being more effective than assigned expert strategies at helping people reach their goals (Peetz and Davydenko, 2021). Participants in our study were provided a set of empirically-derived goal-facilitating behaviours, rather than instructed to list personal, idiosyncratic behaviours. It may be that engaging in more goal-facilitating behaviours than one's own usual is only helpful when these behaviours are consistent with one's goals or relevant to the individual. Finally, it may be that some people are simply better than others at enacting goal-consistent behaviours (e.g., through implementation intentions) in order to overcome obstacles when pursuing their goal (Koestner et al., 2008).

Indeed, the within-person variance in behaviours was rather low, suggesting that some people regularly enacted more behaviours than others (overall). It may be that people simply do not change their behaviour much month to month, especially if they find something that works. Alternatively, since we assessed number of strategies, it is possible that participants used the same number of strategies month to month, but the strategies themselves differed. When we focused on between-person effects, both in the CLMP model presented in online supplements,[9] and the correlation between random intercept factors in the RI-CLMP model, the hypothesized relationship between behaviours and progress emerged for the objective measure of goal progress. Together, this suggests that individuals who generally engage in more goal facilitating behaviours tend to make more progress on average compared to others who engage in fewer such behaviours (although they do not perceive this as progress, as indicated by a lack of relation between behaviours and subjective progress).

Limitations

The measure of goal-facilitating behaviours used in this study has not been previously validated and contains numerous items which measure different constructs (e.g., social support, health monitoring, cost monitoring). Theoretical and empirical research has shown that progress and behaviour monitoring are not monolithic constructs (Wilde and Garvin, 2007; Anseel et al., 2015). Rather, people can assess their behaviour in many ways. Further, behaviour monitoring is most effective at predicting and affecting matching behaviours (e.g., tracking how many times one snacks on cheese may help reduce how often one eats cheese, but may not impact the broader outcome, which is becoming vegan). Future research should better disentangle the various behaviours veg*ns engage in to support their dietary transition. Moreover, certain self-control strategies like implementation intentions are most effective when they are narrow and specific (De Vet et al., 2011). Although participants were asked if they had plans for dealing with cravings, future research would benefit by having individuals transitioning to a veg*n diet make specific, relevant plans for such scenarios.

Additionally, lack of variability with regard to relative autonomous motivation may have influenced the present findings. Participants reported high autonomous motivation and commitment (i.e., intent to continue their veg*n diet after completion of the study; see Anderson and Milyavskaya, 2021; Anderson et al., 2021). New veg*ns in the present study might not represent the general population transitioning to a veg*n diet, who might be more likely to lapse in their diets (Faunalytics, 2016).

In this study, motivation, behaviour, and goal progress were all assessed monthly, and modeled as influencing the following month's responses. This time scale, however, may not be appropriate (for example, motivation may fluctuate more or less frequently). Using different assessment intervals, and modelling the paths differently, may thus yield different results, although there is currently no reason to expect a different assessment schedule to be more appropriate than what was selected in the current study. Motivations, behaviours, and perceptions are all incredibly fluid and changeable; there is simply not enough research on these fluctuations to properly understand how frequently they may shift and should be assessed.

A final limitation concerns the representativeness of our sample. As described in greater detail in our report on this sample, our participants could be considered representative of those who begin new veg*n diets in Canada and the United States with an initial high level of commitment (Anderson et al., 2021). This

9 https://osf.io/ez3wx

means that these findings are not likely to generalize to those who are just experimenting with a veg*n diet, or to individuals in other countries.

Conclusion

In sum, the present study provides preliminary insights on associations between autonomous motivation, goal-facilitating behaviours, and dietary goal progress in individuals transitioning to a veg*n diet. In line with self-determination theory, autonomous motivation was related with greater progress, but this occurred only when progress was assessed at the same time point; no prospective effects were found. These findings shed light onto the relationship between autonomous motivation, behaviours, and goal progress both at the same time and over time.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found at: https://osf.io/zx4sf/.

Ethics statement

The studies involving human participants were reviewed and approved by Carleton University Research Ethics Board-B. The patients/participants provided their written informed consent to participate in this study.

Author contributions

MK and MM came up with the research questions tested in this manuscript. MM and JA designed and conducted the overall larger study. MK conducted the analyses and wrote the manuscript with feedback from MM and JA. All authors contributed to the article and approved the submitted version.

Funding

This research was supported by Social Sciences and Humanities Research Council of Canada Partnership Engage grant to MM and JA, and a grant from Animal Advocacy Research Fund to Faunalytics.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

Anastasiou, C. A., Karfopoulou, E., and Yannakoulia, M. (2015). Weight regaining: from statistics and behaviors to physiology and metabolism. *Metabolism* 64, 1395–1407. doi: 10.1016/j.metabol.2015.08.006

Anderson, J., and Milyavskaya, M. (2021). Going vegan or vegetarian: Motivations & Influences - Faunalytics. Fauna

Anderson, J., Milyavskaya, M., and Kolbuszewska, M. (2021). Going vegan or vegetarian: many paths to one goal. *Fauna.* Available at: https://faunalytics.org/going-veg-many-paths/ (Accessed August 7, 2022).

Anseel, F., Beatty, A. S., Shen, W., Lievens, F., and Sackett, P. R. (2015). How are we doing after 30 years? A meta-analytic review of the antecedents and outcomes of feedback-seeking behavior. *J. Manag.* 41, 318–348. doi: 10.1177/0149206313484521

Asher, K., Green, C., Gutbrod, H., Jewell, M., Hale, G., and Bastian, B. (2014). Study of current and former vegetarians and vegans. Available at: https://faunalytics.org/wp-content/uploads/2015/06/Faunalytics_Current-Former-Vegetarians_Full-Report.pdf (Accessed October 11, 2022)

Asher, K. G., and Peters, P. (2020). Go the whole nine yards? How extent of meat restriction impacts individual dietary experience. *Ecol. Food Nutr.* 59, 436–458. doi: 10.1080/03670244.2020.1737043

Barosh, L., Friel, S., Engelhardt, K., and Chan, L. (2014). The cost of a healthy and sustainable diet – who can afford it? *Aust. N. Z. J. Public Health* 38, 7–12. doi: 10.1111/1753-6405.12158

Bouvard, V., Loomis, D., Guyton, K. Z., Grosse, Y., El Ghissassi, F., Benbrahim-Tallaa, L., et al. (2015). Carcinogenicity of consumption of red and processed meat. *Lancet Oncol.* 16, 1599–1600. doi: 10.1016/S1470-2045(15)00444-1

Cade, J., Upmeier, H., Calvert, C., and Greenwood, D. (1999). Costs of a healthy diet: analysis from the UK Women's cohort study. *Public Health Nutr.* 2, 505–512. doi: 10.1017/S1368980099000683

Chuter, R. (2018). Finding companionship on the road less travelled: A netnography of the whole food plant-based Aussies Facebook group.

Conner, M., Sheeran, P., Norman, P., and Armitage, C. J. (2000). Temporal stability as a moderator of relationships in the theory of planned behaviour. *Br. J. Soc. Psychol.* 39, 469–493. doi: 10.1348/014466600164598

Conroy, D. E., Elavsky, S., Hyde, A. L., and Doerksen, S. E. (2011). The dynamic nature of physical activity intentions: a within-person perspective on intention-behavior coupling. *J. Sport Exerc. Psychol.* 33, 807–827. doi: 10.1123/jsep.33.6.807

De Vet, E., Oenema, A., and Brug, J. (2011). More or better: do the number and specificity of implementation intentions matter in increasing physical activity? *Psychol. Sport Exerc.* 12, 471–477. doi: 10.1016/j.psychsport.2011.02.008

Deci, E. L., and Ryan, R. M. (2000). The "what" and "why" of goal pursuits: human needs and the self-determination of behavior. *Psychol. Inq.* 11, 227–268. doi: 10.1207/S15327965PLI1104_01

Drewnowski, A., and Darmon, N. (2005). The economics of obesity: dietary energy density and energy cost. *Am. J. Clin. Nutr.* 82, 265S–273S. doi: 10.1093/ajcn/82.1.265S

Duckworth, A. L., Gendler, T. S., and Gross, J. J. (2014). Self-control in school-age children. *Educ. Psychol.* 49, 199–217. doi: 10.1080/00461520.2014.926225

Duckworth, A. L., Gendler, T. S., and Gross, J. J. (2016). Situational strategies for self-control. *Perspect. Psychol. Sci.* 11, 35–55. doi: 10.1177/1745691615623247

Dyett, P. A., Sabaté, J., Haddad, E., Rajaram, S., and Shavlik, D. (2013). Vegan lifestyle behaviors. An exploration of congruence with health-related beliefs and assessed health indices. *Appetite* 67, 119–124. doi: 10.1016/j.appet.2013.03.015

Enders, C. K., and Bandalos, D. L. (2001). The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Struct. Equ. Model.* 8, 430–457. doi: 10.1207/S15328007SEM0803_5

Faunalytics (2014). Study of current and former vegetarians and vegans. Faunalytics. Available at: https://faunalytics.org/wp-content/uploads/2015/06/Faunalytics_Current-Former-Vegetarians_Full-Report.pdf (Accessed October 11, 2022).

Faunalytics (2016). *A summary of Faunalytics' study of current and former vegetarians and vegans. Faunalytics*. Available at: https://faunalytics.org/a-summary-of-faunalytics-study-of-current-and-former-vegetarians-and-vegans/ (Accessed December 7, 2020).

Fox, N., and Ward, K. (2008). Health, ethics and environment: a qualitative study of vegetarian motivations. *Appetite* 50, 422–429. doi: 10.1016/j.appet.2007.09.007

Fred Hutch Cancer Center (2022). Food Frequency Questionnaires (FFQ). Available at: https://www.fredhutch.org/en/research/divisions/public-health-sciences-division/research/nutrition-assessment.html#food-frequency (Accessed October 11, 2022).

Georgiadis, M. M., Biddle, S. J., and Stavrou, N. A. (2006). Motivation for weight-loss diets: a clustering, longitudinal field study using self-esteem and self-determination theory perspectives. *Health Educ. J.* 65, 53–72. doi: 10.1177/0017896906066067

Ghaffari, M., Rodrigo, P. G. K., Ekinci, Y., and Pino, G. (2022). Consumers' motivations for adopting a vegan diet: a mixed-methods approach. *Int. J. Consum. Stud.* 46, 1193–1208. doi: 10.1111/ijcs.12752

Godfray, H. C. J., Aveyard, P., Garnett, T., Hall, J. W., Key, T. J., Lorimer, J., et al. (2018). Meat consumption, health, and the environment. *Science* 361:eaam5324. doi: 10.1126/science.aam5324

Grassian, D. (2020). The dietary behaviors of participants in UK-based meat reduction and vegan campaigns – a longitudinal, mixed-methods study. *Appetite* 154:104788. doi: 10.1016/j.appet.2020.104788

Hagger, M. S., Hardcastle, S. J., Chater, A., Mallett, C., Pal, S., and Chatzisarantis, N. L. D. (2014). Autonomous and controlled motivational regulations for multiple health-related behaviors: between- and within-participants analyses. *Health Psychol. Behav. Med.* 2, 565–601. doi: 10.1080/21642850.2014.912945

Hamaker, E. L., Kuiper, R. M., and Grasman, R. P. P. P. (2015). A critique of the cross-lagged panel model. *Psychol. Methods* 20, 102–116. doi: 10.1037/a0038889

Harkin, B., Webb, T. L., Chang, B. P. I., Benn, Y., Prestwich, A., Conner, M., et al. (2016). Does monitoring goal Progress promote goal attainment? A meta-analysis of the experimental evidence. *Psychol. Bull.* 142, 198–229. doi: 10.1037/bul0000025

Herrmann, W., and Geisel, J. (2002). Vegetarian lifestyle and monitoring of vitamin B-12 status. *Clin. Chim. Acta* 326, 47–59. doi: 10.1016/S0009-8981(02)00307-8

Hielkema, M. H., and Lund, T. B. (2021). Reducing meat consumption in meat-loving Denmark: exploring willingness, behavior, barriers and drivers. *Food Qual. Prefer.* 93:104257. doi: 10.1016/j.foodqual.2021.104257

Hodson, G., and Earle, M. (2018). Conservatism predicts lapses from vegetarian/vegan diets to meat consumption (through lower social justice concerns and social support). *Appetite* 120, 75–81. doi: 10.1016/j.appet.2017.08.027

Hu, L., and Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct. Equ. Model. Multidiscip. J.* 6, 1–55. doi: 10.1080/10705519909540118

Inauen, J., Shrout, P. E., Bolger, N., Stadler, G., and Scholz, U. (2016). Mind the gap? An intensive longitudinal study of between-person and within-person intention-behavior relations. *Ann. Behav. Med.* 50, 516–522. doi: 10.1007/s12160-016-9776-x

Izmirli, S., and Phillips, C. (2011). The relationship between student consumption of animal products and attitudes to animals in Europe and Asia. *Br. Food J.* 113, 436–450. doi: 10.1108/00070701111116482

Jabs, J., Devine, C. M., and Sobal, J. (1998). Maintaining vegetarian diets personal factors, social networks and environmental resources. *Can. J. Diet. Pract. Res.* 59, 183–189.

Jakubiak, B. K., and Feeney, B. C. (2016). Daily goal progress is facilitated by spousal support and promotes psychological, physical, and relational well-being throughout adulthood. *J. Pers. Soc. Psychol.* 111, 317–340. doi: 10.1037/pspi0000062

Janssen, M., Busch, C., Rödiger, M., and Hamm, U. (2016). Motives of consumers following a vegan diet and their attitudes towards animal agriculture. *Appetite* 105, 643–651. doi: 10.1016/j.appet.2016.06.039

Judge, T. A., Bono, J. E., Erez, A., and Locke, E. A. (2005). Core self-evaluations and job and life satisfaction: the role of self-concordance and goal attainment. *J. Appl. Psychol.* 90, 257–268. doi: 10.1037/0021-9010.90.2.257

Kahleova, H., Levin, S., and Barnard, N. D. (2018). Vegetarian dietary patterns and cardiovascular disease. *Prog. Cardiovasc. Dis.* 61, 54–61. doi: 10.1016/j.pcad.2018.05.002

Kahleova, H., Matoulek, M., Malinska, H., Oliyarnik, O., Kazdova, L., Neskudla, T., et al. (2011). Vegetarian diet improves insulin resistance and oxidative stress markers more than conventional diet in subjects with type 2 diabetes. *Diabet. Med.* 28, 549–559. doi: 10.1111/j.1464-5491.2010.03209.x

Kerschke-Risch, P. (2015). Vegan diet: motives, approach and duration. Initial results of a quantitative sociological study. *Ernaehrungs Umschau* 62, 98–103. doi: 10.4455/eu.2015.016

Koestner, R., Lekes, N., Powers, T. A., and Chicoine, E. (2002). Attaining personal goals: self-concordance plus implementation intentions equals success. *J. Pers. Soc. Psychol.* 83, 231–244. doi: 10.1037/0022-3514.83.1.231

Koestner, R., Otis, N., Powers, T. A., Pelletier, L., and Gagnon, H. (2008). Autonomous motivation, controlled motivation, and goal Progress. *J. Pers.* 76, 1201–1230. doi: 10.1111/j.1467-6494.2008.00519.x

Kubik, M. Y., Lytle, L., and Fulkerson, J. A. (2005). Fruits, vegetables, and football: findings from focus groups with alternative high school students regarding eating and physical activity. *J. Adolesc. Health* 36, 494–500. doi: 10.1016/j.jadohealth.2004.05.010

Laibson, D. (1997). Golden eggs and hyperbolic discounting. *Q. J. Econ.* 35, 443–478.

Leduc-Cummings, I., Werner, K. M., Milyavskaya, M., Dominick, J. K., and Cole, S. (2022). Experiencing obstacles during goal pursuit: the role of goal motivation and trait self-control. *J. Res. Pers.* 99:104231. doi: 10.1016/j.jrp.2022.104231

Lemale, J., Mas, E., Jung, C., Bellaiche, M., and Tounian, P. (2019). Vegan diet in children and adolescents. Recommendations from the French-speaking pediatric hepatology, gastroenterology and nutrition group (GFHGNP). *Arch. Pédiatrie* 26, 442–450. doi: 10.1016/j.arcped.2019.09.001

Lucas, R. E. (2022). It's time to abandon the cross-lagged panel model. *PsyArXiv* 1–37. doi: 10.31234/osf.io/pkec7

Markowski, K. L., and Roxburgh, S. (2019). "If I became a vegan, my family and friends would hate me:" anticipating vegan stigma as a barrier to plant-based diets. *Appetite* 135, 1–9. doi: 10.1016/j.appet.2018.12.040

Milyavskaya, M., Inzlicht, M., Hope, N., and Koestner, R. (2015). Saying "no" to temptation: want-to motivation improves self-regulation by reducing temptation rather than by increasing self-control. *J. Pers. Soc. Psychol.* 109, 677–693. doi: 10.1037/pspp0000045

Milyavskaya, M., Nadolny, D., and Koestner, R. (2014). Where do self-concordant goals come from? The role of domain-specific psychological need satisfaction. *Personal. Soc. Psychol. Bull.* 40, 700–711. doi: 10.1177/0146167214524445

National Cancer Institute (2022). Diet history questionnaire II (DHQ II) for U.S. & Canada. Available at: https://epi.grants.cancer.gov/dhq2/ (Accessed October 11, 2022).

North, M., Klas, A., Ling, M., and Kothe, E. (2021). A qualitative examination of the motivations behind vegan, vegetarian, and omnivore diets in an Australian population. *Appetite* 167:105614. doi: 10.1016/j.appet.2021.105614

Nurmi, J., Hagger, M. S., Haukkala, A., Araújo-Soares, V., and Hankonen, N. (2016). Relations between autonomous motivation and leisure-time physical activity participation: the mediating role of self-regulation techniques. *J. Sport Exerc. Psychol.* 38, 128–137. doi: 10.1123/jsep.2015-0222

Ohsiek, S., and Williams, M. (2011). Psychological factors influencing weight loss maintenance: an integrative literature review. *J. Am. Acad. Nurse Pract.* 23, 592–601. doi: 10.1111/j.1745-7599.2011.00647.x

Orth, U., Clark, D. A., Donnellan, M. B., and Robins, R. W. (2020). Testing prospective effects in longitudinal research: comparing seven competing cross-lagged models. *J. Pers. Soc. Psychol.* 120, 1013–1034. doi: 10.1037/pspp0000358

Pawlak, R., Lester, S. E., and Babatunde, T. (2014). The prevalence of cobalamin deficiency among vegetarians assessed by serum vitamin B12: a review of literature. *Eur. J. Clin. Nutr.* 68, 541–548. doi: 10.1038/ejcn.2014.46

Peetz, J., and Davydenko, M. (2021). Financial self-control strategy use: generating personal strategies reduces spending more than learning expert strategies. *J. Exp. Soc. Psychol.* 97:104189. doi: 10.1016/j.jesp.2021.104189

Phua, J., Jin, S., and Kim, J. (2020). The roles of celebrity endorsers' and consumers' vegan identity in marketing communication about veganism. *J. Mark. Commun.* 26, 813–835. doi: 10.1080/13527266.2019.1590854

R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Available at: https://www.R-project.org/ (Accessed October 11, 2022).

Radnitz, C., Beezhold, B., and DiMatteo, J. (2015). Investigation of lifestyle choices of individuals following a vegan diet for health and ethical reasons. *Appetite* 90, 31–36. doi: 10.1016/j.appet.2015.02.026

Reuter, T., Ziegelmann, J. P., Lippke, S., and Schwarzer, R. (2009). Long-term relations between intentions, planning, and exercise: a 3-year longitudinal study after orthopedic rehabilitation. *Rehabil. Psychol.* 54, 363–371. doi: 10.1037/a0017830

Rosenfeld, D. L., and Tomiyama, A. J. (2019a). When vegetarians eat meat: why vegetarians violate their diets and how they feel about doing so. *Appetite* 143:104417. doi: 10.1016/j.appet.2019.104417

Rosenfeld, D. L., and Tomiyama, A. J. (2019b). How proximal are pescatarians to vegetarians? An investigation of dietary identity, motivation, and attitudes toward animals. *J. Health Psychol.* 15, 713–727. doi: 10.1177/1359105319842933

Ryan, R. M., and Connell, J. P. (1989). Perceived locus of causality and internalization: examining reasons for acting in two domains. *J. Pers. Soc. Psychol.* 57, 749–761. doi: 10.1037/0022-3514.57.5.749

Ryan, R. M., and Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness.* New York, NY: Guilford Press.

Sallis, J. F., Owen, N., and Fisher, E. (2015). "Ecological models of health behavior", in *Health behavior: Theory, research, and practice. Jossey-Bass*.eds. K. Glanz, B. K. Rimer and K. Viswanath 43–64.

Scholz, U., Nagy, G., Schüz, B., and Ziegelmann, J. P. (2008). The role of motivational and volitional factors for self-regulated running training: associations on the between- and within- person level. *Br. J. Soc. Psychol.* 47, 421–439. doi: 10.1348/014466607X266606.

Schueller, S. M. (2012). Personality fit and positive interventions: extraverted and introverted individuals benefit from different happiness increasing strategies. *Psychology* 3, 1166–1173. doi: 10.4236/psych.2012.312A172

Séré de Lanauze, G., and Sirieix, L. (2022). Impact of social influences and adoptive community on behaviours: an exploratory study of young French vegetarians. *Int. J. Consum. Stud.* 46, 419–433. doi: 10.1111/ijcs.12689

Sheldon, K. M., and Elliot, A. J. (1999). Goal striving, need satisfaction, and longitudinal well-being: the self-concordance model. *J. Pers. Soc. Psychol.* 76, 482–497. doi: 10.1037/0022-3514.76.3.482

Sheldon, K. M., and Houser-Marko, L. (2001). Self-concordance, goal attainment, and the pursuit of happiness: can there be an upward spiral? *J. Pers. Soc. Psychol.* 80, 152–165. doi: 10.1037/0022-3514.80.1.152

Sheldon, K. M., Ryan, R. M., Deci, E. L., and Kasser, T. (2004). The independent effects of goal contents and motives on well-being: It's both what you pursue and why you pursue it. *Personal. Soc. Psychol. Bull.* 30, 475–486. doi: 10.1177/0146167203261883

Shukla, P. R., Skeg, J., Buendia, E. C., Masson-Delmotte, V., Pörtner, H. O., Roberts, D., et al. (2019). Climate change and land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. Intergovernmental Panel on Climate Change. Available at: https://www.ipcc.ch/site/assets/uploads/2019/11/SRCCL-Full-Report-Compiled-191128.pdf (Accessed October 11, 2022).

Siapco, G., and Sabaté, J. (2019). Correction: health and sustainability outcomes of vegetarian dietary patterns: a revisit of the EPIC-Oxford and the Adventist health Study-2 cohorts. *Eur. J. Clin. Nutr.* 73:968. doi: 10.1038/s41430-019-0427-8

Silva, M. N., Markland, D., Carraça, E. V., Vieira, P. N., Coutinho, S. R., Minderico, C. S., et al. (2011). Exercise autonomous motivation predicts 3-yr weight loss in women: med. *Sci. Sports Exerc.* 43, 728–737. doi: 10.1249/MSS.0b013e3181f3818f

Sorensen, G., Stoddard, A., and Macario, E. (1998). Social support and readiness to make dietary changes. *Health Educ. Behav.* 25, 586–598. doi: 10.1177/109019819802500506

Sparkman, G., Macdonald, B. N. J., Caldwell, K. D., Kateman, B., and Boese, G. D. (2021). Cut back or give it up? The effectiveness of reduce and eliminate appeals and dynamic norm messaging to curb meat consumption. *J. Environ. Psychol.* 75:101592. doi: 10.1016/j.jenvp.2021.101592

Stanton, C. A., Green, S. L., and Fries, E. A. (2007). Diet-specific social support among rural adolescents. *J. Nutr. Educ. Behav.* 39, 214–218. doi: 10.1016/j.jneb.2006.10.001

Teixeira, P. J., Carraça, E. V., Markland, D., Silva, M. N., and Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: a systematic review. *Int. J. Behav. Nutr. Phys. Act.* 9:78. doi: 10.1186/1479-5868-9-78

Twine, R. (2014). Vegan killjoys at the table—contesting happiness and negotiating relationships with food practices. *Societies* 4, 623–639. doi: 10.3390/soc4040623

Van Den Berg, S. W., Van Den Brink, A. C., Wagemakers, A., and Den Broeder, L. (2022). Reducing meat consumption: the influence of life course transitions, barriers and enablers, and effective strategies according to young Dutch adults. *Food Qual. Prefer.* 100:104623. doi: 10.1016/j.foodqual.2022.104623

Van Loo, E. J., Caputo, V., and Lusk, J. L. (2020). Consumer preferences for farm-raised meat, lab-grown meat, and plant-based meat alternatives: does information or brand matter? *Food Policy* 95:101931. doi: 10.1016/j.foodpol.2020.101931

Vancampfort, D., Moens, H., Madou, T., De Backer, T., Vallons, V., Bruyninx, P., et al. (2016). Autonomous motivation is associated with the maintenance stage of behaviour change in people with affective disorders. *Psychiatry Res.* 240, 267–271. doi: 10.1016/j.psychres.2016.04.005

Veganuary (2022). Campaign in review. Veganuary. Available at: https://veganuary.com/campaign-reports/ (Accessed October 11, 2022).

Voi, S., and Sainsbury, K. (2019). The roles of autonomous motivation and self-control lapses in concurrent adherence to a gluten-free diet and a self-chosen weight loss plan in adults with coeliac disease. *Psychol. Health* 34, 943–962. doi: 10.1080/08870446.2019.1579912

Wadden, T., Foster, G., and Letizia, K. (1994). One-year behavioral treatment of obesity: comparison of moderate and severe caloric restriction and the effects of weight maintenance therapy. *J. Consult. Clin. Psychol.* 62, 165–171. doi: 10.1037/0022-006X.62.1.165

Werner, K. M., Milyavskaya, M., Foxen-Craft, E., and Koestner, R. (2016). Some goals just feel easier: self-concordance leads to goal progress through subjective ease, not effort. *Personal. Individ. Differ.* 96, 237–242. doi: 10.1016/j.paid.2016.03.002

Westhoek, H., Lesschen, J. P., Rood, T., Wagner, S., De Marco, A., Murphy-Bokern, D., et al. (2014). Food choices, health and environment: effects of cutting Europe's meat and dairy intake. *Glob. Environ. Chang.* 26, 196–205. doi: 10.1016/j.gloenvcha.2014.02.004

Wilde, M. H., and Garvin, S. (2007). A concept analysis of self-monitoring. *J. Adv. Nurs.* 57, 339–350. doi: 10.1111/j.1365-2648.2006.04089.x

Williamson, L. Z., and Wilkowski, B. M. (2020). Nipping temptation in the bud: Examining strategic self-control in daily life. *Pers. Soc. Psychol. Bull.* 46, 961–975. doi: 10.1177/0146167219883606

Wilson, N., Nghiem, N., Mhurchu, C. N., Eyles, H., Baker, M. G., and Blakely, T. (2013). Foods and dietary patterns that are healthy, low-cost, and environmentally sustainable: a case study of optimization modeling for New Zealand. *PLoS One* 8:e59648. doi: 10.1371/journal.pone.0059648

Wing, R. R., Tate, D. F., Gorin, A. A., Raynor, H. A., and Fava, J. L. (2006). A self-regulation program for maintenance of weight loss. *N. Engl. J. Med.* 355, 1563–1571. doi: 10.1056/NEJMoa061883

frontiers | Frontiers in Sustainable Food Systems

TYPE Original Research
PUBLISHED 13 February 2023
DOI 10.3389/fsufs.2023.1040680

OPEN ACCESS

EDITED BY
Christopher J. Hopwood,
University of Zurich, Switzerland

REVIEWED BY
Esther Jolanda Veen,
Aeres University of Applied Science, Netherlands
Trishnee Bhurosy,
Hofstra University, United States

*CORRESPONDENCE
Emma L. Zaal
e.l.zaal@rug.nl

SPECIALTY SECTION
This article was submitted to Nutrition and Sustainable Diets, a section of the journal Frontiers in Sustainable Food Systems

RECEIVED 09 September 2022
ACCEPTED 18 January 2023
PUBLISHED 13 February 2023

CITATION
Zaal EL, Ongena YP and Hoeks JCJ (2023) Explaining vegetarian and vegan dietary behavior among U.S. and Dutch samples applying a reasoned action approach. *Front. Sustain. Food Syst.* 7:1040680. doi: 10.3389/fsufs.2023.1040680

Explaining vegetarian and vegan dietary behavior among U.S. and Dutch samples applying a reasoned action approach

Emma L. Zaal*, Yfke P. Ongena and John C. J. Hoeks

Center for Language and Cognition Groningen, Faculty of Arts, University of Groningen, Groningen, Netherlands

The present research applied the framework of the Reasoned Action Approach (RAA) to investigate intention formation of adopting vegetarian and vegan diets among U.S. and Dutch samples. First, a belief elicitation study was carried out to determine salient beliefs regarding both dietary behaviors. The U.S. sample (N = 59) together provided a total of 551 beliefs (298 vegetarian, 253 vegan) and the Dutch sample (N = 30) 294 beliefs (171 vegetarian, 123 vegan). Second, a regression study determined which reasoned action variables—Attitude, Perceived Norm and Perceived Control—explained Intention to adopt a vegetarian or a vegan diet for two separate samples. For both samples RAA-variables explained Intention relatively well (i.e., between 30 and 43% of the variance). For U.S. participants (N = 204), Instrumental and Experiential Attitude were significant predictors of their Intention to have a vegetarian or a vegan diet. For Dutch participants (N = 345), Instrumental and Experiential Attitude and Descriptive Norm predicted Intention to adopt a vegetarian diet. For adopting a vegan diet, Experiential Attitude was the only predicting variable for the Dutch sample. Almost all salient beliefs collected in the belief elicitation study significantly correlated with Intention to adopt diet, regardless of which RAA-variable they belonged to. Based on our findings, we critically evaluate the use of RAA in explaining behavioral Intentions, especially for behavior with a strong social component. Moreover, we show the importance of—the often not employed—belief elicitation phase and as such, discourage using only a regression approach. From a societal perspective, we argue that there is a strong need for interventions if one wants to encourage behavior change in the field of vegetarianism and veganism as—amongst others—average Intention scores were very low. In addition, we show that while the U.S. and Dutch samples, sharing Western norms and values, often overlapped, they also differed in subtle—yet potentially important—ways when it comes to motivations and cognitions with regard to vegetarian and vegan dietary behavior. Hence, interventions may have to include different content in order to be effective for these seemingly similar target groups and target behaviors.

KEYWORDS

Reasoned Action Approach (RAA), survey research and quantitative research, belief elicitation, vegetarianism, veganism

1. Introduction

Animal-based products have a large, negative impact on the world and its inhabitants, most prominently so on climate change, animal wellbeing and human health (Steinfeld et al., 2006; Donham et al., 2007). As to the first point, experts have calculated that in order to meet stringent climate change targets, it is crucial that the consumption of animal-based products (e.g., meat, fish, dairy, and eggs) is reduced by at least 50% (Hertwich et al., 2010; Hedenus et al., 2014; Heller et al., 2020).

As far as animal wellbeing is concerned, animals that are used for food are often kept under poor conditions, and slaughtered well before they reach their natural age. And finally, humans also do not fare well in relation to the production of animal-based products. For example, human working conditions in the livestock industry tend to be poor (Pew Commission on Industrial Farm Animal Based-Production, 2008; Gray and Kayali, 2009). In addition, the way in which the animal-trade and meat industry are currently organized increases risks of contracting animal-borne diseases like SARS, MERS, and COVID-19 (Gray and Kayali, 2009; Rodriguez-Morales et al., 2020). Human health may also be compromised by consuming animal based-products, such as which can give rise to heart and vascular disease, resistance to antibiotics, obesity, diabetes type II, and a variety of cancers (e.g., Fraser, 1999; de Roos et al., 2003; Nolan and Hitt, 2006; Micha et al., 2010; van Grinsven et al., 2010; Pan et al., 2012; Montonen et al., 2013; Yokoyama et al., 2014; Friedrichsen, 2015; McEachran et al., 2015; WHO, 2015; Lippi et al., 2016).

For these reasons, organizations like the United Nations (UN), World Health Organization (WHO), and the World Wide Fund for Nature (WWF) encourage individuals to reduce their meat consumption and promote the adoption of vegetarian and vegan diets (UN, 2016; WHO, 2016; WWF, 2016). While the interplay of decisions made by governments, industrial factories, companies and (non-profit) organizations can influence the proportion of meat that is produced and consumed, individual consumers are also able to address the negative effects of animal agriculture when they choose to change toward more plant-based diets.

The empirical investigation of such diets has only begun quite recently (e.g., Rothgerber, 2013; Cooney, 2014; Carvalho et al., 2015). While especially the last couple of years saw an increase in research focusing on the avoidance of animal-based products (e.g., de Boer et al., 2016; Carfora et al., 2017; Dowsett et al., 2018), it is still unclear what exactly drives consumers to adopt a vegetarian or vegan diet. Systematic and scoping reviews on vegetarianism and veganism show there is a strong need to intensify research efforts (e.g., Corrin and Papadopoulos, 2017; Graça et al., 2019) in order to get a more thorough understanding of consumers' dietary choices and effective promotion of the avoidance or limiting of the consumption of animal products.

Investigating which beliefs to address in interventions aimed at convincing consumers to adopt a vegetarian or vegan diet has the potential to play a leading role in the reduction of animal based-product consumption. Therefore, the objective of the current research is investigating the cognitive components that are assumed to determine behavior change with respect to adopting a vegetarian and vegan diet. For this purpose, we used the Reasoned Action Approach (RAA), a cognitive theoretical framework of behavior. We explored for samples of student meat-eaters from the United States (U.S.) and the Netherlands which beliefs and other determinants of behavior were associated with their Intention to have a vegetarian diet on the one hand, and their Intention to have a vegan diet on the other.

It may seem counterintuitive to choose student samples as target samples in social science research because these are not representative of the general population, making it difficult to generalize findings over populations differently than the student samples in the study (e.g., Hanel and Vione, 2016). However, we do not aim to generalize over different populations than the population represented by the sample of our study. Indeed, Fishbein and Yzer (2003) stress that each behavior should be understood from the perspective of a specific target population. In this case we deliberately chose college students as our target population because we are convinced that the beliefs, Intentions and behaviors of this specific group are crucial for the transition to a sustainable food system.

The first reason is that changing -or shaping- habits of members of younger target groups will impact our planet more than trying to change habitual behavior of members of older target groups. That is, simply because the former will live longer on this planet. In addition, younger people are generally more likely to be influenced by persuasive messages (O'Keefe, 2002). Second, there is a growing awareness of—especially—young consumers that limiting meat consumption can reduce their negative impact on the environment, and diets like vegetarianism and veganism are gaining in popularity as sustainable, healthy, and ethical food trends among these groups. When one already posits positive associations on a given behavior, one becomes more open to persuasion (e.g., Cooney, 2014; Carvalho et al., 2015). A third reason is that in the transition from secondary school to university, students have to adapt to a new environment in which they are more free in making their own dietary choices, mostly or entirely independent from their parents or caregivers. It is a time in which their future food habits take shape and get determined for a great deal (Von Ah et al., 2004; Deliens et al., 2014).

Hence, while there is often protest—with good reason—against using students samples, in the case of vegetarian and vegan dietary behavior, we believe that there are clear advantages of using students over other samples. That is why we will investigate the more narrow, homogeneous student samples instead of more heterogeneous "general population" samples.

When it comes to choosing to investigate the U.S. and the Netherlands: we argue that it is valuable to carry out cross-cultural research with samples that are both from Western countries. While the U.S. and the Netherlands they are culturally speaking quite similar, they are certainly not identical in all their—animal—consumption patterns. In both the United States and The Netherlands, around 95% of all consumers eat meat (Stahler, 2019; de Waart, 2020). Ritchie et al. (2017) and Ritchie and Roser (2019) investigated how many kilograms of meat, fish/seafood, milk and egg are consumed around the world per capita in from 1961 to 2019. Their investigation was based on data from the Food & Agriculture Organization of the United Nations, an organization that provides free access to and use of data on food and agriculture (FAOSTAT, 2023). Consumption patterns for the U.S.A. and the Netherlands in 2017, the period our RAA studies were carried out, are shown in Table 1. The amount of fish/seafood and eggs that U.S. and Dutch citizens consume is quite similar. However, the amount of meat that is consumed in the U.S.A. is considerably higher than in the Netherlands, while the amount of milk consumed is considerably higher in the Netherlands compared to the U.S.A.

In addition, deviating trends are found in U.S. and Dutch consumers' beliefs on animal based-product consumption. For instance, de Boer et al. (2016) found in a representative Dutch and U.S. sample that only 12% of the Dutch and 6% of the U.S. respondents believed that eating less meat was effective in mitigating climate change. The Dutch sample had a somewhat higher willingness to reduce meat consumption than the U.S. sample. At the same time, knowledge about how members of different cultural groups, at

TABLE 1 Meat, fish/seafood, milk, and egg consumption kilograms per capita in 2017.

Country	Meat (kg)	Fish/Seafood (kg)	Milk (kg)	Egg (kg)
U.S.A.	124.10	22.36	254.87	15.57
The Netherlands	75.81	21.77	340.35	14.12

different stages of their life think about the consumption of meat and other animal based-products or the absence of it is lacking (Ruby, 2012). We believe it is therefore useful to study more specific and homogeneous samples to compare the Intention formation of two Western countries more reliably. As we had access to both Dutch and U.S. participants pools, we compared these two specific Western countries. For this purpose, first, a belief elicitation study was carried out to determine participants' salient belief structures. Second, we conducted a regression study to investigate which belief structures and determinants of Intention, following the RAA framework, explained behavioral Intention to have a vegetarian or a vegan diet.

From a theoretical perspective, we investigated and evaluated the strength of the RAA framework in explaining vegetarian and vegan diets and contributed to the current body of literature that investigates which cognitive components are related to Intention formation. To our knowledge, recent RAA belief elicitation studies on this topic are lacking, and other types of elicitation studies are scarce (e.g., Wyker and Davison, 2010; Zaal et al., 2017). Studies that do investigate belief structures often only look into the strength of beliefs, and use predetermined beliefs decided on by the researchers or based on prior research that uses different samples (e.g., Mullee et al., 2017). While such studies do give some insight into consumer beliefs structures, they do not provide sufficient space for participants' own cognitions and as such, may steer toward the researchers' own bias. That is why it is important to carry out a belief elicitation study before designing the regression study.

From a societal perspective, based on the results of this research we can make recommendations on which beliefs on vegetarian and vegan diets are possible candidate beliefs to use in interventions aimed on encouraging vegetarian and vegan dietary behavior for the population of the sample being investigated.

2. Theoretical framework

2.1. Reasoned action approach

According to RAA (Fishbein and Ajzen, 2010), the intention to have a vegetarian or vegan diet is formed on the basis of one's attitudes, perceived norms, and perceived behavioral control regarding these particular behaviors. Figure 1 (Peters, 2013, based on Fishbein and Ajzen, 2010) illustrates the hypothetical pathways of the different variables that influence Intention following the Reasoned Action Approach. Figure 1 is explained from right (behavior) to left (background factors) in this paragraph with the example of changing a meat-inclusive diet to a vegetarian diet. The Reasoned Action Approach proposes that for behavior change to occur, meat-eaters need an Intention to change their current diet into a vegetarian diet. While having an Intention to stop eating meat serves as a precondition for behavioral change, the Reasoned Action Approach describes two other factors that determine if one will actually act on this Intention, together termed actual control. First, one needs the necessary skills to perform the behavior, like knowing how to prepare a vegetarian meal, or where to buy one. Second, one should be able to overcome any environmental factors that prevent behavioral performance—for instance an unavailability of meat substitutes at the supermarket. Hence, while having an Intention to adopt a vegetarian diet is the most important predictor of actually adopting a vegetarian diet, actual control factors may serve as barriers to changing behavior. RRA focuses particularly on Intention formation, rather than the Intention-behavior relation.

Attitude is one's own evaluation of the behavior of eliminating one's consumption of meat and it includes Instrumental Attitude—an evaluation of positive and negative attributes of the behavior (e.g., necessary vs. unnecessary)—and Experiential Attitude—an evaluation of positive and negative affective experiences with the behavior (e.g., pleasant vs. unpleasant). Perceived Norms are expectations of how relevant others in one's environment evaluate the behavior. It includes Injunctive Norm—the extent to which one thinks important referents will approve or disapprove one having a vegetarian or vegan diet, and Descriptive Norm—whether important others have such diets themselves. Perceived Behavioral Control is the extent to which one thinks to be able to follow a vegetarian or vegan diet successfully. It includes Perceived Capacity—one's perceived ability to have either diet—and Perceived Autonomy—the extent to which people perceive themselves autonomous in the decision to change their diet.

Attitude, Perceived Norm, and Perceived Behavioral Control are a function of specific beliefs. Behavioral or attitudinal beliefs are beliefs about the perceived likelihood of the positive and/or negative consequences of having a vegetarian or vegan diet. Normative beliefs include perceptions about social support from specific individuals in one's social network. Control beliefs comprises perceptions of environmental contexts that facilitate or hamper behavior.

A background variable may or may not be a source of beliefs and cannot act as a moderate or somewhere later in the model following RRA. Background variables can be a belief source on an individual level, a social level and informational level. Examples of background variables are demographic background or personality traits. According to RAA, by introducing new beliefs to individuals or by emphasizing, reinforcing or changing existing beliefs, behavior change can be set in motion.

The Reasoned Action Approach has already identified significant predictors of behavioral intentions to adopt vegetarian and vegan diets. For instance, Attitude and Perceived Behavioral Control are often found as significant predictors to reduce meat consumption and to adopt vegan diets (e.g., Zur and Klockner, 2014; Graça et al., 2015; Carfora et al., 2017). Perceived Norm has been found to predict meat reduction (Zur and Klockner, 2014). Yet, the latter component seems to be a poorer predictor, and is found less often as a predictor in the meat consumption domain compared to Attitude and Perceived Behavioral Control (Graça et al., 2019). This could be due to the fact that often only a small minority in populations

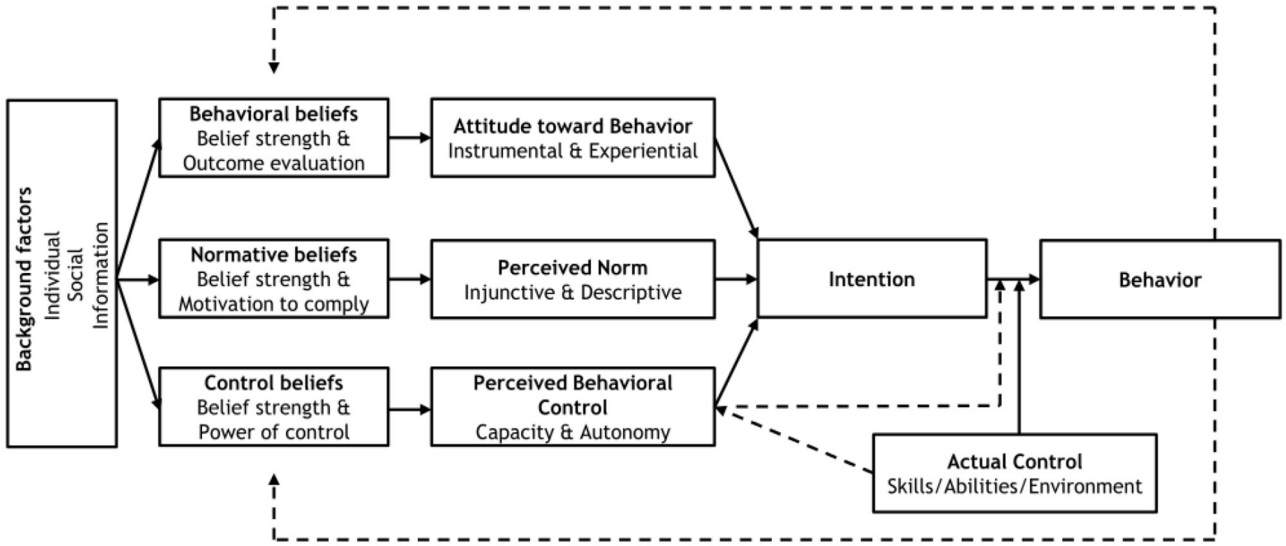


FIGURE 1
Schematic presentation of the reasoned action approach (Peters, 2013, based on Fishbein and Ajzen, 2010).

already have a vegetarian or vegan diet (± 5% for the populations being studied in this research) and it is arguably strongly normative behavior to consume animal products (Stahler, 2019; de Waart, 2020).

To identify the relationship between the unique beliefs that people have about a specific behavior and their behavioral Intention, RAA proposes conducting two types of studies (e.g., Fishbein and Ajzen, 2010). First, a belief elicitation study should be conducted to identify the most important beliefs that are associated with the given behavior. Belief elicitation studies are likely to increase the Reasoned Action Approach's ability to explain behavioral Intention by capturing the full range of important beliefs that ultimately determine one's target population's behavior (Downs and Hausenblas, 2005). Such a study uses a questionnaire with open-ended questions that asks a small sample of the target group about their attitudinal, normative and control beliefs. In a content analysis, participants' responses are categorized and rank ordered based on frequency mentioned. In the second study, the most frequently mentioned beliefs are converted to closed-ended questions, which will complement a questionnaire containing standard questions on RAA components in a second study. Using regression it can be determined which components are most strongly associated with behavioral Intention. In this paper, first the belief elicitation study is described in full (i.e., method-discussion), after which the regression study is presented in the same manner. We end with a general discussion of both studies.

2.2. Formulating target behavior

A vegetarian diet is characterized by not consuming flesh or organs from any animal or any by-products from animal slaughter. In a vegan, or plant-based diet, also products that are produced by animals are not consumed, like dairy and eggs (Stegeman, 1997). The results of previous research in the domains of vegetarianism and veganism are sometimes hard to compare because different, and sometimes ambiguous definitions are used of what it means to have a vegetarian or vegan diet (e.g., Ruby, 2012; Cooney, 2014).

Firstly, studies in the field of vegetarianism do not always clearly distinguish between vegetarianism and veganism, whereas research shows that adopting a vegetarian or vegan diet are two distinct behaviors (e.g., Povey et al., 2001). Secondly, the terms "vegan diet" and "plant-based diet" are often used interchangeably while at the same time studies do not use a uniform description of the target behavior. For instance, Wyker and Davison (2010) conceptualized a plant-based diet as decreasing one's consumption of meat, eggs, and dairy and Povey et al. (2001) classified a vegan diet as not consuming any animal-based products at all. Thus, these definitions differ both in terms of the degree of change (decreasing vs. completely avoiding) and in terms of the types of products avoided (only meat, eggs, and dairy vs. all animal-based products). Not uniformly defining the same behavior makes it very difficult to compare results from different studies directly, while formulating the target behavior in a reliable and valid manner is very important (Fishbein and Ajzen, 2010).

This research treats having a vegetarian diet and having a vegan diet as separate behaviors that will be operationalized following Doerr (2005) behavioral definition recommendations. Following RRA, it is useful to define behaviors as comprised of four elements: "[...] the *action* performed, the *target* at which the action is directed, the *context* in which it is performed, and the *time* at which it is performed (p. 29)." That is, we will consider adopting a vegetarian and vegan diet in frames of the target (meat and fish or meat, fish, dairy, and eggs), action (stopping to eat), context (for every consumption), and time elements (anytime in the next 6 months) for both study 1 and 2 questionnaires.

2.3. Language of the questionnaires

For the U.S. and Dutch sample, identical questionnaires are employed (i.e., the English questionnaire is not translated to Dutch). There are several experiments that show that even small linguistic alterations may lead to a different interpretation of the same question (Harkness et al., 2004; Doerr, 2005). Making respondents fill out a translated questionnaire (i.e., from English to Dutch) may influence answering behavior of respondents more than making respondents fill out a questionnaire in a foreign, but—for the most part—well-known language (i.e., Dutch participants who are very familiar with reading English texts, filling out an English questionnaire) (Sha, 2004; Giesen et al., 2010). Therefore, we chose to keep the questionnaire untranslated.

3. Study 1: Belief elicitation

To determine which attitudinal, normative and control beliefs two samples of meat-eating students have about vegetarian and vegan diets, a belief elicitation study was carried out. The first sample included students studying at the University of Minnesota, and the second sample included students studying at the University of Groningen. Permission to carry out the U.S. and Dutch study was granted by the ethical committees of the University of Minnesota and the University of Groningen, respectively.

3.1. Materials and methods

3.1.1. Participants

U.S. participants were students recruited from the subject pool of the University of Minnesota's School of Journalism and Mass Communication. Fifty-nine meat-eating students of the University of Minnesota completed an online questionnaire for which they received course credit. Participants were 11 males (19%) and 48 females (81%). Their mean age was 20.42 years (SD = 1.62) ranging from 18 to 27. Data was collected in November and December 2016.

Dutch participants were students recruited during in-class courses in Communication- and Information sciences, Media studies and Journalism at the Faculty of Arts of the University of Groningen, the Netherlands. Thirty meat-eating students of the University of Groningen completed an online questionnaire. Participants were 8 males (27%) and 22 females (73%). Their mean age was 20.30 years (SD = 2.21) ranging from 18 to 30. Data was collected in May 2017. We acknowledge that gender is not proportionally distributed in both samples. However, both samples represent comparatively the distribution of students' gender within the mentioned departments of both universities.

3.1.2. Instrument

Survey-builder Qualtrics was used to design the questionnaire (for both studies). The questionnaire contained demographic questions on age [I am (__) years old], gender identification (i.e., What gender do you identify with?) and dietary habits with regard to animal—based—products ("Which of the following statements describes your diet, following the description above?: I eat meat; I never eat meat, but I do eat fish; I never eat meat or fish, but I do eat dairy and/or eggs; I never eat meat, fish, dairy or eggs").

For formulating the target behaviors we used three of the four recommendations of Fishbein and Ajzen (2010): action, target, and time. The "context frame," (Fishbein and Ajzen, 2010, p. 29), describing the situational context of the target behavior (i.e., "for every consumption"), was not explicated in questions. The context component was made apparent in the introduction of the questionnaire before participants answered any questions about either diet. It could be easily inferred that stopping to eat a certain food altogether implies excluding the product from every consumption.

Attitudinal beliefs (underlying Attitude) were addressed by asking: "What are the good things that might happen if you stop eating meat and/or fish anytime in the next 6 months?" and "What are the bad things that might happen if you stop eating meat and/or fish anytime in the next 6 months?" For normative beliefs (underlying Perceived Norm) participants answered "Are there any groups or people who would approve of you stopping to eat meat and/or fish anytime in the next 6 months?" and "Are there any groups or people who would disapprove of you stopping to eat meat and/or fish anytime in the next 6 months?" For control beliefs, underlying Perceived Behavioral Control, participants answered: "What factors or circumstances might make it easier for you to stop eating meat and/or fish anytime in the next 6 months?" and "What factors or circumstances would make it difficult or impossible for you to stop eating meat and/or fish anytime in the next 6 months?" For adopting a vegan diet, beliefs were addressed by asking the same questions for switching to a vegan diet anytime in the next 6 months. All belief elicitation questions were open questions without a word limit.

3.1.3. Procedure

After giving informed consent, participants were asked demographic questions. If participants indicated they never consumed meat or fish, they were excluded from this belief elicitation study, as the target group of this study only includes meat eaters. After answering demographic questions, the remaining participants read a description of a vegetarian diet [when you have a vegetarian diet, you don't consume any meat or fish, but you do eat dairy and/or eggs (products that contain milk, yogurt, cheese, and/or eggs)] and answered the belief elicitation questions on their attitudinal, normative, and control beliefs about adopting a vegetarian diet. Finally, all participants read a description of a vegan diet [when you have a vegan diet you don't consume any animal products: no meat, no fish, and no dairy or eggs (no products that contain milk, yogurt, cheese, and/or eggs) at all] and answered belief elicitation questions about adopting a vegan diet.

3.2. Results

In the belief elicitation study, fifty-nine U.S. participants provided 551 beliefs (298 about having a vegetarian diet, 253 about a vegan diet), with an average of 9.3 beliefs per participant. Thirty Dutch participants provided 294 beliefs (171 about having a vegetarian diet, 123 about a vegan diet), with an average of 9.8 beliefs per participant.

TABLE 2A Results belief elicitation questionnaire: most frequently mentioned (% of participants mentioned) attitudinal beliefs U.S. and Dutch sample.

Positive attitudinal beliefs	Frequency (%) U.S.		Frequency (%) Dutch		Negative attitudinal beliefs	Frequency (%) U.S.		Frequency (%) Dutch	
	Vegetarian	Vegan	Vegetarian	Vegan		Vegetarian	Vegan	Vegetarian	Vegan
Experience positive health consequences	13 (22.0%)	13 (22.0%)	10 (33.3%)	4 (13.3%)	Not get enough protein	25 (42.2%)	9 (15.3%)	5 (16.7%)	1 (3.3%)
Lose weight	12 (20.3%)	11 (18.6%)	1 (3.3%)	1 (3.3%)	Not get all the nutrients my body needs	15 (25.4%)	16 (27.1%)	6 (20.0%)	9 (30.0%)
Have a healthier diet*	5 (8.5%)	6 (10.2%)	–	2 (6.7%)	Have a one-sided diet**	4 (6.8%)	9 (15.3%)	2 (6.7%)	8 (26.7%)
Contribute to a more sustainable environment	5 (8.5%)	3 (5.1%)	8 (26.7%)	4 (13.3%)	Have less energy	5 (8.5%)	6 (10.2%)	5 (16.7%)	2 (6.7%)
Save animal lives	3 (5.1%)	5 (8.5%)	4 (13.3%)	2 (6.7%)	Miss the taste of meat/fish/dairy & eggs	6 (10.2%)	5 (8.5%)	5 (16.7%)	2 (6.7%)
Have a smoother skin*	2 (3.4%)	6 (10.2%)	1 (3.3%)	–	Experience negative health consequences	6 (10.2%)	5 (8.5%)	3 (10.0%)	2 (6.7%)
Behave more ethical concerning animal treatment	4 (6.8%)	3 (5.1%)	4 (13.3%)	1 (3.3%)	Feel hungry more often*	6 (10.2%)	4 (6.8%)	–	–
Improved mood (Feel happier*/better**)	4 (6.8%)	3 (5.1%)	4 (13.3%)	1 (3.3%)	Spend more time and effort on meals	6(10.2%)	3 (5.1%)	5 (16.7%)	6 (20.0%)
Have more energy	5 (8.5%)	1 (1.7%)	3 (10.0%)	1 (3.3%)	Spend more money on food	5 (8.5%)	4 (6.8%)	2 (6.7%)	4 (13.3%)
Feel less guilty	4 (6.8%)	2 (3.4%)	3 (10.0%)	–	Enjoy my meals less	2 (3.4%)	5 (8.5%)	3 (10.0%)	1 (3.3%)
Save money on food	3 (5.1%)	2 (3.4%)	4 (13.3%)	1 (3.3%)	Not get enough iron	5 (8.5%)	1 (1.7%)	4 (13.3%)	1 (3.3%)
Lower my cholesterol*	4 (6.8%)	–	1 (3.3%)	–	Lose too much weight*	3 (5.1%)	1 (1.7%)	–	1 (3.3%)
Consume more vegetables	2 (3.4%)	1 (1.7%)	2 (6.7%)	–	Have more difficulty building muscles*	3 (5.1%)	1 (1.7%)	–	–
Feel proud**	–	–	–	2 (6.7%)					
Improve my self-discipline**	–	–	–	2 (6.7%)					
Total	66	56	45	21		91	69	40	37

*U.S. survey only/**Dutch survey only.

10.3389/fsufs.2023.1040680

10.3389/fsufs.2023.1040680

A content analysis was carried out (by the first author) in which all responses were first categorized into a belief group (attitudinal, normative or control) and then into individual beliefs. Tables 2A–C show the beliefs (and their frequency) that were included in the regression study. In general, the most frequently mentioned beliefs were converted to evaluative statements and included in the regression studies. An exception is "Having a one-sided diet" (mentioned often in U.S. and Dutch samples, yet not included in U.S. regression study).

Because the most frequently mentioned beliefs about having vegetarian and vegan diets overlapped, these responses are grouped together in the tables. Beliefs that can be considered as belonging to the same overarching category were only treated as separate beliefs when they were mentioned more than twice. For instance, the behavioral belief that one will experience having more energy by following a vegetarian or vegan diet falls within the scope of the belief of experiencing positive health consequences. However, because the former belief recurred more than twice, it was treated as a belief that could be salient by itself.

As the Dutch sample was smaller, inclusion criteria were a bit more flexible. For instance, some beliefs that were not mentioned by the U.S. sample, and were mentioned only once or twice in the Dutch sample, were still included in the Dutch regression study (e.g., "Improve my self-discipline"). Some beliefs were only included in the Dutch regression study for having a vegan diet ("Experience health concerns" and "Better indication of products being vegan") as these were only mentioned for having a vegan diet. Men and women as normative referents were mentioned in both belief elicitation studies but were only included in the regression study for the Dutch sample. Including these two categories only in the Dutch study was done because the relative frequency of male referents being mentioned in the Dutch belief elicitation (20% of participants mentioned male referents) was a lot higher compared to the U.S. belief elicitation (6.8%). The possible usefulness of distinguishing between male and female referents and including these as such in the regression study was only recognized after carrying out the second belief elicitation study. Lastly, one control belief that was not mentioned in both belief elicitation studies was incorporated in the regression study, the belief that "Preparing vegetarian (vegan meals) is just as easy as preparing meals with animal-based products." This belief was added as we believed that it could be useful to incorporate a more specific version of the facilitating control belief that was mentioned in both elicitation studies: "Ease of cooking vegetarian meals." Taken together, the discrepancies between beliefs incorporated in the U.S. and Dutch regression study were due to frequency of mentioning and progressive insights after carrying out the U.S. belief elicitation and regression study.

Tables 2A–C displays the attitudinal, normative and control beliefs that are included in the regression study with its frequency mentioned and percentage of participants mentioned. Attitudinal themes most often mentioned were health considerations and weight loss for both the U.S. and Dutch sample. Normative referents mentioned were mostly one's family members and friends for the U.S. sample and friends and male referents (father/male friends) for the Dutch sample. Control perceptions were for both samples primarily about nutritional considerations, important referents' eating habits and availability of meat, vegetarian and vegan products.

TABLE 2B Results belief elicitation questionnaire: most frequently mentioned (% of participants mentioned) normative beliefs U.S. and Dutch sample.

Normative beliefs approve	Frequency (%) U.S.		Frequency (%) Dutch		Normative beliefs disapprove	Frequency (%) U.S.		Frequency (%) Dutch	
	Vegetarian	Vegan	Vegetarian	Vegan		Vegetarian	Vegan	Vegetarian	Vegan
Friends	12 (20.3%)	8 (13.6%)	9 (30.0%)	3 (10.0%)	Family	12 (20.3%)	17 (28.8%)	3 (10.0%)	3 (10.0%)
Family	2 (3.4%)	3 (5.1%)	3 (10.0%)	1 (3.3%)	Doctor*	4 (6.8%)	5 (8.5%)	–	–
Women (mother)**	1 (1.7%)	2 (3.4%)	1 (3.3%)	1 (3.3%)	Friends	3 (5.1%)	5 (8.5%)	3 (10.0%)	4 (13.3%)
					Men (father/male friends)**	4 (6.8%)	2 (3.4%)	6 (20.0%)	1 (3.3%)
					Women (mother)**	3 (5.1%)	3 (5.1%)	–	1 (3.3%)
Total	15	13	13	5		26	32	12	9

*Only U.S. survey. **Only Dutch survey.

TABLE 2C Results belief elicitation questionnaire: most frequently mentioned (% of participants mentioned) control beliefs U.S. and Dutch sample.

Facilitating control beliefs	Frequency (%) U.S.		Frequency (%) Dutch		Hindering control beliefs	Frequency (%) U.S.		Frequency (%) Dutch	
	Vegetarian	Vegan	Vegetarian	Vegan		Vegetarian	Vegan	Vegetarian	Vegan
Learn to maintain a fully nutritional vegetarian (vegan) diet	12 (20.3%)	8 (13.6%)	3 (10.0%)	3 (10.0%)	Experience resistance from important referent	8 (13.6%)	8 (13.6%)	8 (26.7%)	4 (13.3%)
Meat and fish (meat, fish, dairy, and eggs) becomes less available	13 (22.0%)	2 (3.4%)	2 (6.7%)	1 (3.3%)	Experience health/nutritional concerns***	8 (13.6%)	7 (11.9%)	6 (20.0%)	9 (30.0%)
Important referents stop/decrease eating meat and fish (meat, fish, dairy, and eggs)	3 (5.1%)	10 (16.9%)	9 (30.0%)	7 (23.3%)	Experience a lack of motivation	6 (10.2%)	9 (15.3%)	2 (6.7%)	1 (3.3%)
Learn that eating meat and/or fish (meat, fish, dairy, and eggs) lead to negative health consequences	9 (15.3%)	4 (6.8%)	1 (3.3%)	–	Experience a lack of availability of vegetarian (vegan) options	8 (13.6%)	5 (8.5%)	2 (6.7%)	4 (13.3%)
Price reduction vegetarian (vegan) products	3 (5.1%)	6 (10.2%)	4 (13.3%)	2 (6.7%)	Experience a difficulty in changing habits	6 (10.2%)	5 (8.5%)	7 (23.3%)	6 (20.0%)
Price increase meat or fish (meat, fish, dairy, and eggs)	3 (5.1%)	3 (5.1%)	4 (13.3%)	–	Often not feel full (enough) if having a vegetarian (vegan) diet*	5 (8.5%)	2 (3.4%)	–	–
Improvement availability vegetarian (vegan) options	3 (5.1%)	2 (3.4%)	7 (23.3%)	6 (20.0%)	Experience a lack of time to put in a vegetarian (vegan) diet*	3 (5.1%)	4 (6.8%)	–	2 (6.7%)
Enjoy vegetarian (vegan) food just as much as meat or fish	3 (5.1%)	2 (3.4%)	1 (3.3%)	3 (10.0%)	Experience a lack of convenience	6 (10.2%)	1 (1.7%)	2 (6.7%)	1 (3.3%)
Ease of cooking vegetarian (vegan) meals	1 (1.7%)	2 (3.4%)	3 (10.0%)	1 (3.3%)					
If vegan meals were prepared for me	–	3 (5.1%)	–	–					
Better indication of products being vegan**	–	–	–	1 (3.3%)					
Preparing vegetarian (vegan meals) was just as easy***	–	–	–	–					
Total	50	42	34	24		50	41	27	27

*Only U.S. survey. **Only Dutch survey vegan diet. ***Not mentioned in U.S. nor Dutch belief elicitation study.

10.3389/fsufs.2023.1040680

3.3. Discussion study 1

The large amount and variety of beliefs that were mentioned by the participants show that belief elicitation studies provide fruitful insights into salient belief structures of the two samples. Taken together, health, nutritional and environmental beliefs were the attitudinal themes most often indicated. Normative referents mentioned were mostly one's family members and friends. Beliefs mentioned when asked for control perceptions were primarily about important referents' eating habits and convenience of one's current diet.

In addition, the elicitation study showed that the beliefs related to adopting a vegetarian vs. a vegan diet overlapped to a large degree. For instance, almost a third of all participants mentioned the attitudinal belief that they would not get all the nutrients they need if they would adopt a vegetarian or vegan diet. At the same time, the attitudinal belief that one would experience positive health consequences was mentioned often for both diets. But there were also differences, for instance which beliefs were considered important—based on the frequency with which they were mentioned. For example, the attitudinal belief of having more energy appeared four times more often in the context of adopting a vegetarian diet than a vegan diet.

Furthermore, there was a considerable overlap in beliefs mentioned by the U.S. vs. the Dutch sample, although there were also some notable differences in the extent to which they were considered focal (again, based on frequency). For example, the attitudinal belief that one would contribute to a more sustainable environment was mentioned about three times more often by the Dutch sample compared to the U.S. sample for both diets. Conversely, the attitudinal belief that one would not get enough protein was mentioned around three times more often by the U.S. sample compared to the Dutch sample for both diets. Hence, although the U.S.A. and the Netherlands are both Western cultures sharing many commonalities, there are differences in the beliefs that come to mind when answering questions on attitudinal, norm and control beliefs in relation to vegetarian and vegan dietary behavior, at least for Dutch and U.S. college students. These results resonate with the findings of de Boer et al. (2016), who reported that the belief that consuming less meat had the potential to mitigate climate change, was twice as common in their Dutch sample as compared to their U.S. sample.

What the present two samples seem to have in common is the focus on health-related reasons surrounding adopting vegetarian and vegan diets. This concurs with the outcome of a scoping review by Corrin and Papadopoulos (2017) who showed that health (i.e., nutritional) concerns are prominent barriers when it comes to adopting meatless diets in Western cultures.

In sum, finding both similarities and differences underscores the importance of conducting belief elicitation studies. Even when one uses seemingly similar samples and/or similar behaviors there can be (subtle) differences that may nevertheless be relevant with regard to forming belief structures. Which of the beliefs that were collected in this belief elicitation study most strongly relate to Intention to have a vegetarian or vegan diet, was tested in the second study.

TABLE 3 Descriptives for gender, age and meat, fish, dairy, and/or egg consumption.

Participants	U.S. sample	Dutch sample
Omnivorous diet (eating meat)	204 (91.1%)	345 (87.4%)
Non-omnivorous diet (not eating meat, excluded)	20 (8.9%)	58 (12.6%)
Gender		
Male	38 (18.8%)	136 (39.4%)
Female	162 (80.2%)	209 (60.6%)
Other	2 (1.0%)	N/A
Age [M (SD)]	20.5 (1.7)	21.6 (2.5)
Consumption in number of days per week [M (SD)]		
Meat	4.7 (1.9)	4.7 (1.9)
Fish	0.7 (1.0)	0.8 (1.0)
Dairy and/or eggs	5.4 (2.0)	5.6 (2.0)

4. Study 2: Regression study

The objective of the regression study was to investigate the correlational structure of the Intention formation to have a vegetarian and a vegan diet as a function of Attitudes, Perceived Norm, Perceived Behavioral Control, and underlying beliefs in two samples: a sample of U.S. students and a sample of Dutch students. Following the RAA framework, study 2 samples differ from study 1 samples.

4.1. Materials and methods

4.1.1. Participants

U.S. participants were students ($N = 204$) recruited from the subject pool of the University of Minnesota's School of Journalism and Mass Communication. They received course credit for participation. They all answered questions about a vegetarian and a vegan diet. Dutch participants were students recruited *via* an online educational environment (Nestor) on the Communication and Information Sciences' study-page, and during in-class courses of Media Studies, University of Groningen. One hundred eighty-two of the meat-eating Dutch participants answered questions on both a vegetarian and vegan diet, while, for entirely practical reasons, 163 Dutch participants completed questions either on the vegetarian ($N = 81$) or the vegan diet ($N = 82$). Participants who indicated they did not eat meat were excluded from further analysis. Table 3 shows descriptives for U.S. and Dutch participants' diet, gender, and animal based-product consumption in the number of days per week.

4.1.2. Instrument

Fishbein and Ajzen (2010) measurement recommendations were used to develop measures of reasoned action variables, again with the exception of the context frame (see Section 3.1.2). Questions were framed in terms of "stop eating meat and fish anytime in the next 6 months" for a vegetarian diet, and "stop eating meat, fish, dairy, and eggs anytime in the next 6 months" for a vegan diet.

4.1.2.1. Attitude

To measure Attitudes toward having a vegetarian/vegan diet, eight seven-point semantic differential scales were presented to participants: "Me stopping to eat meat and fish (meat, fish, dairy, and eggs) anytime in the next 6 months, would be extremely...:" bad-good; foolish-wise; negative-positive; harmful-beneficial; unnecessary-necessary [Instrumental Attitude: $\alpha = 0.93$ (U.S.)/$\alpha = 0.90$ (Dutch) for a vegetarian and $\alpha = 0.94$ (U.S.)/$\alpha = 0.87$ (Dutch) for a vegan diet]; and unenjoyable-enjoyable; stressful-relaxing; unpleasant-pleasant [Experiential Attitude: $\alpha = 0.90$ (U.S.)/$\alpha = 0.83$ (Dutch) for a vegetarian and $\alpha = 0.92$ (U.S.)/$\alpha = 0.87$ (Dutch) for a vegan diet].

4.1.2.2. Perceived norm

To measure Injunctive Norm, participants were asked: "How do you think most people important to you would feel about you stopping to eat meat and fish (meat, fish, dairy, and eggs) anytime in the next 6 months? They would...:" 1 = strongly approve-7 = strongly disapprove. To measure Descriptive Norm, participants were asked about future behavior of important referents instead of past or current behavior, on the basis of the nature of the behavior under investigation (Fishbein and Ajzen, 2010). As only a small percentage of the U.S. and Dutch population can be considered vegetarian or vegan, it was decided that an appropriate measure would be future behavior. Therefore, the following question was asked for Descriptive Norm: "How many of the people who are most important to you do you think would stop eating meat and fish (meat fish, dairy, and eggs) anytime in the next 6 months? If you are not sure, make your best guess:" 1 = none, 2 = a few, 3 = some, 4 = most, 5 = all.

4.1.2.3. Perceived behavioral control

Perceived Behavioral Control over having a vegetarian/vegan diet was measured by the following seven-point semantic differential scales for Perceived Autonomy [$r = 0.77$ (U.S.)/$r = 0.65$ (Dutch) for a vegetarian and $r = 0.90$ (U.S.)/$r = 0.69$ (Dutch) for a vegan diet]: "Me stopping to eat meat and fish (meat, fish, dairy, and eggs) anytime in the next 6 months, would be...:" not under my control-under my control; not up to me-up to me. To measure Perceived Capacity, the following question was asked: "There can be a variety of obstacles to you to stop eating meat and fish. Even in the face of such obstacles, how sure are you that if you really wanted to you can stop eating meat and fish anytime in the next 6 months?" 1 = completely sure I cannot-7 = completely sure I can.

4.1.2.4. Intention

Intention was measured by asking participants "I can see myself stop eating meat and fish (meat, fish, dairy, and eggs) anytime in the next 6 months:" 1 = very unlikely-7 = very likely. The same question was repeated for "I will stop [...];" and "I intend to stop [...]" [$\alpha = 0.89$ (U.S.)/$\alpha = 0.88$ (Dutch) for a vegetarian and $\alpha = 0.92$ (U.S.)/$\alpha = 0.91$ (Dutch) for a vegan diet].

4.1.2.5. Beliefs

To measure attitudinal beliefs, questions were framed as "How likely is it that the following would happen to you if you stop eating meat and fish (meat, fish, dairy, and eggs) anytime in the next 6 months. I will..." [e.g., experience positive health consequences; contribute to a more sustainable environment], with 1 = very unlikely-7 = very likely.

To measure normative beliefs, the questions were framed as follows: "How do you think your [e.g., close friends] would feel about you stop eating meat and fish (meat, fish, dairy, and eggs) anytime in the next 6 months? They would..." (1 = strongly disapprove−7 = strongly approve) and, "How many of your [e.g., close friends] do you think would stop eating meat and fish (meat, fish, dairy, and eggs) anytime in the next 6 months? If you are not sure, make your best guess" (1 = none, 2 = a few, 3 = some, 4 = most, 5 = all).

Finally, control beliefs were measured by framing questions as: "How sure are you that you can stop eating meat and fish (meat, fish, dairy, and eggs) anytime in the next 6 months, if..." [e.g., people important to me would decrease their meat and fish (meat, fish, dairy, and egg) intake; you experience a lack of motivation], with 1 = very unlikely-7 = very likely. Belief measures are not scaled and analyzed individually.

4.1.3. Procedure

After giving informed consent, participants were asked demographic questions. Then, they read a description of a vegetarian diet and answered questions about attitudinal, normative and control components related to switching to a vegetarian diet. Finally, all participants who finished two questionnaires read a description of a vegan diet and answered the same questions about switching to a vegan diet.

4.2. Results

First, we will show the descriptives. We show correlations, means and standards deviations for each measured RAA variable for having a vegetarian and vegan diet for both samples. Second, we show the results of a regression analysis in which we regressed Intention to have a vegetarian/vegan diet on Instrumental and Experiential Attitude, Injunctive and Descriptive Norm, and Perceived Capacity and Autonomy for both samples. The regression analysis shows which of the RAA components are significantly predictive for Intention. Lastly, we will show the results of a belief identification analysis, in which we examined which specific beliefs correlated strongest with Intention to have a vegetarian and vegan diet for both samples.

4.2.1. Vegetarian diet: Descriptives

Table 4 shows the correlations, means and standard deviations for having a vegetarian diet for U.S. and Dutch participants. Both participant groups' Attitude toward a vegetarian diet was somewhat negative. In addition, all participants expected neither a high or low level of approval from people important to them to have a vegetarian diet and they did not expect important referents to adopt a vegetarian diet in the near future. They felt somewhat capable and autonomous in their decision to have a vegetarian diet, but reported a very low Intention to have a vegetarian diet. The two Normative scales (Injunctive & Descriptive) and the two Control scales (Capability & Autonomy) showed weak correlations for the U.S. and Dutch participants ($r < 0.50$) The two Attitude scales were moderately correlated for Dutch participants ($r = 0.66$) and relatively strongly correlated for U.S. participants ($r = 0.73$).

TABLE 4 Descriptive statistics: correlations, means, and standard deviations for having a vegetarian diet U.S.A. and Netherlands.

	Correlations						Means (M) and standard deviations (SD)	
U.S.A.	IA	EA	IN	DN	PC	PA	M_a	SD
Behavioral intention	0.58**	0.56**	0.25**	0.28**	0.28**	0.07	1.97	1.33
Instrumental attitude (IA)		0.73**	0.28**	0.23**	0.32**	0.28**	3.49	1.28
Experiential attitude (EA)			0.23**	0.26**	0.32**	0.22**	2.97	1.28
Injunctive norm (IN)				0.18*	0.18**	0.22*	3.71	1.29
Descriptive norm (DN)					0.08	0.08	1.72	0.72
Perceived capacity (PC)						0.27**	4.08	1.90
Perceived autonomy (PA)							5.12	1.63
Netherlands								
Behavioral intention	0.53**	0.56**	0.37**	0.38**	0.27**	0.28**	2.18	1.40
Instrumental attitude (IA)		0.66**	0.33**	0.29**	0.34**	0.35**	4.09	1.14
Experiential attitude (EA)			0.37**	0.27**	0.33**	0.31**	3.19	1.03
Injunctive norm (IN)				0.38**	0.28**	0.28**	3.77	1.55
Descriptive norm (DN)					0.08	0.15**	1.66	0.65
Perceived capacity (PC)						0.45**	4.88	1.81
Perceived autonomy (PA)							4.82	1.68

*Significant at $p < 0.05$.
**Significant at $p < 0.001$.
[a]Means are relative to scales ranging from 1 (negative; weak) to 7 (positive; strong) except for descriptive norm, for which the mean is relative to a scale ranging from 1 (negative; weak) to 5 (positive; strong).

4.2.2. Vegan diet: Descriptives

Table 5 shows correlations, means and standard deviations for having a vegan diet for U.S. and Dutch participants. Again, participants did not have a very positive Instrumental Attitude or Experiential Attitude. Participants expected from people important to them to slightly disapprove if they decided to have a vegan diet and they did not expect important referents to adopt a vegan diet in the near future. Participants felt somewhat to rather autonomous in their decision to have a vegan diet and showed lower levels of Perceived Capacity Again, behavioral Intention was very low). The correlations between the two Normative scales ($M = 0.42$) and two Control scales ($r = 0.36$) were moderate for both participant groups ($r < 0.45$). The two Attitude scales were again moderately correlated for the Dutch participants ($r = 0.60$) and strongly correlated for the U.S. participants ($r = 0.76$). A collinearity test showed that the high correlation did not imply that Instrumental and Experiential Attitude formed a single Attitude variable for U.S. participants for both diets (Vegetarian diet: Instrumental Attitude, tolerance = 0.44, VIF = 2.27; Experiential Attitude, tolerance = 0.45, VIF = 2.22)/Vegan diet: Instrumental Attitude, tolerance = 0.40, VIF = 2.50; Experiential Attitude, tolerance = 0.38, VIF = 2.67). In sum, both vegetarian and vegan dietary behaviors show support for the Reasoned Action Approach's dual component conceptualization of determinants (i.e., Attitude consists of two components, Fishbein and Ajzen, 2010).

4.2.3. Regression vegetarian diet

4.2.3.1. U.S.A.

Intention to have a vegetarian diet was regressed on Instrumental and Experiential Attitude, injunctive and Descriptive Norm and Perceived Autonomy and capacity (Table 6). These six variables explained 37% of the variance in Intention to have a vegetarian diet for U.S. participants. Intention proved to be a function of Instrumental Attitude ($\beta = 0.35, p = 0.000$) and Experiential Attitude ($\beta = 0.32, p = 0.002$).

4.2.3.2. Netherlands

The six determinants together explained 40% of the variance in Intention to have a vegetarian diet for Dutch participants. Intention proved to be a function of Instrumental Attitude ($\beta = 0.20$, $p = 0.003$), Experiential Attitude ($\beta = 0.33$, $p = 0.000$), and Descriptive Norm ($\beta = 0.20, p = 0.000$).

4.2.4. Regression vegan diet

4.2.4.1. U.S.A

Intention to have a vegan diet was regressed on the six reasoned action components (Table 6). The light-gray marked areas in the table show significant determinants. The six determinants together explained 43% of the variance in Intention to have a vegan diet. Again, the two Attitude components were a function of Intention (Instrumental Attitude $\beta = 0.21$, $p = 0.022$, Experiential Attitude $\beta = 0.49$, $p = 0.000$).

4.2.4.2. Netherlands

The six determinants together explained 30% of the variance in Intention to have a vegan diet for Dutch participants. Intention proved to be a function of Experiential Attitude ($\beta = 0.43$, $p = 0.000$) only.

TABLE 5 Descriptive statistics: correlations, means, and standard deviations for having a vegan diet.

	Correlations						Means (M) and standard deviations (SD)	
U.S.A.	IA	EA	IN	DN	PC	PA	M_a	SD
Behavioral intention	0.57**	0.65**	0.41**	0.46**	0.45**	0.14*	1.69	1.22
Instrumental attitude (IA)		0.76**	0.40**	0.33**	0.35**	0.22**	3.07	1.36
Experiential attitude (EA)			0.46**	0.39**	0.35**	0.13	2.53	1.25
Injunctive norm (IN)				0.42*	0.41**	0.22*	2.95	1.44
Descriptive norm (DN)					0.24**	0.00	1.36	0.62
Perceived capacity (PC)						0.36**	2.85	1.95
Perceived autonomy (PA)							3.57	1.19
Netherlands								
Behavioral intention	0.41**	0.54**	0.27**	0.22**	0.24**	0.23**	1.31	0.74
Instrumental attitude (IA)		0.60**	0.38**	0.27**	0.27**	0.25**	4.11	2.07
Experiential attitude (EA)			0.39**	0.25**	0.31**	0.23**	2.79	1.54
Injunctive norm (IN)				0.30**	0.47**	0.33**	2.81	1.46
Descriptive norm (DN)					0.12	0.05	1.32	0.55
Perceived capacity (PC)						0.44**	3.58	2.06
Perceived autonomy (PA)							4.49	1.88

*Significant at $p < 0.05$. **Significant at $p < 0.001$.

[a]Means are relative to scales ranging from 1 (negative; weak) to 7 (positive; strong) except for descriptive norm, for which the mean is relative to a scale ranging from 1 (negative; weak) to 5 (positive; strong).

4.2.5. Belief identification

Next, all three types of beliefs (related to Attitude, Perceived Norm, and Perceived Behavioral Control) were examined to test which specific beliefs would have predictive value pertaining to behavioral Intention to have a vegetarian and vegan diet best. Tables 7–9 show correlations of behavioral, normative, and control beliefs about having a vegetarian and having a vegan diet with behavioral Intention. The light-gray marked areas in the table show significant correlations. Some beliefs were evaluated for only one of the diets or one of the samples in accordance with the outcomes of the belief elicitation study (i.e., beliefs that were mentioned by only one sample of for only one diet were only explored for that sample/diet: if a belief was not applicable it is labeled as n/a in Tables 7–9).

4.2.5.1. Attitudinal beliefs

Tables 7A, B shows how the attitudinal beliefs (i.e., perceptions about the perceived likelihood of the positive and/or negative consequences of having a meatless diet that underlie Attitude) correlate with Intention to have a vegetarian and vegan diet for both the U.S. and Dutch sample.

4.2.5.1.1. Vegetarian diet

U.S.A.

Attitudinal beliefs that were most strongly and positively associated with Intention were the beliefs that one would be happier, feel less guilty, experience positive health consequences, have a healthier diet, have more energy, contribute to a more sustainable environment, behave more ethically concerning animal treatment and would lose weight when adopting a vegetarian diet. Attitudinal beliefs that were most strongly negatively related to Intention to have a vegetarian diet were the beliefs that one would miss the taste of meat, enjoy meals less, have less energy and not get all the nutrients needed

Netherlands

Attitudinal beliefs that were most strongly and positively associated with Intention were the beliefs that one would feel better, feel less guilty, experience positive health consequences, have more energy, feel proud, contribute to a more sustainable environment, behave more ethical concerning animal treatment, improve one's self-discipline, and save animal lives when adopting a vegetarian diet. Attitudinal beliefs that were most strongly negatively related to Intention to have a vegetarian diet were the beliefs that one would enjoy meals less, miss the taste of meat, not get all the nutrients needed, not get enough iron, have a one-sided diet, not get enough protein, have less energy and spend more time and effort on meals.

4.2.5.1.2. Vegan diet

U.S.A.

Attitudinal beliefs that were most strongly and positively associated with Intention to have a vegan diet were the beliefs that one would be happier, have more energy, spend less money on food, have a healthier diet and experience positive health consequences, feel less guilty and behave more ethically concerning animal treatment. Not getting enough protein and missing the taste of dairy and eggs were attitudinal beliefs that were most strongly—but only moderately—negatively related to Intention.

Netherlands

Attitudinal beliefs that were most strongly and positively associated with Intention were the beliefs that one would have more energy, feel better, experience positive health consequences, feel less

10.3389/fsufs.2023.1040680

TABLE 6 Regression results: intention regressed on attitudinal, normative, and control variables U.S.A. and Netherlands.

Explanatory variables	Vegetarian diet						Vegan diet					
	U.S.A.				Netherlands		U.S.A.				Netherlands	
	b	SE *b*	*β*	*p*	*b*	SE *b*	*β*	*p*	*b*	SE *b*	*β*	*p*
Instrumental attitude (IA)	0.36	0.09	0.35	0.000	0.25	0.08	0.20	0.003	0.18	0.08	0.21	0.022	0.28	0.13	0.09	0.165
Experiential attitude (EA)	0.33	0.09	0.32	0.000	0.45	0.09	0.33	0.000	0.48	0.09	0.49	0.000	0.21	0.03	0.43	0.000
Injunctive norm (IN)	0.08	0.06	0.08	0.192	0.08	0.05	0.09	0.127	0.04	0.06	−0.05	0.472	0.00	0.03	0.00	0.990
Descriptive norm (DN)	−0.10	0.11	−0.06	0.365	0.42	0.12	0.20	0.000	−0.01	0.12	0.00	0.948	0.11	0.08	0.08	0.172
Perceived capacity (PC)	−0.03	0.04	−0.047	0.424	0.03	0.04	0.04	0.508	−0.05	0.04	0.08	0.249	0.01	0.02	0.02	0.713
Perceived autonomy (PA)	0.06	0.05	0.07	0.240	0.03	0.05	0.04	0.539	0.41	0.07	0.04	0.549	0.02	0.01	0.08	0.174
	$R^2 = 0.37$				$R^2 = 0.40$				$R^2 = 0.43$				$R^2 = 0.30$			

guilty, feel proud, contribute to a more sustainable environment, behave more ethical concerning animal treatment, improve one's self-discipline, save money on food, and save animal lives when adopting a vegan diet. Attitudinal beliefs that were most strongly negatively related to Intention to have a vegan diet were the beliefs that one would enjoy meals less, miss the taste of meat, have a one-sided diet, not get all the nutrients needed, spend more time and effort on meals, not get enough protein, have less energy, not get enough iron, and spend more money on food.

4.2.5.2. Normative beliefs

Table 8 shows how the normative beliefs (i.e., perceptions about social support from specific individuals in one's social network that underlie Perceived Norm) correlate with Intention to have a vegetarian and vegan diet for both the U.S. and Dutch sample.

4.2.5.2.1. Vegetarian diet

U.S.A.

Intention was associated with expected approval from one's friends and to a lesser degree from one's family. Doctor's approval was not statistically significant related to Intention. Expected future behavior of friends and family was moderately related to Intention.

Netherlands

Intention was associated with expected approval from one's friends and to a lesser degree from one's family, women in one's direct environment, and men in one's direct environment. Expected future behavior of friends and family was moderately related to Intention.

4.2.5.2.2. Vegan diet

U.S.A.

Expected approval of one's family, friends and doctor were associated with Intention, as was the expectation that one's family members and friends would adopt a vegan diet in the near future.

Netherlands

Intention was associated with expected approval from one's family ($r = 0.32$), one's friends and women in one's direct environment. Expected future behavior of family and friends was moderately related to Intention.

4.2.5.3. Control beliefs

Tables 9A, B shows how the control beliefs (i.e., perceptions of environmental contexts that facilitate or hamper the ability of changing one's consumption patterns underlying Perceived Control) correlate with Intention to have a vegetarian and vegan diet for both the U.S. and Dutch sample.

4.2.5.3.1. Vegetarian diet

U.S.A.

Important facilitating control beliefs that were related to Intention were the beliefs that meat or fish would increase in price, vegetarian products would reduce in price and become more available, important referents would stop or decrease their meat and fish intake, learning how to prepare vegetarian meals just as easily as meals with meat or fish and learning how to maintain a fully nutritional vegetarian diet. Finally, only one obstructing control belief, that one would often not feel full enough having a vegetarian diet was moderately and negatively related to Intention.

TABLE 7A Positive attitudinal beliefs about having a vegetarian and having a vegan diet: means (M), standard deviations (SD), and correlation (r) with behavioral intention.

Perceived likelihood of having diet (1 = very unlikely−7 = very likely)	U.S.A. vegetarian diet			U.S.A. vegan diet			NL vegetarian diet			NL vegan diet		
	M	SD	*r*	*M*	SD	*r*	*M*	SD	*r*	*M*	SD	*r*
Improved mood (feel happier/feel better)	2.44	1.12	0.52**	2.44	1.17	0.49**	2.82	1.22	0.47**	2.57	1.25	0.34**
Feel less guilty	2.57	1.33	0.51**	2.59	1.22	0.32**	2.50	1.24	0.37**	2.40	1.23	0.32**
Experience positive health consequences	3.06	1.20	0.44**	2.93	1.20	0.32**	2.78	1.09	0.31**	2.54	1.13	0.33**
Have a healthier diet	3.07	1.24	0.43**	3.06	1.20	0.34**	N/A	N/A	N/A	N/A	N/A	N/A
Have more energy	2.58	1.17	0.41**	2.61	1.20	0.39**	2.41	0.97	0.33**	2.26	1.03	0.37**
Contribute to a more sustainable environment	3.41	1.24	0.40**	3.28	1.18	0.22**	3.91	1.01	0.29**	3.63	1.14	0.19**
Behave more ethical concerning animal treatment	3.14	1.27	0.39**	3.05	1.28	0.30**	3.29	1.24	0.25**	3.05	1.28	0.16**
Lose weight	3.16	1.20	0.31**	3.26	1.21	0.17*	3.05	1.16	0.10	3.27	1.29	0.04
Have a smoother skin	2.94	1.08	0.29**	3.04	1.12	0.22**	N/A	N/A	N/A	N/A	N/A	N/A
Lower my cholesterol	3.35	1.01	0.30**	3.32	1.08	0.19**	N/A	N/A	N/A	N/A	N/A	N/A
Save animal lives	3.36	1.33	0.27**	3.26	1.25	0.28**	3.47	1.27	0.19**	3.45	1.26	0.12*
Consume more vegetables	3.97	1.02	0.18**	3.77	1.11	0.03	4.05	1.03	0.06	4.06	1.06	−0.028
Save money on food	2.75	1.24	0.15*	2.34	1.14	0.39**	3.13	1.26	0.05	2.61	1.21	0.14*
Feel proud	N/A	N/A	N/A	N/A	N/A	N/A	2.88	1.25	0.30**	2.55	1.20	0.31**
Improve my self-discipline	N/A	N/A	N/A	N/A	N/A	N/A	3.20	1.24	0.24**	3.22	1.22	0.16*

*$p < 0.05$, **$p < 0.005$. N/A, not incorporated in survey.

10.3389/fsufs.2023.1040680

TABLE 7B Negative attitudinal beliefs about having a vegetarian and having a vegan diet: means (M), standard deviations (SD), and correlation (r) with behavioral intention.

Perceived likelihood of having diet (1 = very unlikely−7 = very likely)	U.S.A. vegetarian diet			U.S.A. vegan diet			NL vegetarian diet			NL vegan diet		
	M	SD	*r*	*M*	SD	*r*	*M*	SD	*r*	*M*	SD	*r*
Miss the taste of meat and/or fish	4.15	1.00	−0.39**	4.09	0.94	−0.24**	4.15	1.00	−0.43**	4.16	1.01	−0.36**
Enjoy my meals less	3.53	1.10	−0.37**	3.93	1.02	−0.24**	3.49	1.17	−0.50**	3.87	1.08	−0.38**
Have less energy	3.39	1.08	−0.34**	3.60	3.60	−0.22**	3.10	1.06	−0.21**	3.51	1.07	−0.24**
Not get all the nutrients my body needs	3.61	1.06	−0.28**	3.88	0.98	−0.23**	3.57	1.05	−0.36**	3.94	0.94	−0.31**
Not get enough protein	3.86	1.06	−0.26**	3.97	0.99	−0.29**	3.52	1.05	−0.25**	3.94	0.98	−0.25**
Not get enough iron	3.89	0.87	−0.26**	3.79	0.94	−0.26**	3.49	0.98	−30**	3.77	0.96	−0.19**
Feel hungry more often	3.78	1.06	−0.24**	3.90	0.96	−0.25**	N/A	N/A	N/A	N/A	N/A	N/A
Have more difficulty building muscles	3.61	0.99	−0.21*	3.74	1.00	−0.25**	N/A	N/A	N/A	N/A	N/A	N/A
Experience negative health consequences	2.93	1.01	−0.16*	3.19	1.05	−0.06	2.76	0.95	−0.23**	3.23	1.04	−0.18**
Spend more time and effort on meals	3.81	1.11	−0.12	3.92	1.03	−0.20**	3.74	1.15	−0.16*	4.18	0.94	−0.27**
Spend more money on food	3.38	1.16	−0.05	3.74	1.03	−0.11	2.93	1.16	0.03	3.53	1.07	−0.15**
Lose too much weight	2.49	1.11	−0.083	2.90	1.11	0.03	N/A	N/A	N/A	N/A	N/A	N/A
Miss the taste of dairy and eggs	N/A	N/A	N/A	4.17	0.96	−0.27**	N/A	N/A	N/A	N/A	N/A	N/A
Have a one-sided diet	N/A	N/A	N/A	N/A	N/A	N/A	3.41	1.05	−0.30**	3.80	1.03	−0.31**

*$p < 0.05$, **$p < 0.005$. N/A, not incorporated in survey.

10.3389/fsufs.2023.1040680

TABLE 8 Normative beliefs about having a vegetarian and having a vegan diet: means (M), standard deviations (SD), and correlation (r) with behavioral intention.

Perceived approval for having diet (1 = strongly disapprove–7 = strongly approve)	U.S.A. vegetarian diet			U.S.A. vegan diet			NL vegetarian diet			NL vegan diet		
	M	SD	*r*	*M*	SD	*r*	*M*	SD	*r*	*M*	SD	*r*
Friends	3.92	1.36	0.31**	3.24	1.38	0.36**	3.78	1.54	0.37**	2.86	1.48	0.27**
Family	3.18	1.42	0.20**	2.70	1.49	0.40**	3.77	1.55	0.28**	2.76	1.52	0.32**
Doctor	3.77	1.33	0.14	3.23	1.48	0.39**	N/A	N/A	N/A	N/A	N/A	N/A
Men	N/A	N/A	N/A	N/A	N/A	N/A	3.24	1.44	0.18**	2.49	1.33	0.11
Women	N/A	N/A	N/A	N/A	N/A	N/A	4.69	1.21	0.24**	3.72	1.13	0.27**
Perceived expectation about having diet in the future (1 = none–5 = all)												
Friends	1.60	0.68	0.27**	1.35	0.62	0.46**	1.49	0.65	0.36**	1.29	0.57	0.21**
Family	1.30	0.60	0.22**	1.22	0.57	0.46**	1.27	0.55	0.20**	1.12	0.43	0.22**

** $p < 0.005$. N/A, not incorporated in survey.

TABLE 9A Facilitating control beliefs about having a vegetarian and having a vegan diet: means (M), standard deviations (SD), and correlation (r) with behavioral intention.

Perceived behavioral control over having diet (1 = not at all sure–7 = completely sure)	U.S.A. vegetarian diet			U.S.A. vegan diet			Vegetarian diet			Vegan diet		
	M	SD	*r*	*M*	SD	*r*	*M*	SD	*r*	*M*	SD	*r*
Price reduction vegetarian (vegan) products	3.03	1.23	0.42**	2.77	1.24	0.30**	3.30	1.26	0.30**	3.03	1.21	0.17**
Important referents stop eating meat and fish (meat, fish, dairy, and eggs)	2.69	1.21	0.39**	2.49	1.14	0.44**	3.12	1.31	0.23**	2.82	1.24	0.17**
Enjoy vegetarian (vegan) food just as much as meat or fish (meat, fish, dairy, and eggs)	3.12	1.32	0.39**	2.93	1.32	0.30**	3.57	1.25	0.20**	3.27	1.34	0.10
Important referents decrease eating meat and fish (meat, fish, dairy, and eggs)	2.78	1.19	0.39**	2.53	1.11	0.46**	3.22	1.21	0.27**	2.81	1.20	0.17**
Price increase meat or fish (meat, fish, dairy, and eggs)	2.90	1.15	0.38**	2.57	1.16	0.35**	3.26	1.08	0.23**	2.77	1.10	0.07
Improvement availability vegetarian (vegan) options	3.28	1.17	0.37**	2.88	1.24	0.30**	3.57	1.17	0.33**	3.20	1.15	0.24**
Ease of cooking vegetarian (vegan) meals	3.21	1.24	0.35**	2.90	1.32	0.29**	3.32	1.24	0.32**	N/A	N/A	N/A
Learn to maintain a fully nutritional vegetarian (vegan) diet	3.26	1.25	0.34*	3.01	1.28	0.28**	3.42	1.20	0.32**	3.12	1.22	0.20**
Meat and fish (meat, fish, dairy, and eggs) become less available	2.98	1.22	0.28**	2.67	1.16	0.33**	3.32	1.05	0.20**	2.99	1.08	0.13**
Better indication of products being vegan	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.64	1.21	0.23**

* $p < 0.05$, ** $p < 0.005$. N/A, not incorporated in survey.

10.3389/fsufs.2023.1040680

TABLE 9B Hampering control beliefs about having a vegetarian and having a vegan diet: means (M), standard deviations (SD), and correlation (r) with behavioral intention.

Perceived behavioral control over having diet (1 = not at all sure—7 = completely sure)	U.S.A. vegetarian diet			U.S.A. vegan diet			NL vegetarian diet			NL vegan diet		
	M	SD	*r*	*M*	SD	*r*	*M*	SD	*r*	*M*	SD	*r*
Often not feel full (enough) if having a vegetarian (vegan) diet	3.70	1.05	−0.28**	3.73	1.07	−0.17*	N/A	N/A	N/A	N/A	N/A	N/A
Learn that eating meat and fish (meat, fish, dairy, and eggs) lead to negative health consequences	3.14	1.19	0.19**	2.84	1.19	0.39**	3.22	1.14	0.24**	3.04	1.16	0.12
Experience a lack of motivation	3.64	1.02	−0.23**	3.76	1.05	−0.23**	3.51	1.09	−0.29**	3.96	0.91	−0.35**
Experience a difficulty in changing habits	3.91	0.97	−0.20**	3.97	1.04	−0.14	3.73	1.10	−0.29*	4.08	0.94	−0.30**
Experience a lack of availability of vegetarian (vegan) options	3.51	1.07	−0.065	3.72	1.04	−0.21**	3.34	1.14	−0.15*	3.73	0.95	−0.16**
Experience a lack of time to put in a vegetarian (vegan) diet	3.59	1.10	−0.18*	3.79	1.08	−0.16*	N/A	N/A	N/A	N/A	N/A	N/A
Experience resistance from important referent	3.04	1.15	−0.07	3.32	1.12	−0.12	2.99	1.23	−0.058	3.42	1.02	−0.13**
Experience a lack of convenience	3.75	0.97	−0.12	3.83	1.14	−0.11	3.42	1.07	−0.17**	3.87	0.98	−0.26**
Experience health/nutritional concerns	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.22	1.02	−0.17**

*p < 0.05, **p < 0.005. N/A, not incorporated in survey.

Netherlands

Important facilitating control beliefs that were related to Intention were the beliefs that the availability of vegetarian options would improve, learning how to prepare vegetarian meals just as easily as meals with meat or fish, learning how to maintain a fully nutritional vegetarian diet, vegetarian options would decrease in price, important referents would stop or decrease their meat and fish intake, meat, or fish would increase in price and become less available. Finally, four obstructing control beliefs; a lack of motivation to maintain a vegetarian diet, difficulty of changing habits, lack of convenience, and a lack of food options were moderately and negatively related to Intention.

4.2.5.3.2. Vegan diet

U.S.A.

Control beliefs that were most strongly positively related to Intention were the facilitating beliefs that important referents would decrease or stop eating meat, fish, dairy, and eggs, learning that eating animal-based products would have serious negative consequences, animal-based products would increase in price and be less available and the availability of vegan products would improve while their price reduces. Finally, only two obstructing control beliefs, that one would experience a lack of motivation and vegan options were moderately and negatively related to Intention.

Netherlands

Control beliefs that were most strongly positively related to Intentions were the beliefs that the availability of vegan options would improve, better indications of products being vegan, learning how to maintain a fully nutritional vegetarian diet, important referents would stop or decrease their meat and fish intake, vegan options would decrease in price, meat or fish would become less available. Finally, six obstructing control beliefs, a lack of motivation to maintain a vegan diet difficulty of changing habits, experiencing a lack of convenience, health concerns, a lack of food options, and resistance from an important referent were moderately and negatively related to Intention.

4.3. Discussion regression study

In our regression study we investigated which beliefs, and which reasoned action concepts were important in predicting the Intention to have a vegetarian diet and a vegan diet. In addition, we explored the extent to which this pattern of prediction was different between the vegetarian vs. the vegan diet and we compared outcomes of the U.S. vs. the Dutch sample.

If we look at the predictive power of the concepts from the Reasoned Action Approach, the two samples showed quite similar patterns when it comes to adopting a vegetarian diet: in both samples Instrumental Attitude (i.e., positive behavioral attributes) and Experiential Attitude (i.e., positive affective behavioral experiences) were significant predictors of behavioral Intention. The fact that we found both Attitude components as important predictors for adopting a meatless diet is in line with previous research (e.g., (Zur and Klockner, 2014; Graça et al., 2015; Carfora et al., 2017). The only other RAA concept that was found to be predictive of Intention to have a vegetarian diet was Descriptive Norm (i.e., whether important referents have a vegetarian diet) for the Dutch

sample. Finding Descriptive Norm, and not Injunctive Norm (i.e., the extent to which one thinks important referents will approve of one having a vegetarian diet), as a significant predictor was unexpected, as the two components of Perceived Norm (i.e., have often been found to have equal predictive power with respect to behavioral Intention (see, e.g., the meta-analysis by McEachan et al., 2016). This apparently small role for Perceived Norm is remarkable, since we know from other research that these norms can play quite an important role in adopting vegetarian or vegan diets (e.g., Sharps et al., 2021; Bolderdijk and Cornelissen, 2022). It may be the case that there is not much variability in what our participants experience around them: most people in their nearest social environment do not engage in meat-free diets, nor do many peers or relatives approve of such diets. Thus, a lack of variability may have obscured the real influence of Perceived Norm on Intention. Such a methodological explanation is supported by the finding that Perceived Norm beliefs do correlate with Intention (see Table 8). So social norms play a role but it is of crucial importance how you measure them. This finding could also be due to the way in which Descriptive Norm was conceptualized in our research. We asked participants how many people important to them would adopt a vegetarian or vegan diet in the next 6 months. It may be that expecting a lot of important referents to adopt a vegetarian or vegan diet in the near future reflects the participants' own expectation to adopt a vegetarian or vegan diet (i.e., higher Descriptive Norms were associated with having higher Intentions). Likewise, expecting only few or none of one's important referents to adopt a vegetarian or vegan diet may have led to participants' own expectation not to adopt one of these diets (i.e., lower Descriptive Norms led to lower Intentions).

Equally unexpected, we did not find Perceived Control components to be significant predictors of participants' Intention. Earlier research did find that beliefs related to Perceived Capacity (i.e., one's perceived ability to have either diet), for instance a perceived lack of cooking skills, were important in explaining behavioral Intention (Corrin and Papadopoulos, 2017). In addition, Graça et al. (2019) found both Perceived Control components to explain Intentions in relation to vegetarian/vegan diets. The fact that we did not find evidence for the predictiveness of either of the Perceived Control concepts could be taken to mean that a change in attitude is necessary before Perceived Capacity or Perceived Autonomy (i.e., the perceived extent to which one thinks to be autonomous in changing one's diet) can play a role. On the other hand, it might be the operationalization of Perceived Capacity and Perceived Autonomy that stood in the way of finding significant correlations: The formulation of the open questions may have been too abstract for our participants (e.g.,: "There can be a variety of obstacles to you to stop eating meat and fish. Even in the face of such obstacles, how sure are you that if you really wanted to you can stop eating meat and fish anytime in the next 6 months?"). As with the Social Norms discussed above, this possible explanation is supported by the significant correlations we do find for Perceived Control beliefs with Intention (see Tables 9A, B).

When we look at the predictive power of RAA components for having a vegan diet we also only found subtle differences between the two samples. What the Dutch and U.S. sample had in common was that Attitude was a significant predictor of Intention, just as we saw for the vegetarian diet. However, Experiential Attitude was the only significant predictor for Intention in the Dutch sample while for the U.S. sample both Instrumental and Experiential Attitude predicted Intention. It is unclear what the reason is for this discrepancy. Possibly, the fact that the Netherlands has a long-standing "dairy culture," with nationwide campaigns that stress the importance of consuming dairy in Dutch culture (like "the Netherlands runs on dairy," De Nederlandse Zuivel Organisatie, 2021) has something to do with an enhanced emotional involvement (i.e., more experiential than instrumental), but the exact mechanism is as yet unknown.

The present research showed the usefulness of conceptualizing vegetarian and vegan dietary behaviors as separate behaviors, as well as the importance of measuring them as such. The strength of the beliefs' association with Intention to have a vegetarian/vegan diet varied widely. In addition, different sets of beliefs ultimately predict behavioral Intentions, which implies that vegetarian and vegan dietary behaviors are perceived to differ from one another.

In summary, the Reasoned Action Approach variables accounted for a sizable amount of the variance in Intention (i.e., the extent to which the variables were able to explain intentions)—respectively 37% (U.S. sample) and 40% (Dutch sample) for adopting a vegetarian diet and 43% (U.S. sample) and 30% (Dutch sample) for adopting a vegan diet.

5. General discussion

The aim of the present research was to explain Intention formation for adopting a vegetarian diet and adopting a vegan diet by applying a Reasoned Action Approach. A belief elicitation study was carried out to identify the most important attitudinal, normative and control beliefs. We then conducted a regression study to investigate to what extent the Intention to have a vegetarian and vegan diet was a function of these beliefs and the concepts of attitudes, perceived norms and perceived behavioral control.

A first important outcome of our study is that vegetarian and vegan dietary behavior should be seen as different, as they involved different belief sets and RAA concepts in the prediction of Intention. For instance, the attitudinal belief of having more energy appeared four times more often in the context of adopting a vegetarian diet than a vegan diet. And even though our U.S. and Dutch sample shared similarities in their norms and values, they did show differences in their motivations and cognitions. For example, the belief that a vegetarian and vegan diet would contribute to a more sustainable environment was mentioned about three times more often by the Dutch sample compared to the U.S. sample. Conversely, the belief that one would not get enough protein was mentioned around three times more often by the U.S. sample compared to the Dutch sample for both diets. This indicates the importance of making a custom analysis for each specific target group and each specific target behavior before designing interventions.

In a more general sense, if we only look at the RAA concepts, the Intention to change to a vegetarian or vegan diet seems to be guided primarily by the attitude of our participants: What they see as positive or negative consequences of this behavior (be it instrumental or experiential) is crucial for the Intention to change their existing eating behavior. None of the other concepts (with the exception of Descriptive Norm in the Dutch sample asked about vegetarianism) seems to have an added value. The reason is perhaps methodological—related to formulations being too abstract, or variability being too low—because the beliefs underlying the other concepts, Social Norms and Perceived Control, did show significant

correlations with Intention. One way to approach this problem would be to reformulate the questions used to measure the concepts of Social Norms and Perceived Control, for instance by distinguishing the various possible important others, or the various obstacles that people can encounter when changing their diets. However, one can also question the usefulness of measuring these global percepts separately. Perhaps it suffices to elicit beliefs in the categories prescribed by the concepts.

Hence, our study highlights the usefulness and importance of including a belief elicitation phase in the study of Intention formation. The great majority of studies that use a reasoned action approach does not at present use such elicitation methods (Yzer, 2013). Instead, researchers tend to rely on earlier research that uses different target groups (e.g., Bryant, 2019) or their own intuitions when formulating possibly relevant beliefs. This strategy can negatively impact outcomes. A case in point is that, through the years, it has often been found that health and ethical considerations are among the most important beliefs that are related to adopting a vegetarian and vegan diet (e.g., Ruby, 2012; Cooney, 2014; Rosenfeld, 2019). However, our research showed that other beliefs, such as those related to the behavior of important referents, are at least as influential. Without carrying out a belief elicitation study, these beliefs would perhaps not have been recognized and subsequently tested.

The outcomes also show which specific beliefs should be considered as candidates for interventions that encourage adopting a vegetarian diet and vegan diet for. That is, beliefs with the highest correlations with Intention and (relatively) low means (i.e., beliefs that have most room for improvement) are likely the best candidates as targets in intervention messages. Based on our study such beliefs were present for each reasoned action component. For instance, behavioral beliefs (e.g., "feel happier/better;" "feel less guilt") and (descriptive) normative beliefs (e.g., "friends are likely to adopt a vegetarian/vegan diet"), but also control beliefs (e.g., "price reduction of vegetarian/vegan products; "ease of cooking vegetarian/vegan meals") could be addressed in interventions. Other candidates are the "control beliefs" falling within the behavioral component (e.g., "enjoy vegetarian/vegan food just as much") and normative component (e.g., "important referents stop eating meat and fish"). In sum, for research that uses Reasoned Action Approach, we recommend to conduct elicitation studies in combination with a regression study and to avoid a singular reliance on a regression study that uses only the standardized Intention, Attitude, Norm, and Control component measures.

Another, point concerns the theoretical framework, the RAA itself. Some findings from the belief elicitation study point to a possible difficulty in the operationalization of components in the RAA approach. For instance, in response to the questions about Perceived Behavioral Control ("What factors or circumstances might make it easier/more difficult for you to stop eating meat and/or fish anytime in the next 6 months?"), participants reported beliefs that are indicative of Perceived Norms. For instance, the belief that it would help to commit to a vegetarian/vegan diet if "Important referents stop/decrease eating meat and fish (meat, fish, dairy, and eggs)" was mentioned by many respondents, especially in the Dutch sample (up to 30% of all control beliefs elicited). Likewise, the belief that it would hinder transitioning toward a meat-free diet if respondents would "Experience resistance from important referent" was also quite frequent (between 13 and 26% of all control beliefs elicited). The tendency of participants to mention normative beliefs in response to questions about attitude or perceived behavioral control has also been described in other studies and seems to pertain to behaviors that are highly social in nature. For instance, Donné et al. (2017) report a similar phenomenon in their study on when and why people talk to others about a health topic. This may indicate that where social behaviors such as talking to others, or behaviors which are subject to strong social norms such as adopting a vegetarian or vegan diet, are concerned, the three basic concepts of attitude, social norms, and behavioral control may become virtually indistinguishable. It is as yet unclear how the RAA can be adapted to incorporate these findings.

5.1. Future directions

This research suggests multiple directions for future research. First, as there were more female than male participants in our present study, we were unable to present a balanced view on gender differences in Intention formation, while gender is known to be an important background variable, especially in relation to vegetarian and vegan dietary behavior. That is, research consistently finds that men and women have different beliefs and show different behavior concerning the consumption of animal-based products (e.g., Lea and Worsley, 2002; Ruby, 2012; Graça et al., 2015). This should be taken into account in future research. In addition, we were unable to present a view on differences between intenders and non-intenders of adopting a vegetarian or vegan diet. Fishbein (2008) shows that it can be important to distinguish between these two groups as those groups may posit different beliefs, and different beliefs that are correlated to Intention. In our study, Intentions were mostly very low, and samples were relatively small. We were not able to compare participants with high Intentions to those who had low Intentions reliably. Future research that uses larger sample sizes might reach a sufficient number of intenders to expand the analysis and investigate potential differences between these groups. Another recommendation for future research is using a sample that is representative for the entire target group being investigated. Our sample was not representative as we used a convenience sample and we did not focus on the full target group (i.e., college students) as we only surveyed students from one background (i.e., students from communication/media studies).

From a societal perspective, the fact that Intentions were low shows there is a strong need for interventions if one wants to encourage behavior change in the field of vegetarianism and veganism for U.S. and Dutch college students. These low mean Intention scores are also interesting from the perspective of socially desirable responding: responding in such a manner as to provide a better image of oneself (van de Mortel, 2008). For instance, because the study was purely about adopting vegetarian and vegan diets, participants may have believed that the researcher viewed vegetarian and vegan diets positively. As a consequence, one would have expected participants to overreport on their Intentions—and other reasoned action components. However, because Intentions were extremely low and scores on other reasoned action components were for the most part also low, we do not expect participants to have had a high tendency to overreport. Perhaps participants felt a need to underreport their behavior and cognitions, as negative stereotypes on vegetarians and vegans widely exist (MacInnis and Hodson, 2017). As such, it may be more norm-compliant to self-report low Intentions and low scores on other reasoned action

components. In order to investigate whether participants are prone to provide socially desirable answers when answering questions on reasoned action components with regard to adopting vegetarian and vegan diets, one could include scales that measure socially desirable responding tendencies (cf: Perinelli and Gremigni, 2016).

Another point of consideration is while this study gathered critical information about which salient belief structures explain behavioral Intention, it leaves unclear how people exactly construe these beliefs (Middlestad, 2012). Expanding a belief elicitation study and regression study with a qualitative focus group study for instance can lead to deeper understanding about belief formation, which may have important implications for the design of interventions promoting (a change in) behavior (e.g., Yzer et al., 2015).

Importantly, the present study did not actually test the effectiveness of interventions promoting vegetarian and vegan diets. It would be extremely helpful, both from a practical but also from a theoretical standpoint if future studies could include an additional experimental phase that tests intervention messages within the same target group incorporating the most important candidate beliefs based on prior belief elicitation and regression studies. In this way, it is possible to validate or disprove the effectiveness of intervention messages based on the framework of the Reasoned Action Approach.

5.2. In closing

In closing, our results underscore that even between western countries and cultures, sharing similarities in their norms and values, similar sub-populations can differ in their motivations and cognitions—even if it is only in a subtle matter. In addition, different beliefs and reasoned action components were related to seemingly similar diets. This indicates the importance of employing a specific target group and target behavior analysis (i.e., by means of carrying out a belief elicitation study, regression study, and relating those beliefs to Intention) before designing interventions aimed at promoting vegetarian and vegan dietary behavior.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Netherlands: Research Ethics Committee of Faculty of Arts (CETO) and U.S.A.: University of Minnesota Ethics Committee. The patients/participants provided their written informed consent to participate in this study.

Author contributions

EZ: design, preparation, and carrying out of study 1 and 2, data analysis study 1 and 2, and writing: abstract, introduction, method, results, discussion, and references. YO: writing: abstract, introduction, method, results, and discussion and data analysis study 2. JH: design and preparation of study 1 and 2, writing: abstract, introduction, method, results, and discussion, and data analysis study 2. All authors contributed to the article and approved the submitted version.

Acknowledgments

We thank Marco Yzer for his valuable input for study 1 and 2.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

Bolderdijk, J. W., and Cornelissen, G. (2022). "How do you know someone's vegan?" They won't always tell you. an empirical test of the do-gooder's dilemma. *Appetite* 168, 1–7. doi: 10.1016/j.appet.2021.105719

Bryant, C. J. (2019). We can't keep meating like this: attitudes towards vegetarian and vegan diets in the united kingdom. *Sustainability* 11, 1–17. doi: 10.3390/su11236844

Carfora, V., Caso, D., and Conner, M. (2017). Correlational study and randomised controlled trial for understanding and changing red meat consumption: the role of eating identities. *Soc. Sci. Med.* 175, 244–252. doi: 10.1016/j.socscimed.2017.01.005

Carvalho, B., Salgueiro, M., and Rita, P. (2015). Consumer sustainability consciousness: a five dimensional construct. *Ecol. Indic.* 58, 402–410. doi: 10.1016/j.ecolind.2015.05.053

Cooney, N. (2014). *Veganomics. The Surprising Science on What Motivates Vegetarians from the Breafkfast Table to the Bedroom*. Brooklyn: Lantern Books.

Corrin, T., and Papadopoulos, A. (2017). Understanding the attitudes and perceptions of vegetarian and plant-based diets to shape future health promotion programs. *Appetite*. 109, 40–47. doi: 10.1016/j.appet.2016.11.018

de Boer, J., de Witt, A., and Aiking, H. (2016). Help the climate, change your diet: a cross-sectional study on how to involve consumers in a transition to a low-carbon society. *Appetite*. 98, 19–27. doi: 10.1016/j.appet.2015.12.001

De Nederlandse Zuivel Organisatie (2021). *Nederland Draait Op Zuivel. Consulted 16/04/2021*. Available online at: https://www.nederlanddraaitopzuivel.nl (accessed April 16, 2021).

de Roos, A., Ward, M., Lynch, C., and Cantor, K. (2003). Nitrate in public water supplies and the risk of colon and rectum cancers. *Epidemiology* 14, 640–649. doi: 10.1097/01.ede.0000091605.01334.d3

de Waart, S. (2020). *Consumptiecijfers en Aantallen Vegetariërs Fact sheet*. Nederlandse Vegetariersbond. Available online at: https://www.vegetariers.nl/serverspecific/default/images/File/Factsheet1Consumptiecijfersenaantallenvegetariersv3.3juni2020.pdf

Deliens, T., Clarys, P., De Bourdeaudhuij, I., and Deforche, B. (2014). Determinants of eating behaviour in university students: a qualitative study using focus group discussions. *BMC Public Health* 14, 53. doi: 10.1186/1471-2458-14-53

Doerr, L. (2005). "Lost in translation: data quality and interpreters in multilingual research: towards an interpreting methodology," in *60th Annual Conference of the American Association for Public Opinion Research* (Miami, FL).

Donham, K. J., Wing, S., Osterberg, D., Flora, J. L., Hodne, C., Thu, K. M., and Thorne, P. S. (2007). Community health and socioeconomic issues surrounding concentrated animal feeding operations. *Environ. Health Perspect.* 115, 317–320. doi: 10.1289/ehp.8836

Donné, L., Jansen, C. J. M., and Hoeks, J. (2017). Uncovering factors influencing interpersonal health communication. *Glob. Qual. Nurs. Res.* 4, 2333393617711607. doi: 10.1177/2333393617711607

Downs, D. S., and Hausenblas, H. A. (2005). Elicitation studies and the theory of planned behavior: a systematic review of exercise beliefs. *Psychol. Sport Exerc.* 6, 1–31. doi: 10.1016/j.psychsport.2003.08.001

Dowsett, E., Semmler, C., Bray, H., Ankeny, R. A., and Chur-Hansen, A. (2018). Neutralising the meat paradox: cognitive dissonance, gender, and eating animals. *Appetite* 123, 280–288. doi: 10.1016/j.appet.2018.01.005

FAOSTAT (2023). *Data Page of the Food and Agriculture Organization of the United Nations*. Available online at: https://www.fao.org/faostat/en/#data (accessed January 16, 2023).

Fishbein, M. (2008). A reasoned action approach to health promotion. *Med. Decis. Making* 28, 834–844. doi: 10.1177/0272989X08326092

Fishbein, M., and Ajzen, I. (2010). *Predicting and Changing Behavior: The Reasoned Action Approach*. New York, NY: Psychology Press.

Fishbein, M., and Yzer, M. C. (2003). Using theory to design effective health behavior interventions. *Commun. Theory* 13, 164–183. doi: 10.1093/ct/13.2.164

Fraser, G. E. (1999). Associations between diet and cancer, ischemic heart disease, and all-cause mortality in non-Hispanic white California Seventh-day Adventists. *Am. J. Clin. Nutr.* 70 (3 Suppl), 532S—538S. doi: 10.1093/ajcn/70.3.532s

Friedrichsen, H. P. (2015). Gesunde ernährung, teil 3. *Zeitschrift Orthomol. Med.* 1, 20–24. doi: 10.1055/s-0034-1395855

Giesen, D., Meertens, V., Vis-Visschers, R., and Beukenhorst, D. (2010). *Vragenlijstontwikkeling*. The Hague: Centraal Bureau voor de Statistiek.

Graça, J., Calheiros, M. M., and Oliveira, A. (2015). Attached to meat? (Un)Willingness and intentions to adopt a more plant-based diet. *Appetite* 95, 113–125. doi: 10.1016/j.appet.2015.06.024

Graça, J., Godinho, C. A., and Truninger, M. (2019). Reducing meat consumption and following plant- based diets: current evidence and future directions to inform integrated transitions. *Trends Food Sci. Technol.* 91, 380–390. doi: 10.1016/j.tifs.2019.07.046

Gray, G. C., and Kayali, G. (2009). Facing pandemic influenza threats: the importance of including poultry and swine workers in preparedness plans. *Poult. Sci.* 88, 880–884. doi: 10.3382/ps.2008-00335

Hanel, P. H., and Vione, K. C. (2016). Do student samples provide an accurate estimate of the general public? *PLoS ONE* 11, 0168354. doi: 10.1371/journal.pone.0168354

Harkness, J. A., Pennell, B. E., and Schoua-Glusberg, A. (2004). "Survey questionnaire translation and assessment," in *Methods for Testing and Evaluating Survey Questionnaires*, eds S. Presser, J. M. Rothgeb, and M. P. Couper (Hoboken, NJ: John Wiley & Sons, Inc), 453–473. doi: 10.1002/0471654728.ch22

Hedenus, F., Wirsenius, S., and Johansson, D. (2014). The importance of reduced meat and dairy consumption for meeting stringent climate change targets. *Clim. Change* 124, 79–91. doi: 10.1007/s10584-014-1104-5

Heller, M., Keoleian, G., and Rose, D. (2020). *Implications of Future US Diet Scenarios on Greenhouse Gas Emissions (Report No. CSS20)*. Ann Arbor, MI: University of Michigan. Available online at: https://css.umich.edu/sites/default/files/publication/CSS20-01.pdf

Hertwich, E., van der Voet, E., Suh, S., Tukker, A., Huijbregts, M., Kazmierczyk, P., et al. (2010). "Assessing the environmental impacts of consumption and production: priority products and materials," in *A Report of the Working Group on the Environmental Impacts of Products and Materials to the International Panel for Sustainable Resource Management* (UNEP).

Lea, E., and Worsley, A. (2002). Benefits and barriers to the consumption of a vegetarian diet in Australia. *Public Health Nutr.* 6, 505–511. doi: 10.1079/PHN2002452

Lippi, G., Mattiuzzi, C., and Cervellin, G. (2016). Meat consumption and cancer risk: a critical review of published meta-analyses. *Crit. Rev. Oncol. Hematol.* 971–14. doi: 10.1016/j.critrevonc.2015.11.008

MacInnis, C. C., and Hodson, G. (2017). It ain't easy eating greens: evidence of bias toward vegetarians and vegans from both source and target. *Group Process. Intergr. Relat.* 20, 721–744. doi: 10.1177/1368430215618253

McEachan, R., Taylor, N., Harrison, R., Lawton, R., Gardner, P., and Conner, M. (2016). Meta-analysis of the reasoned action approach (RAA) to understanding health behaviors. *Ann. Behav. Med.* 50, 592–612. doi: 10.1007/s12160-016-9798-4

McEachran, A. D., Blackwell, B. R., Hanson, J. D., Wooten, K. J., Mayer, G. D., Cox, S. B., et al. (2015). Research. Antibiotics, bacteria, and antibiotic resistance genes: aerial transport from cattle feed yards via particulate matter. *Environ. Health Perspect.* 123, 337–343. doi: 10.1289/ehp.1408555

Micha, R., Wallace, S. K., and Mozaffarian, D. (2010). Red and processed meat consumption and risk of incident coronary heart disease, stroke, and diabetes mellitus: a systematic review and meta-analysis. *Circulation* 121, 2271–2283. doi: 10.1161/CIRCULATIONAHA.109.924977

Middlestad, S. E. (2012). Beliefs underlying eating better and moving more: Lessons learned from comparative salient belief elicitations with adults and youths. *Ann. Am. Acad. Polit. Soc. Sci.* 640, 81–100. doi: 10.1177/000271621142501

Montonen, J., Boeing, H., Fritsche, A., Schleicher, E., Joost, H., Schulze, M., et al. (2013). Consumption of red meat and whole-grain bread in relation to biomarkers of obesity, inflammation, glucose metabolism and oxidative stress. *Eur. J. Nutr.* 52, 337–345. doi: 10.1007/s00394-012-0340-6

Mullee, A., Vermeire, L., Vanaelst, B., Mullie, P., Deriemaeker, P., Leenaert, T., et al. (2017). Vegetarianism and meat consumption: a comparison of attitudes and beliefs between vegetarian, semi-vegetarian, and omnivorous subjects in Belgium. *Appetite* 114, 299–305. doi: 10.1016/j.appet.2017.03.052

Nolan, B. T., and Hitt, K. J. (2006). Vulnerability of shallow groundwater and drinking-water wells to nitrate in the United States. *Environ. Sci. Technol.* 40, 7834–7840. doi: 10.1021/es060911u

O'Keefe, D. (2002). *Persuasion. Theory & Research*. Thousand Oaks, CA: Sage Publications Inc.

Pan, A., Sun, Q., Bernstein, A. M., Schulze, M. B., Manson, J. E., Stampfer, M. J., et al. (2012). Red meat consumption and mortality: results from 2 prospective cohort studies. *Arch. Intern. Med.* 172, 555–563. doi: 10.1001/archinternmed.2011.2287

Perinelli, E., and Gremigni, P. (2016). Use of social desirability scales in clinical psychology: a systematic review. *J. Clin. Psychol.* 72, 534–551. doi: 10.1002/jclp.22284

Peters, G. J. (2013). *Graphical Representation of the Reasoned Action Approach, a Psychological Model to Explain and Predict Behavior*. Available online at: https://www.wikiwand.com/en/Reasoned_action_approach (accessed September 30, 2021).

Pew Commission on Industrial Farm Animal Based-Production (2008). *Putting Meat on the Table: Industrial Farm Animal Based-Production in America*. Washington, DC: Pew Commission on Industrial Farm Animal Based-Production.

Povey, R., Wellens, B., and Conner, M. (2001). Attitudes towards following meat, vegetarian and vegan diets: an examination of the role of ambivalence. *Appetite* 37, 15–26. doi: 10.1006/appe.2001.0406

Ritchie, H., Rosado, P., and Roser, M. (2017). *Meat and Dairy Production*. Available online at: https://ourworldindata.org/meat-production (accessed October 6, 2020).

Ritchie, H., and Roser, M. (2019). *"Seafood Production"*. Available online at: https://ourworldindata.org/seafood-production (accessed October 6, 2020).

Rodriguez-Morales, A. J., Bonilla-Aldana, D. K., Tiwari, R., Sah, R., Rabaan, A., and Dhama, K. (2020). COVID-19, an emerging coronavirus infection: current scenario and recent developments – an overview article. *J. Pure Appl. Microbiol.* 14, 5–12. doi: 10.22207/JPAM.14.1.02

Rosenfeld, D. L. (2019). Why some choose the vegetarian option: are all ethical motivations the same? *Motiv. Emot.* 43, 400–411. doi: 10.1007/S11031-018-9747-6

Rothgerber, H. (2013). Real men don't eat (vegetable) quiche: masculinity and the justification of meat consumption. *Psychol. Men Masculi.* 14, 363–375. doi: 10.1037/a0030379

Ruby, M. B. (2012). Vegetarianism. A blossoming field of study. *Appetite* 58, 141–150. doi: 10.1016/j.appet.2011.09.019

Sha, M. (2004). "Managing survey translation: methodology for researchers who are not multi –lingual," in *Annual Conference of the American Association for Public Opinion Research* (Phoenix, AZ).

Sharps, M. A., Fallon, V., Ryan, S., and Coulthard, H. (2021). The role of perceived descriptive and injunctive norms on the self-reported frequency of meat and plant-based meal intake in uk- based adults. *Appetite* 167, 105615. doi: 10.1016/j.appet.2021.105615

Stahler, C. (2019). *How Many People Are Vegan? The Vegetarian Resource Group*. Available online at: https://www.vrg.org/nutshell/Polls/2019_adults_veg.htm (accessed May 5, 2020)

Stegeman, N. E. (1997). *Voeding Bij Gezondheid En Ziekte*. Groningen: Wolters-Noordhoff.

Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M., and de Haan, C. (2006). *Livestock's Long Shadow: Environmental Issues and Options*. Food and Agriculture Organization of the United Nations.

UN (2016). *Sustainable Development: Take Action*. Available online at: http://www.un.org/sustainabledevelopment/takeaction/(accessed June 12, 2016).

van de Mortel, T. F. (2008). Faking it: social desirability response bias in self-report research. *Austral. J. Adv. Nurs.* 25, 40–48. doi: 10.1.1.818.5855

van Grinsven, H. M., Rabl, A., and de Kok, T. M. (2010). Estimation of incidence and social cost of colon cancer due to nitRAAe in drinking water in the EU: a tentative cost-benefit assessment. *Environ. Health Glob. Access Sci. Source* 958–69. doi: 10.1186/1476-069X-9-58

Von Ah, D., Ebert, S., Ngamvitroj, A., Park, N., and Kang, D. H. (2004). Predictors of health behaviours in college students. *J. Adv. Nurs.* 48, 463–474. doi: 10.1111/j.1365-2648.2004.03229.x

WHO (2015). *ARC Monographs Evaluate Consumption of Red Meat and Processed Meat*. Available online at: https://www.iarc.fr/wpcontent/uploads/2018/07/pr240_E.pdf (accessed October 6, 2020).

WHO (2016). *Protecting Health From Climate Change*. Available online at: http://www.who.int/globalchange/publications/factsheets/Kit2008_annex1_2.pdf?ua=1 (accessed June 12, 2016).

WWF (2016). *Wat WNF doet: Voetafdruk Tips*. Available online at: https://www.wnf.nl/wat-wnf-doet/themas/voetafdruk/tips.html (accessed June 12, 2016).

Wyker, B. A., and Davison, K. K. (2010). Behavioral change theories can inform the prediction of young adults' adoption of a plant-based diet. *J. Nutr. Educ. Behav.* 42, 168–177. doi: 10.1016/j.jneb.2009.03.124

Yokoyama, Y., Nishimura, K., Barnard, N. D., Takegami, M., Watanabe, M., Sekikawa, A., et al. (2014). Vegetarian diets and blood pressure: a meta-analysis. *JAMA Intern. Med.* 174, 577–587.

Yzer, M., Weisman, S., Mejia, N., Hennrikus, D., Choi, K., and DeSimone, S. (2015). Informing tobacco cessation benefit use interventions for unionized blue-collar workers: a mixed-methods reasoned action approach. *Prev. Sci.* 16, 811–821. doi: 10.1007/s11121-015-0566-7

Yzer, M. C. (2013). "Reasoned action theory," in *The SAGE Handbook of Persuasion: Developments in Theory and Practice, 2nd edn*, J. P. Dillard, and L. Shen (Thousand Oaks, CA: Sage), 120–136.

Zaal, E. L., Mills, G., Hagen, A., Huisman, C., and Hoeks, J. C. J. (2017). Convincing conversations: using a computer-based dialogue-system to promote a plant-based diet. *Proceeding Cognitive Science Conference* (London), 3627–3632.

Zur, I., and Klockner, C. A. (2014). Individual motivations for limiting meat consumption. *Br. Food J.* 116, 629–642. doi: 10.1108/BFJ-08-2012-0193

frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 21 April 2023
DOI 10.3389/fpsyg.2023.1021891

OPEN ACCESS

EDITED BY
Christopher J. Hopwood,
University of Zurich, Switzerland

REVIEWED BY
Carla Forte Maiolino Molento,
Federal University of Paraná, Brazil
Aida Turrini,
Independent Researcher,
Scansano, Italy

*CORRESPONDENCE
Marija Branković
✉ marija.brankovic@fmk.edu.rs

SPECIALTY SECTION
This article was submitted to Personality and Social Psychology, a section of the journal Frontiers in Psychology

RECEIVED 17 August 2022
ACCEPTED 29 March 2023
PUBLISHED 21 April 2023

CITATION
Branković M, Budžak A, Tulić N and Janković J (2023) Effects of experimentally induced self-affirmation on the openness to meat reduction and alternative protein sources. *Front. Psychol.* 14:1021891. doi: 10.3389/fpsyg.2023.1021891

Effects of experimentally induced self-affirmation on the openness to meat reduction and alternative protein sources

Marija Branković[1,2]*, Anastasija Budžak[2], Nađa Tulić[2] and Jovana Janković[2]

[1]Insitute for Philosophy and Social Theory, University of Belgrade, Belgrade, Serbia, [2]Faculty of Media and Communications, Singidunum University, Belgrade, Serbia

Introduction: Consumption of animals entails disregarding the pain of sentient beings, and acknowledging this can threaten an individual's image of oneself as a moral person. Also, abstaining from meat in a meat-eating culture can threaten an individual's valued group identity. Previous research on inter-group relations suggests that self-affirmation, affirmation of personally or collectively important values, can help individuals alleviate self-threats since it enhances one's global self-image and decreases threat perceptions.

Methods: We tested for potential effects of self-affirmation on openness toward reducing meat consumption in an experimental study. Participants (N = 277) were randomized into an individual affirmation, group affirmation, or a control condition. Individual affirmation participants ranked a list of values and then wrote a short paragraph about their first-ranked value. Group affirmation participants did a similar task, focusing on the values of their ethnic group, while participants in the control condition had an unrelated task of ranking their color preferences. Participants then read a persuasive message presenting health risks related to meat consumption and the health benefits of reducing meat. Finally, they indicated their openness toward reducing meat consumption and acceptability of plant-based alternatives and lab-grown meat.

Results and Discussion: Results show that affirmed participants expressed more readiness to reconsider their meat consumption habits, reduced perceptions of vegetarianism as a threat to the local culture, and more positive perceptions of the idea of lab-grown meat. However, self-esteem and frequency of meat consumption pose important limitations to the experimental effects. We discuss the findings from the perspective of self-and collective identity threats and the potential of self-affirmations to create a more open debate about animal product consumption.

KEYWORDS

self-affirmation, meat consumption, alternative protein, group affirmation, self-threat

Introduction

As the saying in our country goes, you eat your vegetables and love your meat. Unfortunately, meat consumption habits are notoriously difficult to change (Macdiarmid et al., 2016), as most people believe eating plenty of meat is healthy and even necessary (Hyers, 2006; Piazza et al., 2015). However, the fact that is, for the most part, rationalized away by meat-eaters is that meat requires

the slaughter and suffering of sentient beings (Singer, 1975/2009). Also, meat production threatens the environment as it contributes a great deal to air pollution (Berners-Lee et al., 2012; Shafiullah et al., 2021), as well as pollution of water, soil, and deforestation (Thornton and Herrero, 2010). What is more, empirical evidence has accumulated that relates unfavorable health outcomes to a diet rich in meat (Tilman and Clark, 2014), in particular cardiovascular disease (Abete et al., 2014) and various types of cancer (Farvid et al., 2021) As plant-based diets can be related to a deficiency of micronutrients (Kristensen et al., 2015; Schüpbach et al., 2017; Haider et al., 2018), the exact quality of vegetarian/vegan diet is crucial. However, there appears to be a growing consensus around the health benefit of reducing meat consumption, as reflected, for instance, in the latest Report on Strengthening Europe in the Fight Against Cancer (2022). Given all these arguments, the welfare of humans appears to be inextricably related to the well-being of other animals and the environment, encapsulated by the concept of One Welfare (Pinillos et al., 2016).

Although less meat would be desirable for the sake of both non-human and human animals, in most parts of the world, meat consumption is the norm (Rosenfeld, 2018; Bryant, 2019). What is more, in the contemporary world, there is a global trend toward consuming an increasing amount of meat, to so-called *meatification* of diets (Weis, 2021). Most societies provide the individual with ready-made justifications for continued meat consumption (Piazza et al., 2015), not least championed by the meat industry itself (*meatsplaining*; Hannan, 2020) In addition to being an ingrained habit, meat consumption is also embedded in the individual's identity, social attitudes, and broader worldviews (Dhont et al., 2016; Branković, 2021). People who reduce or eliminate their meat consumption, such as vegetarians and vegans, can face negative stereotyping and even discrimination (MacInnis and Hodson, 2017; Torti, 2017; Bryant, 2019).

Previous research demonstrates, however, that humans do not readily endorse the suffering and killing of animals for meat. Especially when the link between the animals and the meat is made salient, humans experience cognitive dissonance (Loughnan et al., 2014; Bastian and Loughnan, 2017). This paper further explores the psychological mechanisms that sustain meat consumption. As a call to reduce one's consumption of meat can threaten one's sense of the moral self, as well as psychological needs and identities, we wanted to explore whether affirming the self could help create more psychological space for reconsidering one's meat-eating habits. In the following, we will briefly review previous approaches to reducing meat consumption, present the self-affirmation framework and elaborate on why and how it could be applied to the matter at hand.

Meat-reduction interventions

Previous studies demonstrate that it is possible to experimentally affect meat consumption, at least in the short term (Cordts et al., 2014; Kunst and Hohle, 2016; Carfora et al., 2017, 2019; Amiot et al., 2018; Dowsett et al., 2018; for meta-analyzes see Grundy et al., 2021; Kwasny et al., 2022). It appears from a review of the interventions that short-term outcomes, such as the immediate choice of foods, could be more amenable to change than more general habits and attitudes (Dowsett et al., 2018). Several approaches have been tested, the most frequent being providing participants with persuasive messages that informed them about health-related, ethical, environmental, or other consequences of meat consumption. Deleterious health-related effects of meat consumption appear to be the most effective persuasive arguments (Cordts et al., 2014; Carfora et al., 2019), as well as ethical arguments related to animal welfare (Auger and Amiot, 2019; Cordts et al., 2014; Kunst and Hohle, 2016). Evidence related to the noxious effects of meat production on the environment also constitutes a potentially helpful approach (Carfora et al., 2019), however, these effects are not universally present (e.g., Cordts et al., 2014). Also, combining different types of appeals could be less effective than focusing on a single category of effects (Carfora et al., 2019).

In addition to the message contents, cognitive vs. affective appeal also impacts the effectiveness of interventions (Kwasny et al., 2022). Affective aspects, e.g., negative affect related to the consumption of meat (Dowsett et al., 2018), appear to have a more prominent role than cognitive factors in shaping responses to experimental inductions. Also, matching messages with the needs of consumers (e.g., their values or decision stages) increases their effectiveness (Kwasny et al., 2022). Finally, contextual factors, such as nudging or enhancing the visibility/availability of vegetarian options, have proven helpful in encouraging meat-free options (Grundy et al., 2021; Kwasny et al., 2022).

However, there are also limits to the possibility of experimentally induced reconsideration of meat-consumption habits or their change. Some of the previous studies suggest that more complex, multi-component interventions can be effective, for instance, combining information, social norms, fear appeals, mind attribution, and self-monitoring (Amiot et al., 2018). However, some studies suggest that combining different types of appeals reduces their effectiveness (Carfora et al., 2019). Also, to induce changes in deeply ingrained habits, interventions might need to last longer and involve daily messaging to participants (Carfora et al., 2017, 2019).

Furthermore, meat identification or meat attachment (Graça et al., 2015) emerges as one the most important barriers. According to several studies, individuals that are most attached to meat, who value it for different reasons, are also those that are least receptive to counterarguments and generally least open to reconsidering their meat consumption (Allen and Ng, 2003; Dowsett et al., 2018; Roozen and Raedts, 2022). Also, as meat consumption can be closely associated with valued social identities, such as ethnic identity (Branković, 2021) or gender identity (i.e., masculinity, Rothgerber, 2013), the appeals to reduce meat have implications for how one perceives oneself. We will therefore present an intervention conceptualized within the framework of self-affirmation theory.

Affirming the self enhances openness to persuasion

In the present study, we propose and test the potential of the self-affirmation approach to enhance openness to reconsidering meat consumption. When provided with the opportunity to affirm the general value of the self (or their valued ingroup), individuals can become more open to persuasive communications, even the ones related to health and deeply ingrained habits (Epton et al., 2015; Ferrer and Cohen, 2019).

Self-affirmation theory posits that an important motivation is to maintain a sense of self-integrity, a favorable general image of oneself, including the sense of being a moral person (Steele, 1988; Sherman and Cohen, 2006; Sherman, 2013; Cohen and Sherman, 2014). Threats to self-integrity incite defensive reactions to restore this positive

image; these defensive strategies shift the attention toward the source of the threat and consume cognitive resources (Klein and Harris, 2009). Therefore, these defensive strategies diminish openness to information and the capacity for systematic information processing (Cohen and Sherman, 2014). On the other hand, an affirmation of the global sense of self prevents these defensive reactions–shifting the focus away from the specific threat, it restores the global sense of self-worth while at the same time uncoupling the threat from the self. Self-affirmed individuals are thus encouraged to a higher level of construal and perceive the threat at hand as not endangering their global sense of self-worth (Sherman, 2013). They also become more aware of their resources to deal with the threat. This process helps alleviate the consumption of cognitive resources–instead of focusing on short-term and threat-centered defenses, the individual is thus open to more constructive ways of coping with the threat, also encouraging the cycle of positive adaptive potential (Cohen and Sherman, 2014). Positive effects of self-affirmation are an approach orientation, openness to threatening information, and the possibility of using systematic processing of information (Cohen and Sherman, 2014).

Supporting the logic we outlined, experimental studies have demonstrated beneficial effects of self-affirmation procedures on openness to change of attitudes and habits related to both health behaviors (Epton et al., 2015; Ferrer and Cohen, 2019) as well as prejudice (Fein and Spencer, 1997). Furthermore, meta-analytical studies suggest that self-affirmation procedures have small but reliable effects on the acceptance of health messages, as well as heightened motivation for change and subsequent healthier behavior, across a range of health-related outcomes (Epton et al., 2015). For instance, young women at higher risk of breast cancer were more open to messages linking alcohol consumption to breast cancer after being affirmer in an unrelated domain (Harris and Napper, 2005). In addition, affirmed participants who read about the benefits of eating at least five portions of fruit and vegetables per day did report eating more fruit and vegetables at both 7-day and 3-month follow-ups compared to non-affirmed participants (Harris et al., 2014).

Self-affirmations have also been tested in the context of intergroup relations and prejudice reduction. Based on the idea that prejudice can serve self-image maintenance, a classical study revealed that self-affirmation could attenuate the tendency to stereotype out-group members after experiencing self-threat (Fein and Spencer, 1997). According to a recent review, self-affirmations prove helpful in alleviating perceived threats to valued social identities and attenuating negative intergroup relations and prejudice (Badea and Sherman, 2019). For instance, self-affirmation of values rendered participants more open to the acknowledgment of ingroup responsibility for prior conflicts, as well as support for reparative measures in post-conflict settings (Čehajić-Clancy et al., 2011).

The role of self-affirmation for openness to meat reduction communications

How does this logic apply to meat consumption habits? We posit that persuasive communications and, more generally, interventions aimed at a reduction of meat consumption can constitute a self-threat. First, meat consumption entails killing sentient beings, a fact usually removed from the consciousness of meat eaters through dissonance-reducing mechanisms (Loughnan et al., 2014; Bastian and Loughnan, 2017). However, when this fact is made salient, a threat to the sense of one's morality can entail. Previous research usually documents this threat through defensive mechanisms that are being put into action. Culturally supported and transmitted legitimizations for meat consumption (Hyers, 2006; Piazza et al., 2015) also attest to the need to deter the threat to one's morality. However, other dissonance-reducing strategies can also be engaged, such as a change in attitudes toward meat consumption and the consumption behaviors themselves (Kunst and Hohle, 2016).

In the present research, we will build upon the distinction made in the previous research between individual and group affirmations (Sherman et al., 2007). In addition to affirming the individual sense of integrity and morality, an affirmation can also target a collective self-image or a social identity. Although, as evidenced by previous research, the individual affirmations appear to be more effective (Badea and Sherman, 2019), we tested both types of inductions since at least one of the barriers to meat reduction communications is related to social identity.

Previous studies found that meat eaters can experience moral reproach, that is, the expectation that vegetarians and vegans will judge them for their meat consumption (Minson and Monin, 2012; Branković and Budžak, 2021). This concept of moral reproach thus encapsulates the perceived threat to the moral self, and we hypothesize that providing the opportunity for self-affirmation works through alleviating the expectation of moral reproach.

On the other hand, as meat consumption can be closely associated with gender or ethnic identity, reconsidering one's meat consumption habits can entail a social identity threat. As demonstrated by previous research (Branković, 2021), meat consumption and general attitudes toward animals are predicted by one's attachment to the ethnic group. This relationship is mediated by the perceived threat of vegetarianism to traditional cultural values and ways of life. In line with this, experimentally reinforcing the link between abstinence from meat and the religious tradition of fasting helped improve attitudes toward vegetarians in general (Budžak and Branković, 2022). We thus expected that another mediator of self-affirmation (more precisely, group affirmation) would be a decreased sense of cultural threat related to reducing meat consumption.

Thus, given the argumentation that a call to reduce one's meat consumption can constitute a relevant self-threat, we propose that affirming the global sense of self-worth can help alleviate these threats and increase openness to meat reduction advocacy. It has been pointed out that self-affirmation procedures do not remove the underlying cause of prejudice (Badea and Sherman, 2019), and we concur that they cannot in themselves sway either attitudes or habits related to meat consumption. However, if they can effectively alleviate the threat to the individual or social identity, this could help „unfreeze"potential barriers and create more space to engage in systematic processing and consider valid arguments (Cohen and Sherman, 2014). The reviewed literature supports the potential of self-affirmation procedures to incite more openness to both health–and nutrition habits (Harris et al., 2014; Epton et al., 2015; Ferrer and Cohen, 2019) as well as to reduce perceived threats to valued social identities (Branković, 2021).

The present study

In Figure 1, we summarize the theoretical model in which we propose that:

1. individual and group affirmations can increase openness to reduce meat consumption and consider alternative, plant-based sources of protein and lab-grown meat (Cohen and Sherman, 2014; Epton et al., 2015; Ferrer and Cohen, 2019),
2. individual affirmation would work through a reduced sense of moral reproach (Branković and Budžak, 2021), while group affirmations would reduce the perceived cultural threat (Branković, 2021), thus leading to more openness toward meat reduction communications,
3. frequency of meat consumption would negatively impact the capacity of affirmations to create more openness, that is, we expect more frequent meat eaters to be less susceptible to these inductions (Graça et al., 2015).

Materials and methods

Design

Participants were randomized into three conditions: individual affirmation, group affirmation, and no affirmation (control group). The affirmation inductions are specifically value-affirmations (McQueen and Klein, 2006). Participants were asked to rank a list of 10 values and then briefly describe a situation or example that shows how the first-ranked value is reflected in their personal (or group) experience. Participants in the control group were presented with identical tasks related to their color preferences. The experiment was pre-registered at https://aspredicted.org/km3jh.pdf.

Participants

We aimed to recruit at least 246 participants in total, as suggested by power analysis, to be able to record moderate-size effects with the power of 0.8, with the alpha level set at 0.05, using G*Power (Faul et al., 2009).

We applied two exclusion criteria: a. we excluded participants who failed to answer to the questions about values ranking and value description, as they constituted the experimental induction, b. we excluded participants who failed to answer at least 50% of the dependent variable items. We did not exclude the participants who ranked all of the values and wrote at least something in answer to the follow-up questions, however unelaborated (there were 14 such participants), as the unelaborated answers do not indicate a failure to consider the issue but rather reluctance to write complex answers. In addition, we excluded from further analyzes six participants who self-declared as vegans or vegetarians (i.e., who reported not eating any fish or meat) as the dependent variables are not meaningful measures for them. The analyzes were replicated on the whole sample, including the vegetarians and vegans, and the results were not changed.

We recruited participants using the passive snowball method (Parker et al., 2019), though sharing the link for the experiment on social media. The final sample thus included 271 participants, 66% women, aged from 17 to 65 ($M = 30.24$, $SD = 11.42$). The sample included individuals who graduated from primary school (3%), high school (16.6%), students (45%), and individuals who graduated from faculties (29.9%) or post-graduate studies (8.5%). Participants were fairly equally distributed among the conditions; there were 88 participants in the individual affirmation, 94 in the group affirmation, and 89 in the control group. Participants were randomly assigned to the conditions.

Participants were provided with informed consent prior to participation. They were informed about the general research question, that their participation was voluntary and anonymous and that they could withdraw from further participation at any time. Participants were debriefed directly after participation and were provided with the contact of the principal investigator in case they had any questions.

The study was approved by the Institutional Review Board of the Department of Psychology of the Faculty of Media and Communications in Belgrade.

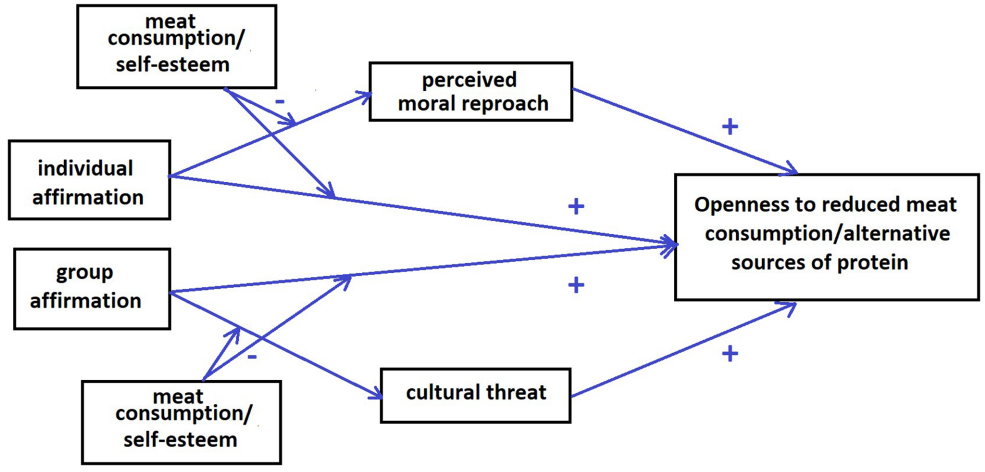


FIGURE 1
The theoretical model: The moderators and mediators of the effect of self-affirmation on the openness to meat reduction/alternative protein sources.

Procedure

The affirmation inductions

Participants in the individual/group affirmation conditions were given a list of 10 values and instructed to rank them according to their personal priority/importance to their ethnic group. We presented the following values: living in the present moment, being connected with friends and family, trust among people, loyalty and integrity, religious values, solidarity in society, sense of humor, contribution to society, democracy, and creativity. All the research team members assessed whether the values related to the threat domain and such values were excluded from the list.

After having ranked the values, we followed up with the instruction to briefly explain why the first-ranked value is of personal/group importance, for instance, to describe a situation from the personal experience or a historical event that clearly demonstrated how it is important for the individual or the group. The Control group had an identical task, except that participants ranked favorite colors and explained how this color is personally appealing, e.g., to describe an object or context in which it was appealing.

The vignette

Thereafter, we presented participants with a vignette briefly introducing health-related risks of meat consumption (e.g., higher incidence of disease), benefits of decreased consumption, as well as alternative sources of protein, including lab-grown meats. After that, participants indicated their interest in learning more about the topic, their readiness to consider their meat-eating habits, reduce their consumption of meat in the following 6 months, and how they perceive the idea of consuming alternative plant-based proteins and lab-grown meats. Participants in all three conditions read the same vignette.

Participants were instructed to carefully read the vignette as we announced that we would ask them some questions about the text at a later point. The vignette was presented in a form resembling a journal article and was 440 words long. We opted to focus on the health-related risks of meat consumption and the benefits of decreased consumption, as we believed the information could be perceived as relatively personally significant for meat-eaters. This belief is reinforced by previous studies that found that health-related messages were successful in affecting attitudes toward meat consumption (Carfora et al., 2019). To make a case for meat reduction sufficiently persuasive, we referenced a paper presenting results of medical research documenting the risks of meat consumption, as well as a nutrition expert and microbiologist to explain the logic behind the idea of lab-grown meat. The translation of the vignette is available at https://osf.io/am9xe/.

Also, we introduced the idea that meat-based protein can be replaced with plant-based sources of protein (e.g., mushrooms, peas, beans, and greens). Finally, we briefly introduced the idea of lab-grown meat, that is, how it is being manufactured and that this would be a healthier and more ethical alternative for those who wish to continue eating meat.

Measures

Ratings of the vignette

After reading the vignette, participants indicated on 10-point rating scales, ranging from 1 (*not at all*) to 10 (*very much*) the extent to which they thought the text was interesting, understandable, informative, persuasive, meaningful, thought-provoking, and stylistically accomplished. We computed a single mean score as the ratings made an internally consistent scale ($\alpha = 0.91$).

Openness to meat reduction

After that, the participants indicated on 10-point scales their (a) interest in learning more about the topic, (b) their readiness to reconsider meat consumption habits, (c) their readiness to reduce meat consumption in the following 6 months, (d) the acceptability of the idea of plant-based protein, and e. the acceptability of the idea of lab-grown meat. We conducted a principal component analysis on the items, which yielded one component that explained 70% of the variance and had high loadings from all of the items (the minimum was 0.664). We computed a mean score of openness to meat reduction ($\alpha = 0.89$).

Perceived moral reproach against non-vegetarians was measured by two items rated on 7-point scales ($\alpha = 0.82$), specifically: "Vegetarians mostly consider non-vegetarians immoral" and "If they saw me eat meat, most vegetarians would consider me immoral" (Branković and Budžak, 2021).

The cultural threat scale was based on the Vegetarianism threat scale developed by Dhont and Hodson (2014), which was translated into Serbian and previously used in research in the local context (Branković, 2021). We chose the three items with the highest factor loadings for the current study, namely: "Vegetarianism poses a threat to our country's customs and traditions," "Vegetarians and vegans should have more respect for the local traditional cuisine, which is simply based on meat," and "People who insist on a vegetarian/vegan diet spoil important family gatherings and celebrations" ($\alpha = 0.73$). We also changed the target group of the items to include both vegetarians and vegans, as previous research shows that vegans could be perceived as a more threatening group than vegetarians (Branković and Budžak, 2021).

Controls

Participants chose what best described their eating habits from the following options: (a) "I consume meat regularly," (b) "I consume meat, but try to decrease the intake," (c) "I consume meat only occasionally," (d) "I consume fish, but not other types of meat," (e) "I do not consume meat, but consume other animal products (dairy, eggs)," and (f) "I never consume meat or any products of animal origin." The item was reverse-coded so that a higher score indicates more frequent meat consumption. The measure was previously validated for the local context (Branković, 2021). The labels (e.g., omnivore, vegetarian, vegan) were intentionally omitted, as they can be understood differently by respondents (e.g., some people who claim to be vegetarian eat meat, and some people who do not eat meat prefer not to be called vegetarians). Most of our participants consume meat regularly (54.6%), 23.2% reported that they consume meat but try to decrease the intake, 18.8% consume meat occasionally, 3.3% consume fish but no other types of meat, 1.1% do not consume meat, but consume other animal products, and 1.1% never consume meat or any other products of animal origin.

Self-esteem was measured by a translated and adapted version of the scale devised by Tafarodi and Swann (2001), capturing the two aspects of a global self-evaluation, self-competence, and self-liking, e.g., "When I think about myself, I feel great." or "I never doubt my own worth". Sixteen items were rated on a 5-point scale, anchored from 1 (*do not agree at all*) to 5 (*completely agree*). We computed a single global score as the items had high inter-correlations ($\alpha = 0.90$).

TABLE 1 Descriptive statistics and correlations of the measured variables (*N*=271).

	M	SD	2	3	4	5	6	7
1. Self-esteem (1–5)	3.50	0.65	0.023	0.055	−0.034	−0.076	−0.160**	0.084
2. Ethnic identification (1–5)	2.60	1.33		0.215**	0.012	0.045	−0.053	0.048
3. Cultural threat (1–7)	2.38	1.40			−0.15*	−0.112	−0.153*	0.096
4. Perceived moral reproach (0–100)	35.53	22.89				0.061	0.114	−0.170**
5. Ratings of the vignette (1–10)	7.47	1.86					0.706**	−0.229**
6. Openness to meat reduction (1–10)	5.87	2.52						−0.383**
7. Frequency of meat consumption (1–4)	3.29	0.87						

*We report mean (*M*) and standard deviations (SD) for all of the variables measured in the first two columns, in the following columns we report their inter-correlations. *N* refers to the sample size. *$p < .05$, **$p < .01$.

TABLE 2 Openness to meat reduction and alternative protein sources (*N*=271).

	M	SD
Interest in learning more about the topic	6.08	2.83
Readiness to re-consider meat consumption habits	6.21	3.03
Readiness to reduce meat consumption in the following six months	5.92	3.15
Acceptability of the idea of plant-based protein	6.70	2.95
Acceptability of the idea of lab-grown meat	4.48	3.16

To establish the strength of ethnic identification, participants indicated how personally important they felt belonging to their ethnic group was on a scale from 1(*not at all important*) to 5 (*highly important*). The validity of the single-item measure was established in previous research in the region (Branković et al., 2020).

Analytical strategy

As pre-registered, ANOVA was used to test the differences between groups, whereas planned contrasts constituted the main tests of the hypothesis: we compared the individual and the group-affirmation condition against the control condition (1 1–2); after that, the individual and the group-affirmation condition were contrasted (1–1 0), to test for possible differences in their efficiency.

Results

Descriptive statistics

Descriptive statistics and the correlations of the variables are presented in Table 1. The mean level of self-esteem is somewhat above the theoretical mid-point, as expected from prior research. However, the level of ethnic identification, perceived vegetarianism threat, and the perceived moral reproach against meat-eaters are somewhat below the midpoint of the scale, indicating that these perceptions are not overly strong in the current sample.

The vignette was rated quite favorably, and the follow-up analysis suggests that the ratings did not differ across the experimental conditions, $F\,(2, 268) = 0.308$, $p = 0.736$. The overall index of openness to meat reduction indicated moderate levels of such openness. In Table 2, we present in more detail the expressed interest in and preparedness to reconsider meat reduction and the acceptability of alternative protein sources. We can see that participants are moderately open to both these ideas, most to considering the alternative, plant-based sources of protein and least to the idea of lab-grown meat. Notably, more frequent meat-eaters rated the vignette less favorably and expressed less openness to meat reduction in general.

Control variables

Participants in the three conditions did not differ significantly in terms of their level of self-esteem, $F\,(2, 268) = 0.68$, $p = 0.519$, the strength of ethnic identification $F\,(2, 268) = 0.51$, $p = 0.600$, or the frequency of meat consumption, $F\,(2, 268) = 2.43$, $p = 0.090$.

Test of the pre-registered hypothesis

Omnibus ANOVA did not yield significant differences, $F\,(2, 265) = 1.89$, $p = 0.153$; however, the planned contrasts described previously helped clarify these results. First, the individual and group affirmation conditions combined were significantly different compared to the control group, $t\,(265) = 1.90$, $p = 0.029$. In contrast, the individual and the group affirmation conditions were not significantly different from each other, $t\,(265) = 0.443$, $p = 0.329$. Thus, the affirmed participants expressed somewhat more openness to meat reduction and alternative sources of protein (the individually affirmed $M = 6.16$ ($SD = 2.38$), group affirmed $M = 6$ (SD = 2.72), control group $M = 5.46$ (SD = 2.39)).

Test of the moderated mediation model

As presented in Figure 1, we hypothesized that the individual affirmations would decrease perceptions of moral reproach, while the group affirmation would decrease perceptions of cultural threat. As

we revealed correlations between the outcome variable with self-esteem and the frequency of meat consumption, we also wanted to test their potential role as the moderators of the experimental inductions: people with higher self-esteem and more frequent meat consumers would be expected to be less susceptible to the affirmations.

To examine these relationships more closely, we conducted moderated mediation analysis using SPSS Process software (Hayes, 2013).

First, self-esteem did not moderate the effects of the individual affirmation on openness to meat reduction, [$b = -0.19$, SE = 1.61, 95%CI (−5.10, 1.26)] nor did the frequency of meat consumption moderate the effects of the group affirmation on openness to meat reduction, [$b = -0.0.02$, SE = 0.01, 95%CI (−0.15, 0.12)]. We also conducted a post-hoc power analysis using G*Power software (Faul et al., 2009), to check whether we had sufficient power, given the small effects. The analysis suggested 65% probability to detect a moderating effect of self-esteem and 42% probability to detect a moderating effect of the frequency of meat consumption. Having in mind the insufficient observed power, we proceeded to test the simple mediation models. Mediation was tested with 5,000 bootstrap samples, and two separate analyzes were conducted for the two presumed paths (individual affirmation to openness via moral reproach; group affirmation to openness via cultural threat perceptions).

The individual affirmation induction did not affect the perceived moral reproach, [$b = 1.25$, SE = 1.00, 95%CI (−0.71, 3.22)]. However, the perceived moral reproach had a significant effect on openness to meat reduction [$b = 0.01$, SE = 0.1, 95%CI (0.00, 0.03)]. When moral reproach was entered into the model, the induction ceased to be a significant predictor, [$b = 0.13$, SE = 0.11, 95%CI (−0.09, 0.34)]. However, we cannot conclude that the mediation is significant since the first path is not.

Similarly, group induction did not affect the perceptions of cultural threat, [$b = -0.08$, $SE = 0.06$, 95%CI (−0.20, 0.04)], whereas the perceptions of cultural threat had a marginally significant effect, ($b = -0.26$, $SE = 0.11$, 95%CI [−0.48, −0.05]). When moral reproach was entered into the model, the induction ceased to be a significant predictor, [$b = 0.04$, $SE = 0.11$, 95%CI (−0.17, 0.25)]. However, we cannot conclude that the mediation is significant since the first path is not.

Thus, our analyzes did not support the role of either perceived moral reproach or perceptions of cultural threat as mediators of the experimental inductions. Further, individual differences in self-esteem and the pre-induction frequency of meat consumption proved to have a generally negative effect on the openness to meat reduction. Their effects suppressed the effects of the experimental inductions, thus indicating significant barriers to meat reduction advocacy.

Discussion

In the current study, we presented our participants with an opportunity to affirm their individual or group values, and after that, they were given valid arguments to reconsider meat consumption. We expected that the self-affirmation procedure would help alleviate the self-relevant threats (e.g., to the morality of self or valued group traditions and identities), thus rendering participants more open to arguments about ethical issues and health-related risks of meat consumption. Our inductions produced small but significant effects, such that both affirmed groups expressed more openness to meat reduction than the control group. However, we also established that people with higher self-esteem and more frequent meat eaters are generally less open to reconsider their meat consumption, regardless of whether they are presented with persuasive messages.

Our findings align with previous research that found small positive effects of similar affirmation procedures on health–and nutrition-related habits (Epton et al., 2015; Ferrer and Cohen, 2019). However, as some previous reviews suggested (Badea and Sherman, 2019), we did not find a significant difference in the effectiveness of the individual over group-based affirmations. In our study, the expressed openness to meat-reduction arguments was highly correlated with the ratings of message persuasiveness (0.70). However, ratings of the message did not significantly differ between the experimental groups and the control group. Thus, we do not have sufficient evidence to conclude that the affirmation procedures increased the capacity for systematic processing, as suggested by the theoretical framework (Cohen and Sherman, 2014).

The presented findings thus support further study of affirmation procedures for meat-reduction communications. However, our findings also suggest at least three important caveats.

First, the effects we captured are small, and several characteristics of the persuasive message we devised could be relevant to this finding. The arguments presented were rated quite highly, so this might have produced a ceiling effect in attitude change. We opted for offering strong arguments, as the general idea behind self-affirmations is to incite more positive reactions only when valid arguments are presented. This is also ethically more acceptable as presenting weak arguments could lead to even more entrenched attitudes about the benefits of meat consumption. However, given the presumed ceiling effect, perhaps larger effects of the induction would be detected in case argument quality were also manipulated (*cf.* Petty and Cacioppo, 1986). For instance, a control group of participants who are not offered any arguments could be included to establish the base-rate reaction of meat-eaters. As even the control group read the vignette that presented valid and persuasive arguments in favor of meat reduction in the present study, this constituted a fairly strict test of the effectiveness of self-affirmation. Another relevant aspect of the message is that the arguments were supported by citing scientific sources. Perhaps larger resistance and larger potential benefits of affirmation could be expected if it were ascribed to an out-group source, e.g., a vegan activist (Hornsey and Imani, 2004).

Further, regarding the effectiveness of the individual and group-based affirmation, the current framework did not allow for a more precise matching of the underlying motivations for meat consumption, identities, and perceived threats related to meat reduction. As all of these characteristics can vary between individuals (Rosenfeld and Burrow, 2017), individual affirmations could be more relevant for those sensitive to individual self-image threats, e.g., the threat to morality. In contrast, group affirmations would be more effective for individuals with a stronger sense of cultural threat or a stronger ethnic identification. Future studies could attempt such participant-message matching to be able to identify the most promising affirmation procedures. Moreover, specific rhetoric strategies used by the animal agriculture industry should be studied within this framework for the most ecologically valid conclusions (Hannan, 2020).

In terms of the underlying processes through which affirmation procedures work to unfreeze attitudes, we hypothesized that individual affirmation would work to alleviate the perceived moral reproach related to meat consumption (Minson and Monin, 2012) while group affirmation would work through a decreased perception of cultural

threat (Branković, 2021). However, while both mediators did have a significant relation to the openness to meat reduction, neither was affected by the experimental inductions. One possible reason for this is the nature of the persuasive message we used. Specifically, the arguments presented were mainly related to health risks and benefits. Since we only touched upon the ethical issues and did not consider the social and cultural context of meat consumption in the message, perhaps the underlying reasoning or affective processes were not sufficiently generalized to these issues, as their relationship had not been made salient. Thus, future studies need to conceptualize the procedures and mediating processes at a more specific level.

Finally, our findings show that there are important limitations as to the effectiveness of affirmation procedures, and both self-esteem and the previous frequency of meat consumption emerged as significant negative predictors of the openness to meat reduction. Previous literature suggests that mostly lower self-esteem recipients can experience the strongest effects of self-affirmation procedures (McQueen and Klein, 2006). Our findings are generally consistent with this, although we did not have sufficient power to detect a moderation effect. We presume this is because participants with higher self-esteem typically have more effective defensive strategies and, therefore, can rely on their own psychological resources to alleviate self-threats that emerge in meat-reduction communications. Alternatively put, lower self-esteem participants could experience the most benefit from self-affirmation. This point is to be further corroborated in future research.

Further, more frequent meat eaters are also less susceptible to persuasion attempts, even when the arguments are valid and they have been provided with the opportunity to affirm their self-integrity. Such resistance is interpretable as an effect of personal involvement and the consequent biased processing (Kunda, 1990; Zuwerink and Devine, 1996) and is in line with previous studies demonstrating the role of meat attachment (Graça et al., 2015; Roozen and Raedts, 2022). Presumably, frequent meat eaters are more motivated to be defensive toward meat-reduction communications, but they could also have more elaborated or stronger counter-attitudes or justifications (Piazza et al., 2015). In effect, self-affirmation does not appear as a promising path to unfreezing attitudes in this group of participants. For them, other approaches should be tested, such as the availability of plant-based options that could be shown as sufficiently attractive in the first place (Lehner et al., 2016; Kurz, 2018) or paradoxical interventions that have proven useful in unfreezing resistant attitudes in different domains (Bar-Tal and Hameiri, 2020). Furthermore, it has been proposed that meat justifications can be rooted in a broader irrational worldview (Hannan, 2020), and potential underlying irrational beliefs should be further studied.

Despite the limitations, our study does lend preliminary support to the usefulness of self-affirmation procedures, although their effects should be specified through further research. Presumably, self-affirmations are to be combined with other interventions to be effective, for instance, as a first step in creating room for discussion. In the present study, we opted for the most commonly used procedure to induce affirmation, writing about one's values (McQueen and Klein, 2006). However, other procedures might be more suited for the issue of meat reduction and should be further tested. We also relied on health-related arguments for meat reduction, but other types of content and arguments should also be investigated. Given the predominance of the health-related association in the perception of vegetarians and vegans suggested by previous research (Branković and Budžak, 2021), we thought this would constitute relevant content for the persuasive message. However, ethical and moral issues could be the ones most directly related to self-integrity and the experienced self-that (Cohen and Sherman, 2014), so perhaps self-affirmations could play an even more prominent role in such cases.

Against the general backdrop of meat-reduction efforts and barriers, this study is the first to test the potential of the self-affirmation approach. Given the importance of meat reduction to the well-being of humans, other animals, and the environment (Pinillos et al., 2016; Weis, 2021), we hope these findings help understand and devise more effective policies and communications and inspire further research.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by Institutional Review Board of the Department of Psychology of the Faculty of Media and Communications, Singidunum University in Belgrade. The patients/participants provided their written informed consent to participate in this study.

Author contributions

MB, AB, NT, and JJ contributed to the study's conceptualization, design, and data collection. MB conducted the analyzes and prepared the manuscript. All authors contributed to the article and approved the submitted version.

Funding

This research was supported by the European Association of Social Psychology extraordinary grant, Social Psychology Ambassadors, awarded to the MB.

Acknowledgments

We would like to thank our colleagues, Anja Pejović and Bogdan Lazarević, for their help with data collection.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

Abete, I., Romaguera, D., Vieira, A. R., de Munain, A. L., and Norat, T. (2014). Association between total, processed, red and white meat consumption and all-cause, CVD and IHD mortality: a meta-analysis of cohort studies. *Br. J. Nutr.* 112, 762–775. doi: 10.1017/S000711451400124X

Allen, M. W., and Ng, S. H. (2003). Human values, utilitarian benefits and identification: the case of meat. *Eur. J. Soc. Psychol.* 33, 37–56. doi: 10.1002/ejsp.128

Amiot, C. E., El Hajj, B. G., Sukhanova, K., and Karelis, A. D. (2018). Testing a novel multicomponent intervention to reduce meat consumption in young men. *PLoS One* 13:e0204590. doi: 10.1371/journal.pone.0204590

Auger, B., and Amiot, C. E. (2019). The impact of imagined contact in the realm of human-animal relations: Investigating a superordinate generalization effect involving both valued and devalued animals. *J. Exp. Soc. Psychol.* 85:103872. doi: 10.1016/j.jesp.2019.103872

Badea, C., and Sherman, D. K. (2019). Self-affirmation and prejudice reduction: when and why? *Curr. Dir. Psychol. Sci.* 28, 40–46. doi: 10.1177/0963721418807705

Bar-Tal, D., and Hameiri, B. (2020). Interventions to change well-anchored attitudes in the context of intergroup conflict. *Soc. Personal. Psychol. Compass* 14:e12534. doi: 10.1111/spc3.12534

Bastian, B., and Loughnan, S. (2017). Resolving the meat-paradox: a motivational account of morally troublesome behavior and its maintenance. *Personal. Soc. Psychol. Rev.* 21, 278–299. doi: 10.1177/1088868316647562

Berners-Lee, M., Hoolohan, C., Cammack, H., and Hewitt, C. N. (2012). The relative greenhouse gas impacts of realistic dietary choices. *Energy Policy* 43, 184–190. doi: 10.1016/j.enpol.2011.12.054

Branković, M. (2021). What we eat is who we are: the role of ethnic attachment as an ideological base of animal exploitation. *Anthrozoös* 34, 321–338. doi: 10.1080/08927936.2021.1898216

Branković, M., and Budžak, A. (2021). *The Healthy, Yet Unhealthy Choice: Contents and Positivity of Stereotypes about Vegetarians and Vegans in a Meat-eating Culture*. Available at: https://psyarxiv.com/.

Branković, M., Žeželj, I., and Turjačanin, V. (2020). How knowing others makes us more inclusive: social identity inclusiveness mediates the effects of contact on out-group acceptance. *J. Theor. Soc. Psychol.* 4, 95–106. doi: 10.1002/jts5.60

Bryant, C. J. (2019). We can't keep meating like this: attitudes towards vegetarian and vegan diets in the United Kingdom. *Sustainability* 11:6844. doi: 10.3390/su11236844

Budžak, A., and Branković, M. (2022). The traditional vegetarians–improving attitudes toward vegetarians through emphasizing similarities between vegetarianism and traditional fasting. *J. Soc. Psychol.* 3, 1–13. doi: 10.1080/00224545.2022.2139216

Carfora, V., Caso, D., and Conner, M. (2017). Correlational study and randomised controlled trial for understanding and changing red meat consumption: the role of eating identities. *Soc. Sci. Med.* 175, 244–252. doi: 10.1016/j.socscimed.2017.01.005

Carfora, V., Catellani, P., Caso, D., and Conner, M. (2019). How to reduce red and processed meat consumption by daily text messages targeting environment or health benefits. *J. Environ. Psychol.* 65:101319. doi: 10.1016/j.jenvp.2019.101319

Čehajić-Clancy, S., Effron, D. A., Halperin, E., Liberman, V., and Ross, L. D. (2011). Affirmation, acknowledgment of in-group responsibility, group-based guilt, and support for reparative measures. *J. Pers. Soc. Psychol.* 101, 256–270. doi: 10.1037/a0023936

Cohen, G. L., and Sherman, D. K. (2014). The psychology of change: self-affirmation and social psychological intervention. *Annu. Rev. Psychol.* 65, 333–371. doi: 10.1146/annurev-psych-010213-115137

Cordts, A., Nitzko, S., and Spiller, A. (2014). Consumer response to negative information on meat consumption in Germany. *Int. Food Agribus. Manage. Rev.* 17, 83–106. doi: 10.22004/ag.econ.164599

Dhont, K., and Hodson, G. (2014). Why do right-wing adherents engage in more animal exploitation and meat consumption? *Personal. Individ. Differ.* 64, 12–17. doi: 10.1016/j.paid.2014.02.002

Dhont, K., Hodson, G., and Leite, A. C. (2016). Common ideological roots of speciesism and generalized ethnic prejudice: the social dominance human–animal relations model (SD-HARM). *Eur. J. Personal.* 30, 507–522. doi: 10.1002/per.2069

Dowsett, E., Semmler, C., Bray, H., Ankeny, R. A., and Chur-Hansen, A. (2018). Neutralising the meat paradox: cognitive dissonance, gender, and eating animals. *Appetite* 123, 280–288. doi: 10.1016/j.appet.2018.01.005

Epton, T., Harris, P. R., Kane, R., van Koningsbruggen, G. M., and Sheeran, P. (2015). The impact of self-affirmation on health-behavior change: a meta-analysis. *Health Psychol.* 34, 187–196. doi: 10.1037/hea0000116

Farvid, M. S., Sidahmed, E., Spence, N. D., Mante Angua, K., Rosner, B. A., and Barnett, J. B. (2021). Consumption of red meat and processed meat and cancer incidence: a systematic review and meta-analysis of prospective studies. *Eur. J. Epidemiol.* 36, 937–951. doi: 10.1007/s10654-021-00741-9

Faul, F., Erdfelder, E., Buchner, A., and Lang, A. G. (2009). Statistical power analyses using G* power 3.1: tests for correlation and regression analyses. *Behav. Res. Methods* 41, 1149–1160. doi: 10.3758/BRM.41.4.1149

Fein, S., and Spencer, S. J. (1997). Prejudice as self-image maintenance: affirming the self through derogating others. *J. Pers. Soc. Psychol.* 73, 31–44. doi: 10.1037/0022-3514.73.1.31

Ferrer, R. A., and Cohen, G. L. (2019). Reconceptualizing self-affirmation with the trigger and channel framework: lessons from the health domain. *Personal. Soc. Psychol. Rev.* 23, 285–304. doi: 10.1177/1088868318797036

Graça, J., Calheiros, M. M., and Oliveira, A. (2015). Attached to meat?(un) willingness and intentions to adopt a more plant-based diet. *Appetite* 95, 113–125. doi: 10.1016/j.appet.2015.06.024

Grundy, E. A., Slattery, P., Saeri, A. K., Watkins, K., Houlden, T., Farr, N., et al. (2021). Interventions that influence animal-product consumption: a meta-review. *Future Foods* 2022:100111. doi: 10.1016/j.fufo.2021.100111

Haider, L. M., Schwingshackl, L., Hoffmann, G., and Ekmekcioglu, C. (2018). The effect of vegetarian diets on iron status in adults: a systematic review and meta-analysis. *Crit. Rev. Food Sci. Nutr.* 58, 1359–1374. doi: 10.1080/10408398.2016.1259210

Hannan, J. (2020). *Meatsplaining: The Animal Agriculture Industry and the Rhetoric of Denial*. Sydney, Australia: Sydney University Press.

Harris, P. R., Brearley, I., Sheeran, P., Barker, M., Klein, W. M., Creswell, J. D., et al. (2014). Combining self-affirmation with implementation intentions to promote fruit and vegetable consumption. *Health Psychol.* 33, 729–736. doi: 10.1037/hea0000065

Harris, P. R., and Napper, L. (2005). Self-affirmation and the biased processing of threatening health-risk information. *Personal. Soc. Psychol. Bull.* 31, 1250–1263. doi: 10.1177/0146167205274694

Hayes, A. F. (2013). *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*. New York: Guilford Press.

Hornsey, M. J., and Imani, A. (2004). Criticizing groups from the inside and the outside: an identity perspective on the intergroup sensitivity effect. *Personal. Soc. Psychol. Bull.* 30, 365–383. doi: 10.1177/0146167203261295

Hyers, L. L. (2006). Myths used to legitimize the exploitation of animals: an application of social dominance theory. *Anthrozoös* 19, 194–210. doi: 10.2752/089279306785415538

Klein, W. M. P., and Harris, P. R. (2009). Self-affirmation enhances attentional bias toward threatening components of a persuasive message. *Psychol. Sci.* 20, 1463–1467. doi: 10.1111/j.1467-9280.2009.02467.x

Kristensen, N. B., Madsen, M. L., Hansen, T. H., Allin, K. H., Hoppe, C., Fagt, S., et al. (2015). Intake of macro-and micronutrients in Danish vegans. *Nutr. J.* 14, 1–10. doi: 10.1186/s12937-015-0103-3

Kunda, Z. (1990). The case for motivated reasoning. *Psychol. Bull.* 108, 480–498. doi: 10.1037/0033-2909.108.3.480

Kunst, J. R., and Hohle, S. M. (2016). Meat eaters by dissociation: how we present, prepare and talk about meat increases willingness to eat meat by reducing empathy and disgust. *Appetite* 105, 758–774. doi: 10.1016/j.appet.2016.07.009

Kurz, V. (2018). Nudging to reduce meat consumption: immediate and persistent effects of an intervention at a university restaurant. *J. Environ. Econ. Manag.* 90, 317–341. doi: 10.1016/j.jeem.2018.06.005

Kwasny, T., Dobernig, K., and Riefler, P. (2022). Towards reduced meat consumption: a systematic literature review of intervention effectiveness, 2001–2019. *Appetite* 168:105739. doi: 10.1016/j.appet.2021.105739

Lehner, M., Mont, O., and Heiskanen, E. (2016). Nudging–a promising tool for sustainable consumption behaviour? *J. Clean. Prod.* 134, 166–177. doi: 10.1016/j.jclepro.2015.11.086

Loughnan, S., Bastian, B., and Haslam, N. (2014). The psychology of eating animals. *Curr. Dir. Psychol. Sci.* 23, 104–108. doi: 10.1177/0963721414525781

Macdiarmid, J. I., Douglas, F., and Campbell, J. (2016). Eating like there's no tomorrow: Public awareness of the environmental impact of food and reluctance to eat less meat as part of a sustainable diet. *Appetite* 96, 487–493. doi: 10.1016/j.appet.2015.10.011

MacInnis, C. C., and Hodson, G. (2017). It ain't easy eating greens: evidence of bias toward vegetarians and vegans from both source and target. *Group Process. Intergroup Relat.* 20, 721–744. doi: 10.1177/1368430215618253

McQueen, A., and Klein, W. M. (2006). Experimental manipulations of self-affirmation: a systematic review. *Self Identity* 5, 289–354. doi: 10.1080/15298860600805325

Minson, J. A., and Monin, B. (2012). Do-gooder derogation: disparaging morally motivated minorities to defuse anticipated reproach. *Soc. Psychol. Personal. Sci.* 3, 200–207. doi: 10.1177/1948550611415695

Parker, C., Scott, S., and Geddes, A. (2019). *Snowball Sampling*. Thousand Oaks, CA: SAGE research methods foundations.

Petty, R. E., and Cacioppo, J. T. (1986). "The elaboration likelihood model of persuasion" in *Communication and Persuasion*. eds. J. T. Cacioppo and R. E. Petty (New York: Springer), 1–24.

Piazza, J., Ruby, M. B., Loughnan, S., Luong, M., Kulik, J., Watkins, H. M., et al. (2015). Rationalizing meat consumption. The 4Ns. *Appetite* 91, 114–128. doi: 10.1016/j.appet.2015.04.011

Pinillos, R. G., Appleby, M. C., Manteca, X., Scott-Park, F., Smith, C., and Velarde, A. (2016). One welfare – a platform for improving human and animal welfare. *Vet. Rec.* 179, 412–413. doi: 10.1136/vr.i5470

Report on Strengthening Europe in the Fight Against Cancer. (2022). *Report on Strengthening Europe in the Fight Against Cancer–Towards a Comprehensive and Coordinated Strategy*. European Parliament, A9-0001/2022.

Roozen, I., and Raedts, M. (2022). What determines omnivores' meat consumption and their willingness to reduce the amount of meat they eat? *Nutr. Health* 02601060221080255:026010602210802. doi: 10.1177/02601060221080255

Rosenfeld, D. L. (2018). The psychology of vegetarianism: recent advances and future directions. *Appetite* 131, 125–138. doi: 10.1016/j.appet.2018.09.011

Rosenfeld, D. L., and Burrow, A. L. (2017). The unified model of vegetarian identity: a conceptual framework for understanding plant-based food choices. *Appetite* 112, 78–95. doi: 10.1016/j.appet.2017.01.017

Rothgerber, H. (2013). Real men don't eat (vegetable) quiche: masculinity and the justification of meat consumption. *Psychol. Men Masculinity* 14, 363–375. doi: 10.1037/a0030379

Schüpbach, R., Wegmüller, R., Berguerand, C., Bui, M., and Herter-Aeberli, I. (2017). Micronutrient status and intake in omnivores, vegetarians and vegans in Switzerland. *Eur. J. Nutr.* 56, 283–293. doi: 10.1007/s00394-015-1079-7

Shafiullah, M., Khalid, U., and Shahbaz, M. (2021). Does meat consumption exacerbate greenhouse gas emissions? Evidence from US data. *Environ. Sci. Pollut. Res.* 28, 11415–11429. doi: 10.1007/s11356-020-11331-9

Sherman, D. K. (2013). Self-affirmation: understanding the effects. *Soc. Personal. Psychol. Compass* 7, 834–845. doi: 10.1111/spc3.12072

Sherman, D. K., and Cohen, G. L. (2006). "The psychology of self-defense: self-affirmation theory" in *Advances in Experimental Social Psychology*. ed. M. P. Zanna, vol. *38* (San Diego, CA: Academic Press), 183–242.

Sherman, D. K., Kinias, Z., Major, B., Kim, H. S., and Prenovost, M. (2007). The group as a resource: reducing biased attributions for group success and failure via group affirmation. *Personal. Soc. Psychol. Bull.* 33, 1100–1112. doi: 10.1177/0146167207303027

Singer, P. (1975/2009). *Animal Liberation*. New York: HarperCollins Publishers.

Steele, C. M. (1988). "The psychology of self-affirmation: sustaining the integrity of the self" in *Advances in Experimental Social Psychology*. ed. L. Berkowitz, vol. *21* (New York: Academic Press), 261–302.

Tafarodi, R. W., and Swann, W. B.Jr. (2001). Two-dimensional self-esteem: theory and measurement. *Personal. Individ. Differ.* 31, 653–673. doi: 10.1016/S0191-8869(00)00169-0

Thornton, P., and Herrero, M. (2010). *The Inter-Linkages between Rapid Growth in Livestock Production, Climate Change, and the Impacts on Water Resources, Land Use, and Deforestation*. World Bank Policy Research Working Paper, No. 5178.

Tilman, D., and Clark, M. (2014). Global diets link environmental sustainability and human health. *Nature* 515, 518–522. doi: 10.1038/nature13959

Torti, J. M. (2017). *The Social and Psychological Well-being of Vegetarians: A Focused Ethnography*. Doctoral Dissertation, University of Alberta. Available at: https://era.library.ualberta.ca/items/b2a600a6-c3d1-40b8-9cc6-3e699f9a157a).

Weis, T. (2021). "Meatification" in *Handbook of Critical Agrarian Studies*. eds. A. H. Akram-Lodhi, K. Dietz, B. Engels and B. M. McKay (Cheltenham, UK: Edward Elgar Publishing), 561–567.

Zuwerink, J. R., and Devine, P. G. (1996). Attitude importance and resistance to persuasion: It's not just the thought that counts. *J. Pers. Soc. Psychol.* 70, 931–944. doi: 10.1037/0022-3514.70.5.931

frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 23 June 2023
DOI 10.3389/fpsyg.2023.1021013

OPEN ACCESS

EDITED BY
Jared Piazza,
Lancaster University, United Kingdom

REVIEWED BY
Ammar Redza Ahmad Rizal,
National University of Malaysia, Malaysia
Christopher J. Hopwood,
University of Zurich, Switzerland

*CORRESPONDENCE
Sparsha Saha
✉ saha@fas.harvard.edu

RECEIVED 12 September 2022
ACCEPTED 30 May 2023
PUBLISHED 23 June 2023

CITATION
Saha S (2023) Why don't politicians talk about meat? The political psychology of human-animal relations in elections. *Front. Psychol.* 14:1021013. doi: 10.3389/fpsyg.2023.1021013

Why don't politicians talk about meat? The political psychology of human-animal relations in elections

Sparsha Saha*

Department of Government, Harvard University, Cambridge, MA, United States

Building on literature from political science and psychology, I argue that political attention on animals and animal-friendly political candidates cause voter backlash. I test this using two different kinds of experiments with large, representative samples. I ask respondents to consider political candidates running for office in a U.S. presidential primary context. I find that, overall, political attention on the need to reduce meat consumption for environmental reasons caused voter backlash compared to both a control condition and attention on the need to reduce reliance on gasoline-powered vehicles (also for environmental reasons). But, the heterogeneous effects of partisan identification were strong: voter backlash was mainly driven by Republicans and Democrats were neutral. Surprisingly, candidates who put attention on farm animal rights during elections faced no voter backlash from Republicans or Democrats. Animal-friendly candidates, particularly Black women and Latinas, with attributes that demonstrate personal concern for farm animals and strong support for animal rights generally fared very well in elections, receiving large boosts in voter support. This work launches a research agenda in political psychology that "brings the animal in" to politics.

KEYWORDS

political behavior, meat, political psychology, voters, animal rights, politicians, social norms, leaders

Introduction

Most scientists now agree that our climate change goals will not be met without addressing food, particularly animal products (Weathers and Hermanns, 2017; Shukla et al., 2019; Clark et al., 2020; Harwatt et al., 2020). According to the FAO, the livestock supply chain represents 11–20% of total global GHG emissions (GLEAM[1]; Poore and Nemecek, 2018; Gerber et al., 2013; Xu et al., 2021; Tubiello et al., 2022). In the United States, a dietary shift to plant-based foods has the potential to reduce food's emissions by 61–73% due to American over-consumption of meat (Poore and Nemecek, 2018). Animal-based foods also involve tremendous land-system changes: 83% of the world's farmland is used to produce meat, aquaculture, eggs, and dairy, yet these outputs provide just 18% of all calories and 37% of all protein globally produced (Poore and Nemecek, 2018). In the United States, where 41% of all land in the contiguous states is used for livestock (pasture and cropland) (Merrill and Leatherby, 2018[2]), there is great opportunity if the diet-land-climate change nexus is recognized (Eshel et al., 2019) due to livestock's enormous carbon opportunity cost (Hayek et al., 2021). As the main driver of natural habitat loss worldwide and the largest anthropogenic land use type, the production of animal-based

1 https://www.fao.org/gleam/en/

2 Based on data from the U.S. Department of Agriculture's Economic Research Service, "Major Uses of Land in the United States." https://www.ers.usda.gov/data-products/major-land-uses/.

foods (including commercial fishing) is likely the leading cause of modern species extinctions (Steinfeld et al., 2006; Machovina et al., 2015; Díaz et al., 2019). In Central US (and other hotspots in China and India), the planetary boundary for freshwater use has been exceeded already *due to* livestock (Leng and Hall, 2021; see also, Richter et al., 2020; Mekonnen and Hoekstra, 2012).

But, despite the large environmental costs of animal-based foods, governments have done little if nothing to address this issue. In the U.S. context, the very opposite has been the case with growing subsidies that facilitate the production of cheap meat (Howard, 2019; Sewell, 2019), legislative restrictions that exclude factory farms from having to report their emissions and waste to the EPA (Miller and Muren, 2019), and a virtual lack of policy to address the need to reduce American over-consumption of meat. Even the progressive left, which we might expect to be the most vocal given their environmental agenda, has barely acknowledged the role that animal agriculture plays in climate change and other critical environmental areas like biodiversity loss.

To transition away from environmentally costly animal-based foods and ensure food and water sustainability in the future, scholars argue that political leaders have to play a role (Fuchs et al., 2016; Moberg et al., 2021). Yet, scientists are surprised that there is so much political reticence around meat given the dire need to address the health and environmental problems associated with producing it, "Politicians and policy makers demonstrate little, if any, interest in strategies to reduce meat consumption and to encourage more sustainable eating practices" (Dagevos and Voordouw, 2013; see also Springmann et al., 2017). What explains this lack of attention from policymakers? I test one reason that is usually assumed to be true in public and scholarly discussions of meat and politics in the U.S. context: voter backlash. The common wisdom in political science is that environmental issues are "vote losing" (Bodansky, 2007; Carter and Ockwell, 2007; Ockwell et al., 2009; Rabe and Borick, 2012), yet this might not be the case for all types of voters, particularly Democrats (Merkley and Stecula, 2018; Fiorino, 2022). To the best of the author's knowledge, this is the first work in political science to examine whether political attention on a particular environmental issue area—meat—is vote-losing by exploring voter evaluations of a hypothetical U.S. presidential primary candidate who puts this topic on his formal political agenda in an election context.

Strategies to encourage people to eat less meat include "nudges" that restructure the physical environment (Garnett et al., 2019) and direct appeals based on environmental and/or health information (Bianchi et al., 2018; Jalil et al., 2020; Wolstenholme et al., 2020), but there has been much less attention on the effectiveness of moral appeals related to animal rights (Bianchi et al., 2018). According to a recent meta-analysis, appeals to farm animal welfare did reduce meat consumption with large effects (RR = 1.22 with $p < 0.05$, Mathur et al., 2021). To the best of the author's knowledge, there is no experimental work in political science that assesses how political leaders might fare among voters if they use moral appeals about animal rights. The common wisdom from work in political theory is that animal rights is seen as electorally costly and thus avoided in the politics of Western nations because of "the perception that advocating for animal rights will end up harming the struggles of other disadvantaged groups" (Kymlicka and Donaldson, 2014, p. 118). Given the promise of moral appeals to reduce meat consumption (Palomo-Vélez et al., 2018), and the fact that, in reality, it is minoritized communities in the United States who bear the brunt of industrialized animal agriculture's environmental and health costs (Guenther et al., 2005; Nicole, 2013; Son et al., 2021), I also examine voter evaluations of hypothetical political candidates who put political attention on animal rights and who have animal-friendly attributes associated with animal rights (like veganism, for example) in a U.S. presidential primary context.

Study 1 employs a vignette experiment to investigate whether political attention on meat's environmental costs or animal rights engenders voter backlash in a presidential primary context. In Study 2, I use a conjoint experiment, which allows me to vary the race and gender of the hypothetical political candidate running in the presidential primary, to explore more fully the surprising result of the first study (i.e., no voter backlash from Democrats *or* Republicans against a candidate who puts attention on animal rights) by measuring voter evaluations of the kinds of candidates most likely to put animals on the political agenda.

Where's the beef in U.S. politics?

Despite the significant and growing costs of animal agriculture, there has been virtually no development of policies that would reduce this sector's impact. Policy options for governmental action on this issue range from taxation to induced innovation (and many more; see Global Panel on Agriculture and Food Systems for Nutrition, 2020 for overview). But, when even low cost or "negative" cost proposals are not adopted (Wreford et al., 2017), the problem of *inattention*, not lack of action, is necessary to solve first before policymakers can begin to sort out which recommended actions should be or could be implemented.

Study 1 focuses on the electoral effects of political attention on animals. I use the phrase "political attention on animals" throughout the rest of the paper to refer to attention on two areas—meat's environmental costs and farm animal rights. Study 1 includes two treatment conditions that test the effects of attention on both of these areas, which previous research shows can lead to individuals indicating that they intend to reduce their meat consumption.

Political attention is a type of public agenda setting—the process through which political actors prioritize information, such that "attention [is] allocated to some problems rather than others" (Jones and Baumgartner, 2005, p. 8–9). This kind of political attention is distinguished from other forms of attention from policymakers, like supporting public investment in the alternative proteins sector through congressional appropriations and/or other less publicized methods (see, for e.g., The Good Food Institute's strategic plans, which highlight some of this work).[3] Political actors can engage in agenda-setting in multiple ways (Jones and Baumgartner, 2005), and elections often serve as focal points, when media and public engagement is high (Johnson, 2013). During elections, candidates and parties convey messaging around their

3 https://gfi.org/wp-content/uploads/2021/09/GFI-Strategic-Plan-v.7-Aug-2021-1.pdf

planned agenda through a host of platforms, including television advertising (Sweetser et al., 2008), press releases (Tedesco, 2005), party manifestos (Gabel and Huber, 2000), and speeches (Laver et al., 2003; Oliver and Rahn, 2016). Existing work in political attention relies heavily on political speeches and manifestos, in particular (Jennings and John, 2009; Hemphill and Schöpke-Gonzalez, 2020). For this reason, I use an experiment in Study 1 involving a hypothetical political candidate's stump speech as a way of cuing public political attention to measure voter reactions.

Study 2 investigates the electoral effects of various attributes commonly associated with candidates who are most likely to put political attention on animals: vegan dietary preference, strong support for animal rights, and personal concern for farm animals (in particular). Conjoint analysis, used in Study 2, allows for tests of multiple hypotheses by independently randomizing numerous candidate characteristics in a single experiment. Most relevant to this topic is the gender and race of the hypothetical political candidate. Given that the issue of animal rights is avoided by American policymakers due to a fear that taking it up might harm the interests of disadvantaged human subgroups (Kymlicka and Donaldson, 2014), and that women comprise the vast majority of animal rights activists (Gaarder, 2011), it is possible that the electoral effects of animal-friendly attributes depend on the gender and race of the political candidate, making intersectional analysis highly relevant to understanding how voters might react.

The political basis of voter backlash

There are some obvious explanations for the political reluctance to address meat in the United States. The meat industry in the United States is a centralized and powerful political force, wielding both regulatory and legislative influence. Special interests and lobbying groups in this sector have spent millions supporting policies and candidates who are friendly to public investments in and virtually no regulation of meat that keep prices well below true environmental and social costs (Nestle, 2013; Simon, 2013; Lazarus et al., 2021). Yet, compared to other large corporations who spread lots of money around, the meat industry "targets their approach to a small number of key lawmakers and regulators that have a direct impact on their business interests" (Johnson, 2016, p. 1). This targeted approach, which has been very successful, nonetheless implies that not all politicians are constrained by the powerful meat industry in the United States.

What is surprising then is the virtual universality of this political reticence in the United States, from even those who do not receive support from the meat industry and also those who have centered the environment on their agendas on the far left. For example, amongst those who do not receive support from the meat industry are key (national-level) vegan/vegetarian politicians, including Cory Booker, Tulsi Gabbard, Jamie Raskin, and Adam Schiff. None of these politicians have ever formally included meat and/or animal rights on their political agendas during elections. On the far left, despite the long time relevance of the environment to progressive politicians, the Green New Deal does not even once directly mention animal agriculture, beef, or livestock, though it explicitly addresses vehicles, transit, power grids, rail, and manufacturing (H.Res.109, 2019). An accompanying official document to the Green New Deal did reference cows, but it was quickly redacted.

While important and revealing, economic reasons, by themselves, are insufficient to explain the totality of this lack of political attention in the United States. But, what about political explanations? The notion that bringing up this topic is vote-losing has been assumed to be true in news coverage, particularly by public opinion leaders like Bill Gates (Temple, 2021), Steven Chu (McMahon, 2019), and Michael Pollan (Pollan, 2011). My fieldwork has also confirmed this sentiment: key policymakers who might otherwise be receptive to talking about meat or farm animals are concerned about how voters might react.[4] Historically, Rude (2016b) argues that it was the American passion for beef that caused the Democrats to lose control of Congress in 1946 (for the first time in 16 years), widely known as the "Beefsteak Election." Even though the economy was soaring, President Truman's imposition of a price ceiling on meat led to a meat shortage that caused a public uproar: "Using their rights as free citizens, voters went to the polls in 1946 declaring *no meat — no vote*" (Rude, 2016a). More recently, Kamala Harris (Blum, 2020) and Alexandria Ocasio-Cortez (Remnick, 2019) have both been accused by Republicans of trying to "*take hamburgers away*," even though they have avoided the topic formally. Outside of the United States, similar patterns have emerged: a Spanish politician (Burgen, 2022) and a French Mayor (Cohen, 2021) who faced backlash because of their comments that linked meat to the environmental crisis. In 2012, a fat tax (effectively a meat and dairy tax) in Denmark was repealed after just 1 year due to unprecedented public and private sector fallout (Bødker et al., 2015).

Political scientists widely view the environment as "bad politics" (Bodansky, 2007). Broadly, some scholars argue that climate policies designed to curb fossil fuel use are perceived by some voters as financially costly (Hann, 1986; Carter and Ockwell, 2007; Rabe and Borick, 2012). Through this economic lens, the implication is that there might likely be broad or diffuse public support for political attention on climate change (Aldy et al., 2012; Ansolabehere and Konisky, 2016; Carmack et al., 2022), but concentrated or strong opposition to it in the specific areas or industries where the costs are imposed, which can lead to voter backlash against incumbent governments that is spatially distributed (Stokes, 2016). To the author's knowledge, there has been no experimental testing in the candidate evaluation literature within American Political Science to examine the effects of (proposed) climate policies on voter support during elections.

Political psychologists challenge the notion that climate policy has diffuse public support. Using this lens, voter support for a political candidate who centers an environmental agenda would strongly depend on partisanship. Public attitudes toward climate politics are polarized, with more negative attitudes among Republicans than Democrats (Van Boven et al., 2018;

4 Based on conversations with or questions posed to Good Food Institute on January 18th 2022, Animal Justice on April 27th 2022, Social Compassion in Legislation on May 5th 2022, a political candidate running for office at the state level (New England) on April 11th 2022, and The Humane League on May 19th 2022.

Fiorino, 2022). In the United States, compared to Republicans, Democrats show higher levels of knowledge about the environment (Stoutenborough and Vedlitz, 2014) and are generally more receptive to scientific messaging around climate change (Gauchat, 2012; MacInnis and Krosnick, 2020). The main psychological mechanism to explain climate change attitude polarization based on political identification is motivated reasoning (Bayes and Druckman, 2021), which involves people using information that confirms their existing beliefs (related to their partisan identity) and rejecting that which contradicts them (Clayton and Manning, 2018). For Republican voters, skepticism about the existence or scale of climate change, and (more generally) lower pro-environmental beliefs and attitudes (Gifford and Nilsson, 2014), is explained by a higher anthropocentric worldview (Fortuna et al., 2021), as well as exacerbating top-down influences of conservative and well-funded political elites on their climate opinions (Skocpol and Hertel-Fernandez, 2016; Hahnel et al., 2020).

The transportation sector in the United States provides evidence toward the spatially distributed nature of voter support for political attention on fossil fuels, as well as heterogeneous effects on it based on partisanship. Considerable political attention on the negative impacts of traditional modes of transportation like cars on climate change has led to meaningful policy changes and greater public funding for developing and scaling up alternatives (Meckling and Nahm, 2018). But, while there could be broad or general voter support for a climate agenda that tackles transportation's role in climate change, there is certainly voter backlash in places where the costs of this fossil fuel phase-out are concentrated (Egli et al., 2022). In addition, public support for phasing out fossil fuel cars depends on party identification: the vast majority of Democrats (~70%) support the implementation of phase-out policies in 2020, but less than 50% of Republicans do so (Rinscheid et al., 2020). Using a social identity framework, Sintov et al. (2020) argue that significantly lower electric vehicle (EV) adoption among Republicans is due to their weaker symbolic attribute perceptions, or the extent to which EVs reinforce aspects of their self-identity as *Republican*.

However, there is a dearth of any work in the various fields of political science on the environmental politics of meat, in particular. Meat presents a potential challenge to the distributional analysis conducted by political economists, making it unlikely that there would be broad voter support for political attention on the environmental costs of meat, because the vast majority of Americans over-consume large quantities of animal-based foods (Willett et al., 2019) and exhibit high levels of attachment to the symbolic value of meat in their social and cultural lives (Heinz and Lee, 1998; Nguyen and Platow, 2021). In addition, Americans exhibit low levels of knowledge about the environmental impacts of animal-based foods (Camilleri et al., 2019). Still, it is likely that voters in rural areas, where factory farms and slaughterhouses tend to be located, may be most opposed to putting meat on the political agenda because it is in these areas where the costs of lower meat consumption would be concentrated.

The work on climate politics and fossil fuels in political psychology suggests that voter support for political attention on meat's environmental impacts will also depend on partisan identity. Using a large sample of survey data, Mosier and Rimal (2020) find that Democrats are significantly more likely to report a vegan or vegetarian-based diet compared to Republicans. This could be because conservatives in the U.S. are more attached to meat compared to liberals due to feeling less concern about social justice and less supported socially for diet changes (Hodson and Earle, 2018). Another possible explanation concerns "food neophobia" or the reluctance to eat unfamiliar foods, which is higher among conservatives (than liberals) because they tend to hold more negative attitudes toward those outside their social identity (Guidetti et al., 2022). This partisan underpinning of identification with meat is playing out in U.S. national politics with more fervor than ever before: "I will NEVER eat one of those FAKE burgers made in a LAB. Eat too many and you'll turn into a SOCIALIST DEMOCRAT. Real BEEF for me!!" (Tweet on November 5th 2022 from Representative Ronny Jackson, Texas's 13th district).

Political attention on (farm) animal rights may also engender general voter backlash, with stronger effects along racial lines and on the right than the left in the United States. The anticipation of backlash, particularly from minoritized groups, is a key driver of why there is virtually no discussion of animal rights in American national politics. The reason for this may be connected to negative perceptions of the animal protection movement as racially homogeneous or insensitive (Kymlicka and Donaldson, 2014; Wrenn, 2016), comprised by mostly white and middle-class participants (Maurer, 2010), and failing to adequately address racial inequity within it (Harper, 2010; Reisman et al., 2021). Despite the Left's disavowal of animal rights, the vast majority of vegans who choose to eschew animal-based foods for ethical reasons are left-leaning (Wrenn, 2017). More generally, recent empirical work reveals differences across Americans on favorability toward animal rights issues, with Democrats and Democratic-leaning Independents being much more supportive overall than Republicans and Republican-leaning Independents (Riffkin, 2015; Park and Valentino, 2019). This means that voter backlash against a political candidate who puts attention on animal rights, while generally the case independent of partisanship, may be harsher for Republicans in particular.

Insights from psychology: other kinds of voter evaluations

A "nascent, fast-growing body of work" in psychology finds that social identification does not stop at the species border (Dhont et al., 2019, p. 773). The extent to which humans identify with the human in-group and are hostile toward the non-human (animal) out-group varies across individuals (Amiot and Bastian, 2017; Auger and Amiot, 2019; Caviola et al., 2019). Similar to other group-based social dynamics, backlash occurs when an individual deviates from human in-group norms, like those of anthropocentrism, a set of attitudes, beliefs, and standards that defines an arbitrary and implicit inter-species hierarchy on earth, which strongly favors the interests of the most dominant and powerful species (human) (Saha, as quoted in Hindin, 2022).

One line of research in this body of work has explored social backlash faced by vegans who deviate from anthropocentric norms because they are less hostile toward the non-human out-group (Minson and Monin, 2012; Earle and Hodson, 2017; MacInnis and Hodson, 2017; Judge and Wilson, 2019; Stanley, 2021). Personal motivations matter; vegans who cite animal rights or environmental concern as a basis for renouncing meat are viewed as particularly threatening compared to vegans who are motivated by health reasons (MacInnis and Hodson, 2017; Hodson et al., 2019). This is because individuals who deviate from majority group norms for ethical reasons pose a challenge to the group's positive evaluation of itself (Cramwinckel et al., 2015)—for e.g., individuals derive a positive self-concept from being a part of a species or group that is seen as "good" as opposed to "cruel" or "environmentally destructive".

This body of work highlights two main norms associated with human group membership: (1) only humans matter morally and that (2) human dominance over nature and other animals is absolute (see also White, 1967; Naess, 1986). Violations of these standards by vegans and vegetarians who eschew some or all animal products can lead to negative judgments about their morality and strength, in particular (Minson and Monin, 2012; Judge and Wilson, 2019; see also Greenebaum and Dexter, 2018 for connection between high meat consumption and masculine norms of power/dominance). However, to the author's knowledge, these theories have not been tested in a political or election context. For this reason, I also measure other voter evaluations of the hypothetical political candidate in Study 1 as "immoral" or "weak" in order to understand what particular perceptions could be driving voter backlash. To the extent that a political candidate who puts political attention on either farm animal rights or meat's environmental costs can trigger similar evaluations as vegans and vegetarians do, then I expect that voters perceive such a candidate as morally deviant or less dominant.

Another line of research in this body of work explores meat-related cognitive dissonance that can trigger "dislike" of targets who remind individuals that their values (for e.g., care for animals) and actions (for e.g., meat eating) do not align. When a dissonant state occurs, affected individuals can either change their behavior or use dissonance reduction strategies like disassociation of meat from its animal origins (Kunst and Hohle, 2016) and denial/rationalization (Bastian et al., 2012; Piazza et al., 2015). Most relevant to candidate evaluation is an indirect perceptual strategy of dissonance reduction called *do-gooder derogation*, which leads to backlash against the individual who triggers the dissonant state (Minson and Monin, 2012). Since this "kill the messenger" effect can occur simply by raising the topic of meat reduction or farm animals (Rothgerber, 2020), I expect that voters perceive a political candidate who puts political attention on either farm animal rights or meat's environmental costs as less likable. To the author's knowledge, a test of do-gooder derogation (resulting from meat-related cognitive dissonance) in a political or election context has not been conducted.

Study 2, which uses a conjoint experiment that facilitates intersectional analysis relevant to this topic, builds on this human-animal intergroup dynamics literature directly by exploring how diverse political leaders with characteristics like a vegan dietary preference, strong support for animal rights, and personal concern for farm animals in particular fare in national elections. The experimental work discussed in this section has only considered backlash at the individual level, so a key theoretical contribution of this paper is to assess how these attributes, when explicitly presented, impact voter support at the leader level in a political context. Since political candidates with such attributes can violate human in-group norms and may also trigger do-gooder derogation, I expect less voter support for them, all else equal, while noting that there might be variation based on their gender and/or race, and respondent party affiliation.

Study 1

The vignette experiment investigates how political attention on transportation's environmental costs, meat's environmental costs, and farm animal rights impacts the likelihood of voter support for a hypothetical U.S. presidential primary candidate. In addition, I assess other voter evaluations like the perceived morality, dominance, and likeability of the political candidate to explore what underlying perceptions could be driving potential voter backlash against someone who violates the norms of human group membership in an election context.

Method

NORC, at the University of Chicago, fielded Study 1 using the AmeriSpeak probability-based panel, designed to be representative of the U.S. household population. A total of 2,116 U.S. citizens were randomly sampled from a national panel, to which is recruited participants using U.S. mail, telephone, and in-person methods. Pursuant to the recommendations of Kane and Barabas (2019), a factual manipulation check was used to test whether the treatment manipulations conducted in the experiment were perceived by the subjects. Such a test is particularly important when the treatment stimuli require that participants read carefully (Kane and Barabas, 2019), as the vignettes used in this experiment do. A total of 244 subjects were dropped from the final dataset for failing the factual manipulation check. The final sample, therefore, included 1,872 U.S. citizens. The vignette experiment was conducted online via NORC's in-house survey platform. Descriptive statistics and other details about question wording for both Study 1 and 2 can be found in Section 1 of the Supplementary material. I note that the main results for Study 1 hold for the full sample of respondents (N = 2,116) as well.

Design

Subjects were presented with one of four versions of a stump speech from a hypothetical political candidate running in a presidential primary. The experiment had, in total, 4 conditions (i.e., versions of the stump speech): 1 control and 3 experimental. The control version of the stump speech was adapted from a speech written by two former political speechwriters, Republican and Democrat, hired by 538, a poll analysis website, to write,

"The Perfect Presidential Stump Speech" (Swaim and Nussbaum, 2016). Each treatment added just one paragraph to the stump speech used in the control condition. Political attention on meat's environment costs was cued with the following paragraph [the "Meat (Environment)" condition]: "On the environment, we know that meat consumption plays a huge role in climate change. And, that's why it's time for us to work together as a nation to reduce our reliance on meat and dairy and focus on solutions like plant-based foods and artificial meats instead." Political attention on transportation's environmental costs was cued with [the "Transportation (Environment)" condition]: "Finally, on the environment, we know that transportation plays a huge role in climate change. And, that's why it's time for us to work together as a nation to reduce our reliance on gasoline-powered vehicles and focus on solutions like public transportation and electric cars instead." Finally, political attention on farm animal rights was cued with the following additional paragraph (the "Animal Rights" condition): "Finally, on animal rights, we know that animals deserve proper protection. Our nation should work toward clearly defining the limits of how animals—particularly farm animals—may be treated and what they can be used for."

For all versions of the speech, respondents were asked to consider a hypothetical presidential primary candidate named "Tom Larson," thereby holding gender and race constant across the experimental conditions in Study 1. It is most likely that respondents assumed that "Tom Larson" was white and male identifying (Petsko and Rosette, 2022). Following the speech, respondents were asked how likely they would be to vote for the candidate to be a nominee for President within their party using a 7-point Likert scale. A note was added for those who do not identify with a political party: "If you do not identify as a Republican or Democrat, please evaluate the primary candidate as a potential presidential nominee who you might consider." Respondents were also asked to rate the likeability, morality, and dominance ("weakness") of the political candidate using an 11-point Likert scale. Finally, respondents answered a factual manipulation check question, which served as both an attention test and confirmation that the treatment had the intended effect (Kane and Barabas, 2019).

Results of Study 1

All analyses were conducted using R 4.2.0 GUI for Mac.

Treatment effects on likelihood of voting: diffuse effects

The distributional analysis conducted by political scientists suggests that there is overall broad voter support for governments that put political attention on climate change. Table 1 shows average treatment effects (ATEs) across the experimental conditions in Study 1 (derived from a linear model using survey weights provided by NORC). An ATE can be interpreted as the average causal effect of a particular treatment on the likelihood of voting for the hypothetical political candidate (1–7 scale) compared to the control condition. For political attention on transportation's environmental costs, there were no significant effects on the likelihood of voting for the candidate (compared to the control condition) in the full sample [ATE = 0.088, SE = 0.109, $p = 0.422$, Cohen's d = −0.03]. However, a hypothetical political candidate who puts political attention on meat's environmental costs did face broad voter backlash relative to the control candidate in the full sample of U.S. citizens, though the effect size is small [ATE = −0.579, SE = 0.109, $p < 0.01$, Cohen's $d = 0.36$]. Similarly, even when compared to the transportation condition, political attention on meat led to significant voter backlash [ATE = −0.666, SE = 0.112, $p < 0.01$, Cohen's $d = 0.39$; Supplementary Table 3].

TABLE 1 Average treatment effects (all respondents).

	Dependent variable
	Support
Meat (environment)	−0.579***
	(0.109)
Animal rights	0.060
	(0.108)
Transportation (environment)	0.088
	(0.109)
Observations	1,870
R^2	0.025
Adjusted R^2	0.023

The results are relative to the control condition. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

TABLE 2 Conditional average treatment effects (urban/rural).

	Dependent variable	
	Support	
	(Urban respondents)	(Rural respondents)
Meat (environment)	−0.427***	−1.354***
	(0.123)	(0.283)
Observations	789	138
R^2	0.015	0.144
Adjusted R^2	0.014	0.138

The results are relative to the control condition. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

The work in political theory on animal rights indicates that, overall, political attention on animal rights could bring about general voter backlash. Surprisingly, in Study 1, a hypothetical political candidate who puts political attention on farm animal rights faced no electoral backlash compared to the candidate in the control condition [ATE = 0.060, SE = 0.108, $p = 0.578$, Cohen's d = −0.02]. This finding also held for the animal rights condition when compared to the transportation condition [ATE = −0.028, SE = 0.112, $p = 0.805$, Cohen's d = −0.01].

Conditional treatment effects on likelihood of voting: concentrated effects

Unfortunately, the NORC dataset did not provide information to accurately determine *where* fossil fuel phaseout costs would

TABLE 3 Conditional average treatment effects (Black/White respondents).

	Dependent variable	
	Support	
	(Black respondents)	(White respondents)
Animal rights	−0.316	0.166
	(0.352)	(0.131)
Observations	77	649
R^2	0.011	0.002
Adjusted R^2	−0.003	0.001

The results are relative to the control condition. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

TABLE 4 Conditional average treatment effects (Democrats/Republicans).

	Dependent variable	
	Support	
	(Democratic respondents)	(Republican respondents)
Meat (environment)	−0.203	−1.079***
	(0.157)	(0.192)
Animal rights	0.226	−0.110
	(0.158)	(0.171)
Transportation (environment)	0.443***	−0.331*
	(0.150)	(0.169)
Observations	478, 456, 471 (in order from top)	341, 377, 368
R^2	0.003, 0.004, 0.018	0.085, 0.001, 0.010
Adjusted R^2	0.001, 0.002, 0.016	0.083, −0.002, 0.008

The results are relative to the control condition. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

be concentrated for the entire country. For the phaseout costs associated with meat reduction, it is mainly those in rural areas who would be most negatively impacted. Table 2 presents conditional average treatment effects (CATEs) by respondent region for the meat (environment) condition. A CATE, in this case, is the average causal effect of the meat (environment) treatment on the likelihood of voting for the hypothetical political candidate compared to the control, conditioned on whether the respondent lives in an urban or rural area (as defined by the US Census Bureau). For urban respondents, political attention on meat's environmental costs led to a 0.43 point (average) drop in voter support [SE = 0.123, $p < 0.01$, Cohen's $d = 0.32$]. For rural respondents, this kind of political attention led to a much larger average drop in voter support [CATE = −1.354, SE = 0.283, $p < 0.01$, Cohen's $d = 0.58$]. The difference between these respondent subgroups holding the experimental condition (meat) is also significant ($p < 0.01$; Supplementary Table 4).

The lack of political attention on animal rights might be explained, in part, by identity politics: a concern that including animal rights on the agenda might compete with or trivialize the interests of disadvantaged human subgroups. Table 3 shows CATEs for Black and White respondents in the animal rights condition. There was no significant effect of the animal rights treatment on voter support compared to the control for either subgroup. I also checked for effects in this experimental condition for Non-White Hispanic respondents in the sample. There was no significant effect of the animal rights treatment on voter support for this group of respondents either (Supplementary Table 5). Finally, I considered any differences among these three racial/ethnic groups in the sample for the animal rights condition and found no significant interactive effects for any (Supplementary Table 6).

TABLE 5 Average treatment effects (all respondents, other voter evaluations).

	Dependent variable		
	Morality	Dominance	Likeability
	(1)	(2)	(3)
Meat (environment)	−0.011	0.244	−0.794***
	(0.171)	(0.176)	(0.147)
Animal rights	−0.472***	−0.171	−0.088
	(0.170)	(0.174)	(0.146)
Observations	1,372	1,376	1,387
R^2	0.007	0.004	0.024
Adjusted R^2	0.006	0.002	0.023

The results are relative to the control condition. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Conditional treatment effects on likelihood of voting: party effects

Political psychologists highlight the polarizing role of party identification when it comes to environmental politics. Table 4 presents CATEs for Republican and Democratic respondents across the experimental conditions. For Democrats, political attention on meat's environmental costs had no significant impact on voter support (compared to the control). For Republicans, however, political attention on meat's environmental costs led to a large average drop of 1.08 points on the 1–7 voter support scale [SE = 0.192, $p < 0.01$, Cohen's $d = 0.67$]. Holding the meat (environment) condition, the difference between Republicans and Democrats is significant ($p < 0.01$; Supplementary Table 7). Turning to the animal rights condition, there were no significant effects of this treatment on voter support for either Republicans or Democrats in the sample. Finally, political attention on transportation's environmental costs led to a vote bump of +0.44 points on average for Democrats [SE = 0.150, $p < 0.01$, Cohen's d = 0.25] but backlash from Republicans in the sample [CATE = −0.331, SE = 0.169, $p < 0.1$, Cohen's $d = 0.22$]. Holding the transportation (environment) condition, the difference between Republicans and Democrats is significant ($p < 0.01$; Supplementary Table 7).

Average treatment effects on other voter evaluations: exploring perceived morality, dominance, and likeability

Insights from psychology point to key social and cognitive mechanisms that could underpin voter backlash against a candidate who puts political attention on animal issues. Table 5 shows the ATEs of the animal-related experimental conditions (compared to

the control) across three models with different dependent variables (0–10 scale for all): perceived morality, dominance, and likeability of the hypothetical candidate in Study 1. Political attention on meat's environmental costs reduced the likeability of the political candidate [ATE = −0.794, SE = 0.147, $p < 0.01$, Cohen's d = 0.38], but there were no significant effects on perceived morality or dominance. On the other hand, political attention on farm animal rights reduced the perceived morality of the candidate [ATE = −0.472, SE = 0.170, $p < 0.01$, Cohen's d = 0.12], but there were no significant effects on perceived dominance or likeability. Given the strong effects of respondent party identification in the earlier section, I checked for heterogeneous effects for each of these findings: effects on both perceived morality and likeability of the candidate in the animal rights and meat (environment) conditions, respectively, were more negative for Republicans than Democrats ($p < 0.05$; see Supplementary Table 8).

Discussion

The results of Study 1 challenge the conventional wisdom among some political scientists that climate policy in the United States enjoys broad public support by experimentally testing the effects of political attention on addressing environmental costs in two comparable sectors: meat and transportation. Previous studies that have shown that American voters are largely supportive of climate policy have either relied on small sample observational data (Carmack et al., 2022 compared voter results between two election cycles, with the second post-COVID) or public opinion survey data (Aldy et al., 2012; Ansolabehere and Konisky, 2016). While it may be the case that Americans are supportive, in theory, of some climate policies, it is in elections when most take action through voting and evaluating candidates based on their political agendas. This experimental work shows that overall voter support depends on the particular environmental issue area in question. Climate policy focused on the meat sector in the U.S. likely would not have broad or diffuse public support; instead, there may be voter backlash, with even stronger negative effects where the phase-out costs would be concentrated (in rural agricultural areas). For transportation and climate policy, the results show that, overall, voters are neutral in elections.

Partisan identification, however, did seem to play a strong role in predicting voter support for political candidates who center the environment. The results of Study 1 demonstrated strong differences by respondent party, with Democrats significantly more supportive of political attention on the environmentally costly meat and transportation sectors than Republicans. These findings are in line with research indicating that political orientation is a decisive factor in Anglo-Saxon countries where left-wing governments are significantly more likely to pass climate friendly laws relative to right-wing governments (Fankhauser et al., 2015). Study 1 contributes to this literature by showing that there is variation in levels of support (and backlash), dependent on the environmental issue area. Most notably, Democrats provided a boost to a political candidate who brings up transportation's environmental costs, but they did not provide a similar boost to a political candidate who puts meat's environmental costs on the agenda. Left-leaning voters may exhibit inconsistency in their support for climate policy depending on the target sector. This implies that the salience of the food and climate change nexus is low among Democratic voters, which is corroborated by a recent representative survey that shows that most people across 5 country contexts (including the U.S.) don't see industrial meat as a key cause of global warming (Madre Brava, 2023), something that can be addressed through greater media coverage, education campaigns, and better scientific communication.

The surprising lack of voter backlash against a political candidate who centers farm animal rights on their agenda on the left and right is in line with the results of recent state-level referendums in the United States. The lack of federal animal welfare legislation has moved the focus of animal welfare groups to the state level, where 12 states have passed laws to protect farm animals via referendums, often with large majorities and strong bipartisan support (Vogeler, 2020). While the results of Study 1 showed no differences in voter support across respondent racial/ethnic groups, the sample sizes were small for Black (N = 77) and Non-White Hispanic subjects (N = 130) in the animal rights experimental condition.

Finally, political attention on animals affected other voter evaluations, but how depended on the framing. Backlash due to violations of anthropocentric norms (i.e., the candidate as "morally deviant") occurred only against the hypothetical political candidate who puts political attention on farm animal rights, and it was driven by Republicans; nevertheless, it did not seem to translate to *voter backlash*. Only in the meat (environment) condition was the political candidate rated as less likable (compared to the control; again, driven by Republicans), an outcome associated with do-gooder derogation. However, Study 1 did not directly test that meat-related cognitive dissonance had, in fact, been triggered by the stimuli. In addition, it is unclear how these other voter evaluations impact voter support because the research design did not enable mediation analysis and so all outcomes were modeled separately.

Study 2

The conjoint experiment further explores the surprising results of Study 1 (i.e., no backlash from Republicans or Democrats for political attention on farm animal ethics) by directly testing candidate characteristics like veganism, concern for farm animals, and personal support for animal rights to measure their effects on (forced) vote choice. Unlike vignette experiments, conjoints enable independent randomization of multiple variables within a single experiment (Hainmueller et al., 2013). As a result, Study 2 adds valuable and relevant insight into how less anthropocentric candidates with different gender and racial identities might fare in national elections. Given the significance of identity group politics to the exclusion of animal rights on the political agenda, intersectional analysis is key to understanding voter evaluations of those political actors who are most likely to put attention on farm animals.

Method

Dynata fielded the conjoint experiment used in Study 2 to their panel, which is the largest first-party one in the world.

Suppose there is a primary in your party for an open seat for President, and the two individuals below are considering running. We'd like you to consider the following two potential candidates for this office. Please review the following two resumes:

	Candidate 1	Candidate 2
Race	White	Black
Gender	Female	Male
Age	35	45
Dietary Preferences	Vegetarian	Vegan (no animal products including dairy and eggs)
Political Experience	Senator	Representative in congress
Pets	Owns cats	Owns cats
Marital Status	Divorced	Divorced
To what extent does candidate support animal rights legislation?	Moderate supporter	Does not support

FIGURE 1
Design for the conjoint experiment (what a respondent might have seen).

They recruited a total of 857 U.S. citizens. This sample is not probability-based, but it was balanced to be representative of the U.S. population on age, gender, ethnicity, region (all based on Census data), and partisan affiliation (based on a recent Gallup poll).

Respondents in Study 2 were presented with five hypothetical presidential primary elections and asked to consider the candidates within their party. Each election involved a table with two candidate resumes including information about each candidate's dietary preference (none, vegetarian, or vegan), pets (no pets, cats, dogs, or rescued farm animals), personal support for animal rights (does not support, moderate supporter, or strong supporter), race (White, Latino/a, or Black), and gender (man or woman). Other relevant attributes were also included in the table to create a full candidate profile, like age (35, 45, 55, or 65), marital status (single, married, or divorced), and previous political experience (no experience, Mayor, Representative in Congress, or Senator). Attributes for each candidate were independently and randomly selected from the set of options for each characteristic. Figure 1 presents an example of what a respondent might have seen. After each table, respondents were asked to pick which candidate of the two they would be most likely to vote for in the presidential primary.

Though researchers have found that respondent selections in conjoints do mirror real-life preferences (Hainmueller et al., 2015), this study reduces the artificiality of the experiment even further through a small deception, implemented before the survey starts, which led participants to believe that the candidates in the tables they were about to view were real people working with a political recruitment organization. This methods innovation promotes greater cognitive engagement with the task by enhancing the overall authenticity of the tables and scenario.

Results of Study 2

All analyses were conducted using R 4.2.0 GUI for Mac.

Determinants of vote choice

Figure 2 presents results for the determinants of voice choice for the full sample of respondents in Study 2. The quantity of interest is the Average Marginal Component-specific Effect (AMCE), which is the treatment effect of a particular attribute level (compared to the base level) averaged over the joint distribution

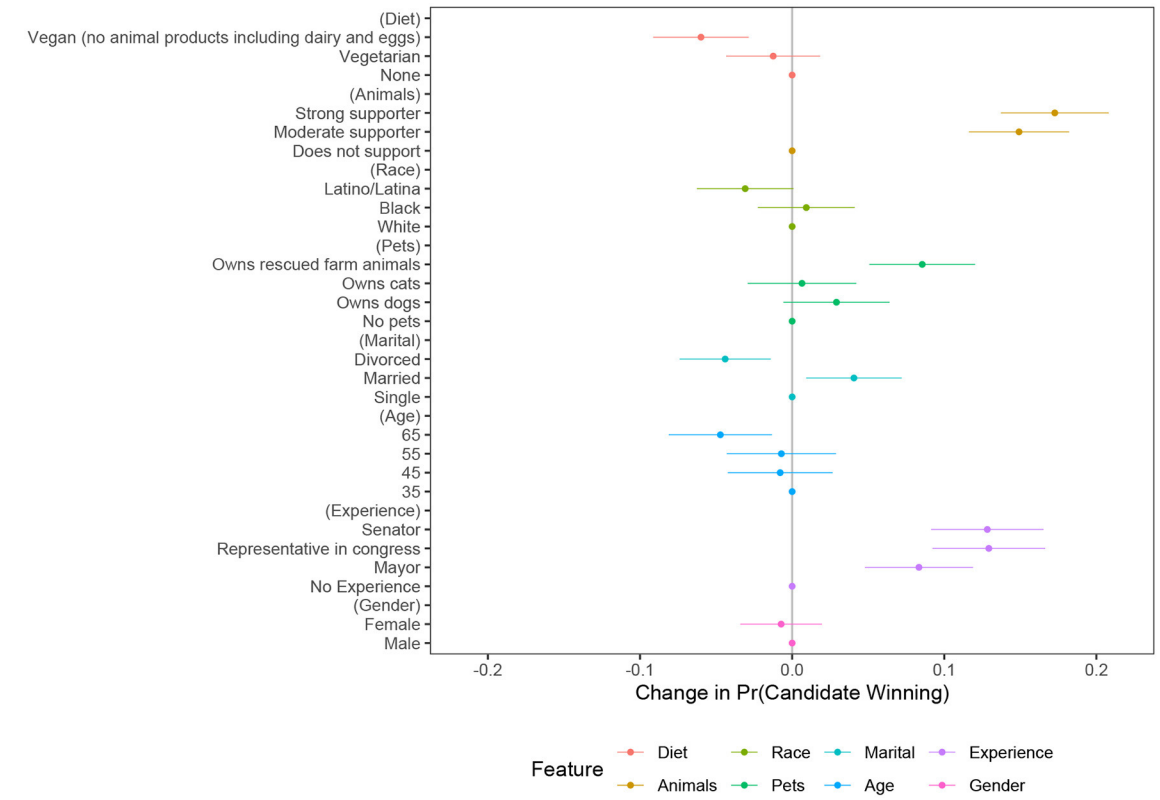


FIGURE 2
Determinants of vote choice. Figure shows percentage point change in probability of winning. Sample size N = 857 respondents, or at candidate level N = 8,570. 95% confidence intervals are represented by bands around plotted estimates.

of all other attribute values (Hainmueller et al., 2013). I cluster standard errors at the respondent level to account for within-election variation. I find that, contrary to expectations and in line with the results of Study 1, a candidate who has rescued farm animals or strongly supports animal rights was more likely to win their election, all else equal. Compared to a candidate who does not support animal rights, a strong supporter enjoyed a large 17.3% boost ($p < 0.01$) in the probability of winning. Similarly, compared to a candidate who has no pets, one who owns rescued farm animals got a bump of almost 9% points ($p < 0.01$) in the likelihood of winning their election. In contrast, a vegan candidate was less likely to win compared to a candidate who has no dietary restrictions (-6%, $p < 0.01$).

Determinants of vote choice by respondent party affiliation (Democrats and Republicans)

Comparisons of AMCEs between subgroups of respondents can lead to unclear inferences because these estimates depend on the arbitrary selection of attribute baselines by the researcher (Leeper et al., 2020). For this reason, Figure 3 plots the conditional marginal means (MMs) by respondent party affiliation and the differences in these means (far right panel). MMs can be interpreted as the probability of a respondent selecting a candidate with a particular attribute level. There were no significant differences between Democrats and Republicans regarding preferences for candidates who have rescued farm animals or who strongly support animal rights. On the other hand, there was significant voter backlash against vegan candidates driven by Republicans, who were less likely to vote for such candidates compared to Democrats (MMs for Democrats and Republicans, respectively, were 0.49 and 0.43; a difference of 6% points, $p < 0.01$).

Most preferred candidate profiles for Democratic and Republican respondents

The hypothetical candidate in Study 1 was always "Tom Larson" due to the difficulty of implementing multiple treatments using a vignette design. Thus, a key purpose of using a conjoint experiment in Study 2 is to conduct intersectional analysis and present results by candidate race and gender. Tables 6, 7 show the top 10 profiles of candidates most likely to win their elections for Democrats and Republicans in the sample, respectively. To identify these top profiles, I estimated Average Marginal Interaction Effects (AMIEs). AMIEs are non-parametrically estimated using ANOVA regression with weighted zero-sum constraints, enabling the estimation of predicted treatment effects for a large number of joint attribute values or candidate profiles (Egami and Imai, 2018). Democrats most favored Latina and Black women candidates who are strong animal rights supporters (top 8 of 10 ranked profiles) and have rescued farm animals (overall 8 of 10 ranked profiles). Republicans most favored White men candidates who support

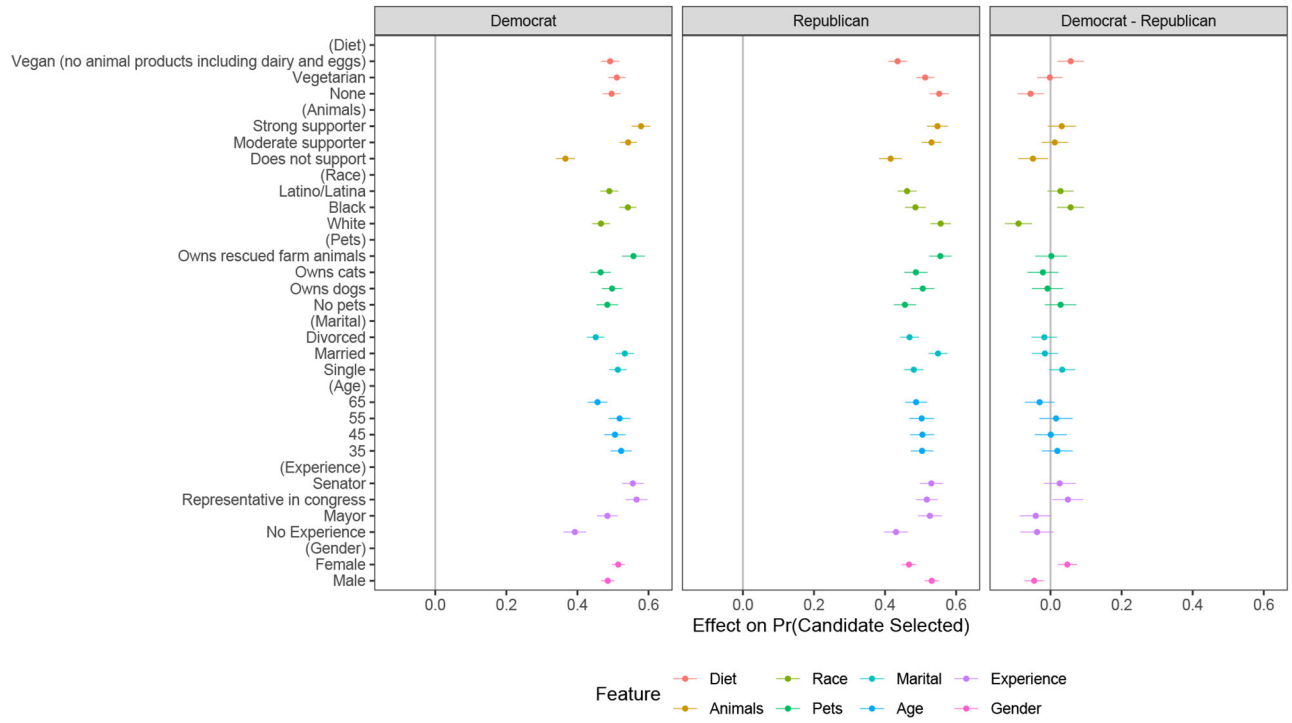


FIGURE 3
Conditional marginal means by respondent party ID. Figure shows favorability toward candidate profiles for respondents identifying as Democrat, Republican, and the difference using conditional marginal means. Sample size N = 3,970 Republicans and 4,540 Democrats, or at candidate level N = 8,510. 95% confidence intervals are represented by bands around plotted estimates.

animal rights (strongly or moderately, for all 10 ranked profiles) and have rescued farm animals (overall 4 of 10 ranked profiles and most frequently ranked, including in the top 2 most preferred profiles).

The seemingly very strong preference of Democrats in the sample for women of color candidates who demonstrate personal concern for farm animals and support animal rights more generally warrants further investigation. Considering only those hypothetical candidates who either strongly support animal rights or have rescued farm animals, Supplementary Table 9 presents these AMCEs by candidate gender and race for all Democratic respondents. Compared to a White woman candidate who strongly supports animal rights, Democrats gave a boost of 14.9% points ($p < 0.01$) to a Black woman candidate who similarly strongly supports animal rights. For Latina candidates, this boost was 17.2% points ($p < 0.01$). In terms of pet ownership, Democrats preferred a Black woman candidate who owns rescued farm animals compared to a White woman candidate who also owns rescued farm animals by +14.1% points ($p < 0.05$). For Latina candidates who own rescued farm animals, Democrats were 13.7% points ($p < 0.05$) more likely to vote for her (compared to a similar White woman candidate).

Discussion

Study 2 is consistent with the surprising result of Study 1: a national-level political candidate who is personally concerned for farm animals or strongly supports animal rights (more generally) received a significant bump in voter support. This is true independent of respondent party identification, implying there is taste on both the left and the right in the United States for animal-friendly political candidates. A possible explanation is that these attributes cue higher levels of perceived empathy, humanizing political leaders through demonstrative concern for the powerless (Pycior, 2005; Everett et al., 2019). But, such a vote bump did not extend to a vegan political candidate who did face backlash from Republican respondents (Democrats were neutral). The finding that conservatives are more likely to socially punish vegans (Dhont and Hodson, 2014; Judge and Wilson, 2019) may likely extend to the leader level on the right.

The results of Study 2 also show that the race and gender of animal-friendly candidates mattered for Republicans and Democrats. Republicans most preferred white men candidates who are animal-friendly, while Democrats provided the biggest vote bumps to women of color candidates with such attributes. Hayes (2005) argues that Republican candidates are perceived to be stronger, more moral leaders, while Democrats have the advantage in perceived compassion and empathy due to each party's ownership of different issue areas (e.g., defense for Republicans and social welfare for Democrats). Overall, voters perceive Black politicians as more empathetic (Gordon and Miller, 2005), even though Republican voters tend to generally prefer White candidates compared to Democratic voters (Crowder-Meyer et al., 2021). It is possible that trait-issue ownership by parties and racial cues interact in American politics such that the electoral benefits of higher

TABLE 6 Profiles of candidates who are most likely to win among democrats.

Rank	Treatment effect	Race and gender of candidate	Diet	Animal rights	Pets
1	0.144270138	Black woman candidate	Vegetarian	Strong supporter	Owns rescued farm animals
2	0.144270138	Black woman candidate	None	Strong supporter	Owns rescued farm animals
3	0.142227958	Black woman candidate	Vegan	Strong supporter	Owns rescued farm animals
4	0.120972308	Latina candidate	None	Strong supporter	Owns rescued farm animals
5	0.120972308	Latina candidate	Vegetarian	Strong supporter	Owns rescued farm animals
6	0.118930127	Latina candidate	Vegan	Strong supporter	Owns rescued farm animals
7	0.105088686	Black woman candidate	Vegetarian	Strong supporter	Owns dogs
8	0.105088686	Black woman candidate	None	Strong supporter	Owns dogs
9	0.103766048	Black woman candidate	None	Moderate supporter	Owns rescued farm animals
10	0.103766048	Black woman candidate	Vegetarian	Moderate supporter	Owns rescued farm animals

Results come from analysis of predicted values for unique treatment combinations using the FindIt package for R version 4.2.0 (Egami et al., 2018).

TABLE 7 Profiles of candidates who are most likely to win among republicans.

Rank	Treatment effect	Race and gender of candidate	Diet	Animal rights	Pets
1	0.11615711	White man candidate	None	Strong supporter	Owns rescued farm animals
2	0.11615711	White man candidate	None	Moderate supporter	Owns rescued farm animals
3	0.09345981	White man candidate	None	Moderate supporter	Owns dogs
4	0.09345981	White man candidate	None	Strong supporter	Owns dogs
5	0.09205777	White man candidate	Vegetarian	Strong supporter	Owns rescued farm animals
6	0.09205777	White man candidate	Vegetarian	Moderate supporter	Owns rescued farm animals
7	0.07969924	White man candidate	None	Strong supporter	Owns cats
8	0.07969924	White man candidate	None	Moderate supporter	Owns cats
9	0.0555999	White man candidate	Vegetarian	Strong supporter	Owns dogs
10	0.0555999	White man candidate	Vegetarian	Moderate supporter	Owns cats

Results come from analysis of predicted values for unique treatment combinations using the FindIt package for R version 4.2.0 (Egami et al., 2018).

perceived candidate empathy (owned by Democrats) is greatest for women of color candidates on the left and white men candidates on the right. Another possibility is that Democratic voters are more sensitive to the concern that the inclusion of animal rights competes with or trivializes the interests of minoritized groups like African-Americans or Non-White Hispanics, so they tend to feel more comfortable supporting animal-friendly candidates from these racial/ethnic groups. Unfortunately, Study 2 is limited in the extent to which it can provide a clear explanation of the underlying mechanisms since it only measures one outcome (vote choice). Furthermore, the sample sizes for Black and Non-White Hispanic subjects were too small in Study 2 to investigate differences in voter preferences by respondent racial/ethnic group (like in Study 1).

General discussion

Study 1 revealed that national-level Democratic presidential primary candidates in the United States may not have to worry about voter backlash if they put attention on the country's need to reduce its reliance on environmentally costly animal-based foods. A logical next step for this line of research on how voters react to meat on the political agenda is to extend the findings using a general election setting and other country contexts outside the United States. In the United States, partisan rancor has already emerged around meat (for a good summary, see Smith, 2021), despite meat's glaring omission from key pieces of environmental legislation like the 2022 Inflation Reduction Act. Future research in political psychology on meat politics can hone in on testing framing strategies that inoculate political actors during general elections against extremist right-wing claims, like the one that "[Democrats] are trying to take hamburgers away" (Sebastian Gorka, Conservative Political Action Conference on February 28, 2019).

Outside of the U.S. context, there has been variation in how public audiences have reacted to proposed national policies to reduce meat consumption. In Germany, meat consumption has decreased significantly since 2020 due to, in part, political attention on the need to shift diets from key political leaders like Cem Özdemir, the Minister of Food and Agriculture (Torrella, 2022). But, in the Netherlands, government plans to reduce the number of livestock in the country by a third

were met with strong opposition from farmers, leading to an unexpected sweeping win by a small pro-farmers party in the 2023 local elections that upset the liberal (pro-environment) ruling party (Coates, 2023). Future research might explore further the important role of coalition building, which was largely absent in the Netherlands case, as well as the electoral trade-offs associated with more stringent, heavy-handed policies vs. softer approaches (like in Germany where political attention tied to changes in the food environment seems to have already made a difference).

The successful inclusion of animal rights and animal-friendly politicians to national-level politics could yield environmental and ethical benefits by shaping social norms around the need to reduce meat consumption from the top-down. While there may be social backlash against individuals who violate anthropocentric norms, based on Study 1 and 2, it does not appear that this backlash extends to the leader level for (farm) animal rights in a voting context. This could be due to a leader's unique ability to escape social costs associated with deviation from in-group norms, which can, in some cases, lead to social innovation and progress (Moscovici and Lage, 1976; Abrams et al., 2018). For example, in Study 1, even though respondents did find the political candidate who put attention on farm animal rights to be morally deviant—evidence of deviation from group norms—they were not less likely to vote for him. These findings align with recent research (published in *Nature*) showing that, in Germany, animal welfare concerns are a stronger determinant of public support for meat taxation than climate change mitigation (Perino and Schwickert, 2023). A next step in research is to identify the precise causal mechanisms at the leader level that underpin these findings, potentially using a parallel mediation design (Imai and Yamamoto, 2013) to explore perceived empathy, in particular. Multiple studies find a link between moral concern for animals and higher levels of internal empathy (Kessler et al., 2016; Caviola et al., 2018; Rosenfeld, 2018). But, whether this translates to higher perceived empathy, a powerful factor in elections on both sides of the aisle (Laustsen and Bor, 2017; McDonald et al., 2019), is unknown.

Summary and conclusion

In this study, I evaluated how voters reacted to political attention on animals and animal-friendly candidates of diverse backgrounds running in hypothetical U.S. presidential primaries using two different kinds of experimental methods. I found that, overall, political attention on the need for climate policy that addresses meat's environmental costs triggered a small level of voter backlash. At the same time, voter reactions were strongly determined by partisan affiliation: Democrats were neutral, but there was strong voter backlash from Republicans. On the other hand, I found no evidence of voter backlash, either on the left or right, for political attention on farm animal rights. A second study added to this finding by testing how diverse candidates who are animal-friendly fared in elections. While there was overall voter support for candidates who are personally concerned for farm animals and strong animal rights supporters (without significant differences by party), the gender and race of candidates mattered differently for Republicans and Democrats.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: https://doi.org/10.7910/DVN/ZDT7TW.

Ethics statement

The studies involving human participants were reviewed and approved by Harvard's Committee on the Use of Human Subjects. The patients/participants provided their written informed consent to participate in this study.

Author contributions

SS conducted all the research and wrote this paper.

Acknowledgments

I thank Alexander Wendt and Peter Singer for helpful discussions that led to the formulation of this question and the theoretical framework. I also thank Margaret Rennix for early help with refining the theory, members of the Early Career Gender in Politics Writing Group, especially Rachel Bernhard, Mariel Barnes, Katharina Lawall, Katey Stauffer, Saskia Stucki, Kevin Oster, Time-Sharing Experiments in the Social Sciences (NSF-funded), Jamie Druckman, Cosette Creamer, Kris-Stella Trump, Ana Catalano Weeks, Desiree Acholla, Noah Greifer, Ryan Enos, Hilde Coffe, Tom Jehn, Courtney Dillard, Stephen Ansolabehere, Micha Germann, Stanford SEB Group, RECAP group (Chris Bryant, Jo Anderson, Garrett Broad, and others), Nivi Jaswal, Jared Piazza, Ammar Redza Ahmad Rizal, Christopher Hopwood, Harvard American Politics Research Workshop, and Mike Fillyaw.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1021013/full#supplementary-material

References

Abrams, D., Travaglino, G. A., Marques, J. M., Pinto, I., and Levine, J. M. (2018). Deviance credit: tolerance of deviant ingroup leaders is mediated by their accrual of prototypicality and conferral of their right to be supported. *J. Soc. Issues* 74, 36–55. doi: 10.1111/josi.12255

Aldy, J. E., Kotchen, M. J., and Leiserowitz, A. A. (2012). Willingness to pay and political support for a us national clean energy standard. *Nat. Clim. Change* 2, 596–599. doi: 10.1038/nclimate1527

Amiot, C. E., and Bastian, B. (2017). Solidarity with animals: assessing a relevant dimension of social identification with animals. *PLoS ONE* 12, e0168184. doi: 10.1371/journal.pone.0168184

Ansolabehere, S., and Konisky, D. M. (2016). *Cheap and Clean: How Americans Think About Energy in the Age of Global Warming*. MIT Press.

Auger, B., and Amiot, C. E. (2019). Testing the roles of intergroup anxiety and inclusion of animals in the self as mechanisms that underpin the "pets as ambassadors" effect. *Anthrozoös* 32, 5–21. doi: 10.1080/08927936.2019.1550277

Bastian, B., Loughnan, S., Haslam, N., and Radke, H. R. (2012). Don't mind meat? the denial of mind to animals used for human consumption. *Pers. Soc. Psychol. Bull.* 38, 247–256. doi: 10.1177/0146167211424291

Bayes, R., and Druckman, J. N. (2021). Motivated reasoning and climate change. *Curr. Opin. Behav. Sci.* 42, 27–35. doi: 10.1016/j.cobeha.2021.02.009

Bianchi, F., Dorsel, C., Garnett, E., Aveyard, P., and Jebb, S. A. (2018). Interventions targeting conscious determinants of human behaviour to reduce the demand for meat: a systematic review with qualitative comparative analysis. *Int. J. Behav. Nutr. Phys. Act.* 15, 1–25. doi: 10.1186/s12966-018-0729-6

Blum, J. (2020). *Mike Pence Says He'll Keep Kamala Harris from Meddling with America'S Meat*. Lanham, MD: HuffPost.

Bodansky, D. (2007). "Targets and timetables: good policy but bad politics?" in *Architectures for Agreement: Addressing Global Climate Change in the Post-Kyoto World*, eds J. E. Aldy and R. N. Stavins (Cambridge University Press).

Bødker, M., Pisinger, C., Toft, U., and Jørgensen, T. (2015). The rise and fall of the world's first fat tax. *Health Policy* 119, 737–742. doi: 10.1016/j.healthpol.2015.03.003

Burgen, S. (2022). *Poor Meat and Ill-Treated Animals: Spain in Uproar Over Minister's Remarks*. BBC.

Camilleri, A. R., Larrick, R. P., Hossain, S., and Patino-Echeverri, D. (2019). Consumers underestimate the emissions associated with food but are aided by labels. *Nat. Clim. Change* 9, 53–58. doi: 10.1038/s41558-018-0354-z

Carmack, M., Dolšak, N., and Prakash, A. (2022). Electoral appeal of climate policies: the green new deal and the 2020 US house of representatives elections. *PLoS Clim.* 1, e0000043. doi: 10.1371/journal.pclm.0000043

Carter, N., and Ockwell, D. (2007). *New Labour, New Environment? An Analysis of the Labour Government's Policy on Climate Change and Biodiversity Loss*. Report commissioned by Friends of the Earth. Centre for Ecology, Law and Policy (CELP) at the University of York and the Sussex Energy Group at the University of Sussex.

Caviola, L., Everett, J. A., and Faber, N. S. (2018). The moral standing of animals: towards a psychology of speciesism. *J. Pers. Soc. Psychol.* 116, 1011–1029. Available online at: https://psycnet.apa.org/doiLanding?doi=10.1037%2Fpspp0000182

Caviola, L., Everett, J. A., and Faber, N. S. (2019). The moral standing of animals: towards a psychology of speciesism. *J. Pers. Soc. Psychol.* 116, 1011. doi: 10.1037/pspp0000182

Clark, M. A., Domingo, N. G., Colgan, K., Thakrar, S. K., Tilman, D., Lynch, J., et al. (2020). Global food system emissions could preclude achieving the 1.5° and 2°c climate change targets. *Science* 370, 705–708. doi: 10.1126/science.aba7357

Clayton, S. E., and Manning, C. E. (2018). *Psychology and Climate Change: Human Perceptions, Impacts, and Responses*. London: Elsevier Academic Press.

Coates, B. (2023). *Why Dutch Farmers Turned Their Flag Upside Down*. The New York Times.

Cohen, R. (2021). *A French City Dropped Meat From Kids' Lunches. The Nation Erupted*. The New York Times.

Cramwinckel, F. M., van den Bos, K., and van Dijk, E. (2015). Reactions to morally motivated deviance. *Curr. Opin. Psychol.* 6, 150–156. doi: 10.1016/j.copsyc.2015.08.007

Crowder-Meyer, M., Gadarian, S. K., and Trounstine, J. (2021). Ranking candidates in local elections: neither panacea nor catastrophe for candidates of color. *J. Exp. Polit. Sci.* 1–18. doi: 10.1017/XPS.2023.6

Dagevos, H., and Voordouw, J. (2013). Sustainability and meat consumption: is reduction realistic? *Sustain. Sci. Pract. Policy* 9, 60–69. doi: 10.1080/15487733.2013.11908115

Dhont, K., and Hodson, G. (2014). Why do right-wing adherents engage in more animal exploitation and meat consumption? *Pers. Individ. Diff.* 64, 12–17. doi: 10.1016/j.paid.2014.02.002

Dhont, K., Hodson, G., Loughnan, S., and Amiot, C. E. (2019). Rethinking human-animal relations: the critical role of social psychology. *Group Process. Intergroup Relat.* 22, 769–784. doi: 10.1177/1368430219864455

Díaz, S. M., Settele, J., Brondízio, E., Ngo, H., Guèze, M., Agard, J., et al. (2019). *The Global Assessment Report on Biodiversity and Ecosystem Services: Summary for Policy Makers*. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.

Earle, M., and Hodson, G. (2017). What's your beef with vegetarians? predicting anti-vegetarian prejudice from pro-beef attitudes across cultures. *Pers. Individ. Diff.* 119, 52–55. doi: 10.1016/j.paid.2017.06.034

Egami, N., and Imai, K. (2018). Causal interaction in factorial experiments: application to conjoint analysis. *J. Am. Stat. Assoc.* 1–34. Available online at: https://www.tandfonline.com/doi/full/10.1080/01621459.2018.1476246

Egami, N., Ratkovic, M., and Imai, K. (2018). *Findit: Finding Heterogeneous Treatment Effects*. R package available at CRAN.

Egli, F., Schmid, N., and Schmidt, T. S. (2022). Backlash to fossil fuel phase-outs: the case of coal mining in us presidential elections. *Environ. Res. Lett.* 17, 094002. doi: 10.1088/1748-9326/ac82fe

Eshel, G., Stainier, P., Shepon, A., and Swaminathan, A. (2019). Environmentally optimal, nutritionally sound, protein and energy conserving plant based alternatives to us meat. *Sci. Rep.* 9, 1–11. doi: 10.1038/s41598-019-46590-1

Everett, J. A., Caviola, L., Savulescu, J., and Faber, N. S. (2019). Speciesism, generalized prejudice, and perceptions of prejudiced others. *Group Process. Intergroup Relat.* 22, 785–803. doi: 10.1177/1368430218816962

Fankhauser, S., Gennaioli, C., and Collins, M. (2015). The political economy of passing climate change legislation: evidence from a survey. *Glob. Environ. Change* 35, 52–61. doi: 10.1016/j.gloenvcha.2015.08.008

Fiorino, D. J. (2022). Climate change and right-wing populism in the united states. *Environ. Polit.* 31, 1–19. doi: 10.1080/09644016.2021.2018854

Fortuna, P., Wróblewski, Z., and Gorbaniuk, O. (2021). The structure and correlates of anthropocentrism as a psychological construct. *Curr. Psychol.* 1–13. doi: 10.1007/s12144-021-01835-z

Fuchs, D., Di Giulio, A., Glaab, K., Lorek, S., Maniates, M., Princen, T., et al. (2016). Power: the missing element in sustainable consumption and absolute reductions research and action. *J. Clean. Product.* 132, 298–307. doi: 10.1016/j.jclepro.2015.02.006

Gaarder, E. (2011). *Women and the Animal Rights Movement*. Piscataway, NJ: Rutgers University Press.

Gabel, M. J., and Huber, J. D. (2000). Putting parties in their place: inferring party left-right ideological positions from party manifestos data. *Am. J. Polit. Sci.* 94–103. doi: 10.2307/2669295

Garnett, E. E., Balmford, A., Sandbrook, C., Pilling, M. A., and Marteau, T. M. (2019). Impact of increasing vegetarian availability on meal selection and sales in cafeterias. *Proc. Natl. Acad. Sci. U.S.A.* 116, 20923–20929. doi: 10.1073/pnas.1907207116

Gauchat, G. (2012). Politicization of science in the public sphere: a study of public trust in the United States, 1974 to 2010. *Am. Sociol. Rev.* 77, 167–187. doi: 10.1177/0003122412438225

Gerber, P. J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., et al. (2013). *Tackling Climate Change Through Livestock: A Global Assessment of Emissions and Mitigation Opportunities*. Food and Agriculture Organization of the United Nations (FAO).

Gifford, R., and Nilsson, A. (2014). Personal and social factors that influence pro-environmental concern and behaviour: a review. *Int. J. Psychol.* 49, 141–157. doi: 10.1002/ijop.12034

Global Panel on Agriculture and Food Systems for Nutrition (2020). *Future Food Systems: For People, Our Planet, and Prosperity*. *Foresight 2.0*.

Gordon, A., and Miller, J. (2005). *When Stereotypes Collide: Race/Ethnicity, Gender, and Videostyle in Congressional Campaigns*, Vol. 4. New York, NY: Peter Lang.

Greenebaum, J., and Dexter, B. (2018). Vegan men and hybrid masculinity. *J. Gender Stud.* 27, 637–648. doi: 10.1080/09589236.2017.1287064

Guenther, P. M., Jensen, H. H., Batres-Marquez, S. P., and Chen, C.-F. (2005). Sociodemographic, knowledge, and attitudinal factors related to meat consumption in the United States. *J. Am. Diet. Assoc.* 105, 1266–1274. doi: 10.1016/j.jada.2005.05.014

Guidetti, M., Carraro, L., and Cavazza, N. (2022). Dining with liberals and conservatives: the social underpinnings of food neophobia. *PLoS ONE* 17, e0262676. doi: 10.1371/journal.pone.0262676

H.Res.109 (2019). *H.res 109 Recognizing the Duty of the Federal Government to Create a Green New Deal*. Available online at: https://www.congress.gov/bill/116th-congress/house-resolution/109/text

Hahnel, U. J., Mumenthaler, C., and Brosch, T. (2020). Emotional foundations of the public climate change divide. *Clim. Change* 161, 9–19. doi: 10.1007/s10584-019-02552-0

Hainmueller, J., Hangartner, D., and Yamamoto, T. (2015). Validating vignette and conjoint survey experiments against real-world behavior. *Proc. Natl. Acad. Sci. U.S.A.* 112, 2395–2400. doi: 10.1073/pnas.1416587112

Hainmueller, J., Hopkins, D. J., and Yamamoto, T. (2013). Causal inference in conjoint analysis: understanding multidimensional choices via stated preference experiments. *Polit. Anal.* 22, 1–30. doi: 10.1093/pan/mpt024

Hann, D. (1986). The process of government and UK oil participation policy. *Energy Policy* 14, 253–261.

Harper, A. B. (2010). *Sistah Vegan: Food, Identity, Health, and Society: Black Female Vegans Speak*. Brooklyn, NY: Lantern Books.

Harwatt, H., Ripple, W. J., Chaudhary, A., Betts, M. G., and Hayek, M. N. (2020). Scientists call for renewed Paris pledges to transform agriculture. *Lancet Planet. Health* 4, e9–e10. doi: 10.1016/S2542-5196(19)30245-1

Hayek, M. N., Harwatt, H., Ripple, W. J., and Mueller, N. D. (2021). The carbon opportunity cost of animal-sourced food production on land. *Nat. Sustain.* 4, 21–24. doi: 10.1038/s41893-020-00603-4

Hayes, D. (2005). Candidate qualities through a partisan lens: a theory of trait ownership. *Am J. Polit. Sci.* 49, 908–923. doi: 10.1111/j.1540-5907.2005.00163.x

Heinz, B., and Lee, R. (1998). Getting down to the meat: the symbolic construction of meat consumption. *Commun. Stud.* 49, 86–99.

Hemphill, L., and Schöpke-Gonzalez, A. M. (2020). "Two computational models for analyzing political attention in social media," in *Proceedings of the International AAAI Conference on Web and Social Media* (Ann Arbor, MI), 260–271.

Hindin, D. A. (2022). "The root causes of our environmental crises we ignore," in *Global Challenges of Climate Change, Vol. 2: Risk Assessment, Political and Social Dimension of the Green Energy Transition*, eds T. C. Devezas, J. C. C. Leitão, Y. Yegorov, and D. Chistilin (Springer), 1–16.

Hodson, G., Dhont, K., and Earle, M. (2019). "Devaluing animals, animalistic humans, and people who protect animals," in *Why We Love and Exploit Animals*, eds K. Dhont, and G. Hodson (London: Routledge), 67–89.

Hodson, G., and Earle, M. (2018). Conservatism predicts lapses from vegetarian/vegan diets to meat consumption (through lower social justice concerns and social support). *Appetite* 120, 75–81. doi: 10.1016/j.appet.2017.08.027

Howard, P. H. (2019). "Corporate concentration in global meat processing: the role of feed and finance subsidies," in *Global Meat: Social and Environmental Consequences of the Expanding Meat Industry*, eds B. Winders, and E. Ransom (Cambridge, MA: The MIT Press) 31–53.

Imai, K., and Yamamoto, T. (2013). Identification and sensitivity analysis for multiple causal mechanisms: revisiting evidence from framing experiments. *Polit. Anal.* 21, 141–171. doi: 10.1093/pan/mps040

Jalil, A. J., Tasoff, J., and Bustamante, A. V. (2020). Eating to save the planet: evidence from a randomized controlled trial using individual-level food purchase data. *Food Policy* 95, 101950. doi: 10.1016/j.foodpol.2020.101950

Jennings, W., and John, P. (2009). The dynamics of political attention: public opinion and the queen's speech in the United Kingdom. *Am. J. Polit. Sci.* 53, 838–854. doi: 10.1111/j.1540-5907.2009.00404.x

Johnson, S. (2016). The politics of meat. *PBS Frontline. Modern Meat.*

Johnson, T. J. (2013). *Agenda Setting in a 2.0 World: New agendas in Communication*. New York, NY: Routledge.

Jones, B. D., and Baumgartner, F. R. (2005). *The Politics of Attention: How Government Prioritizes Problems*. Chicago, IL: University of Chicago Press.

Judge, M., and Wilson, M. S. (2019). A dual-process motivational model of attitudes towards vegetarians and vegans. *Eur. J. Soc. Psychol.* 49, 169–178. doi: 10.1002/ejsp.2386

Kane, J. V., and Barabas, J. (2019). No harm in checking: using factual manipulation checks to assess attentiveness in experiments. *Am. J. Polit. Sci.* 63, 234–249. doi: 10.1111/ajps.12396

Kessler, C. S., Holler, S., Joy, S., Dhruva, A., Michalsen, A., Dobos, G., et al. (2016). Personality profiles, values and empathy: differences between lacto-ovo-vegetarians and vegans. *Complement. Med. Res.* 23, 95–102. doi: 10.1159/000445369

Kunst, J. R., and Hohle, S. M. (2016). Meat eaters by dissociation: how we present, prepare and talk about meat increases willingness to eat meat by reducing empathy and disgust. *Appetite* 105, 758–774. doi: 10.1016/j.appet.2016.07.009

Kymlicka, W., and Donaldson, S. (2014). Animal rights, multiculturalism, and the left. *J. Soc. Philos.* 45, 116–135. doi: 10.1111/josp.12047

Laustsen, L., and Bor, A. (2017). The relative weight of character traits in political candidate evaluations: warmth is more important than competence, leadership and integrity. *Elect. Stud.* 49, 96–107. doi: 10.1016/j.electstud.2017.08.001

Laver, M., Benoit, K., and Garry, J. (2003). Extracting policy positions from political texts using words as data. *Am. Polit. Sci. Rev.* 97, 311–331. doi: 10.1017/S0003055403000698

Lazarus, O., McDermid, S., and Jacquet, J. (2021). The climate responsibilities of industrial meat and dairy producers. *Clim. Change* 165, 1–21. doi: 10.1007/s10584-021-03047-7

Leeper, T. J., Hobolt, S. B., and Tilley, J. (2020). Measuring subgroup preferences in conjoint experiments. *Polit. Anal.* 28, 207–221. doi: 10.1017/pan.2019.30

Leng, G., and Hall, J. W. (2021). Where is the planetary boundary for freshwater being exceeded because of livestock farming? *Sci. Tot. Environ.* 760, 144035. doi: 10.1016/j.scitotenv.2020.144035

Machovina, B., Feeley, K. J., and Ripple, W. J. (2015). Biodiversity conservation: the key is reducing meat consumption. *Sci. Tot. Environ.* 536, 419–431. doi: 10.1016/j.scitotenv.2015.07.022

MacInnis, B., and Krosnick, J. (2020). *Climate Insights 2020: Partisan Divide. Resources for the Future*. Stanford, CA.

MacInnis, C. C., and Hodson, G. (2017). It ain't easy eating greens: evidence of bias toward vegetarians and vegans from both source and target. *Group Process. Intergroup Relat.* 20, 721–744. doi: 10.1177/1368430215618253

Madre Brava (2023). *People Don't See Industrial Meat as a Key Cause of Global Warming — Poll*.

Mathur, M. B., Peacock, J., Reichling, D. B., Nadler, J., Bain, P. A., Gardner, C. D., et al. (2021). Interventions to reduce meat consumption by appealing to animal welfare: Meta-analysis and evidence-based recommendations. *Appetite* 164, 105277. doi: 10.1016/j.appet.2021.105277

Maurer, D. (2010). *Vegetarianism: Movement or Moment: Promoting a Lifestyle for Cult Change*. Philadelphia, PA: Temple University Press.

McDonald, J., Karol, D., and Mason, L. (2019). "An inherited money dude from queens county": how unseen candidate characteristics affect voter perceptions. *Polit. Behav.* 42, 1–24. doi: 10.1007/s11109-019-09527-y

McMahon, J. (2019). *Meat and Agriculture Are Worse for the Climate Than Power Generation, Steven Chu Says*. Forbes.

Meckling, J., and Nahm, J. (2018). When do states disrupt industries? electric cars and the politics of innovation. *Rev. Int. Polit. Econ.* 25, 505–529. doi: 10.1080/09692290.2018.143481

Mekonnen, M. M., and Hoekstra, A. Y. (2012). A global assessment of the water footprint of farm animal products. *Ecosystems.* 15, 401–415. doi: 10.1007/s10021-011-9517-8

Merkley, E., and Stecula, D. A. (2018). Party elites or manufactured doubt? the informational context of climate change polarization. *Sci. Commun.* 40, 258–274. doi: 10.1177/1075547018760334

Merrill, D., and Leatherby, L. (2018). *Here's How America Uses Its Land*. Bloomberg.

Miller, D. L., and Muren, G. (2019). *Cafos: What We Don't Know Is Hurting Us*. The Natural Resources Defense Council (NRDC).

Minson, J. A., and Monin, B. (2012). Do-gooder derogation: disparaging morally motivated minorities to defuse anticipated reproach. *Soc. Psychol. Pers. Sci.* 3, 200–207. doi: 10.1177/1948550611415695

Moberg, E., Allison, E. H., Harl, H. K., Arbow, T., Almaraz, M., Dixon, J., et al. (2021). Combined innovations in public policy, the private sector and culture can drive sustainability transitions in food systems. *Nat. Food* 2, 282–290. doi: 10.1038/s43016-021-00261-5

Moscovici, S., and Lage, E. (1976). Studies in social influence III: majority versus minority influence in a group. *Eur. J. Soc. Psychol.* 6, 149–174. doi: 10.1002/ejsp.2420060202

Mosier, S. L., and Rimal, A. P. (2020). Where's the meat? An evaluation of diet and partisanship identification. *Brit. Food J.* 122, 860–909. doi: 10.1108/BFJ-03-2019-0193

Naess, A. (1986). The deep ecological movement: some philosophical aspects. *Philos. Inq.* 8, 10–31.

Nestle, M. (2013). "Food politics," in *Food Politics* (University of California Press).

Nguyen, A., and Platow, M. J. (2021). "I'll eat meat because that's what we do": the role of national norms and national social identification on meat eating. *Appetite* 164, 105287. doi: 10.1016/j.appet.2021.105287

Nicole, W. (2013). CAFOs and environmental justice: the case of North Carolina. *Environ. Health Perspect.* 121, a182–a189. doi: 10.1289/ehp.121-a182

Ockwell, D., Whitmarsh, L., and O'Neill, S. (2009). Reorienting climate change communication for effective mitigation: forcing people to be green or fostering grass-roots engagement? *Sci. Commun.* 30, 305–327. doi: 10.1177/1075547008328969

Oliver, J. E., and Rahn, W. M. (2016). Rise of the trumpenvolk: Populism in the 2016 election. *Ann. Am. Acad. Polit. Soc. Sci.* 667, 189–206. doi: 10.1177/0002716216662639

Palomo-Vélez, G., Tybur, J. M., and Van Vugt, M. (2018). Unsustainable, unhealthy, or disgusting? Comparing different persuasive messages against meat consumption. *J. Environ. Psychol.* 58, 63–71. doi: 10.1016/j.jenvp.2018.08.002

Park, Y. S., and Valentino, B. (2019). Animals are people too: explaining variation in respect for animal rights. *Hum. Rights Q.* 41, 39–65. doi: 10.1353/hrq.2019.0002

Perino, G., and Schwickert, H. (2023). Animal welfare is a stronger determinant of public support for meat taxation than climate change mitigation in Germany. *Nat. Food* 4, 1–10. doi: 10.1038/s43016-023-00696-y

Petsko, C. D., and Rosette, A. S. (2022). Are leaders still presumed white by default? racial bias in leader categorization revisited. *J. Appl. Psychol.* 108, 330–340. doi: 10.1037/apl0001020

Piazza, J., Ruby, M. B., Loughnan, S., Luong, M., Kulik, J., Watkins, H. M., et al. (2015). Rationalizing meat consumption. The 4ns. *Appetite* 91, 114–128. doi: 10.1016/j.appet.2015.04.011

Pollan, M. (2011). *How Change Is Going to Come in the Food System*. The Nation.

Poore, J., and Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science* 360, 987–992. doi: 10.1126/science.aaq0216

Pycior, H. (2005). The making of the "first dog": President Warren G. Harding and Laddie Boy. *Soc. Anim.* 13, 109–138. doi: 10.1163/1568530054300190

Rabe, B. G., and Borick, C. P. (2012). Carbon taxation and policy labeling: experience from American states and Canadian provinces. *Rev. Policy Res.* 29, 358–382. doi: 10.1111/j.1541-1338.2012.00564.x

Reisman, A., Ahmmad, B., and Reisman, A. (2021). Voices of the movement: toward an equitable farmed animal protection movement. *Equity Based Dial. Inclusion*.

Remnick, D. (2019). *Alexandria Ocasio-Cortez Is Coming for Your Hamburgers!* The New Yorker.

Richter, B. D., Bartak, D., Caldwell, P., Davis, K. F., Debaere, P., Hoekstra, A. Y., et al. (2020). Water scarcity and fish imperilment driven by beef production. *Nat. Sustain.* 3, 319–328. doi: 10.1038/s41893-020-0483-z

Riffkin, R. (2015). *In U.S., More Say Animals Should Have Same Rights as People*. Gallup Social and Policy Issues.

Rinscheid, A., Pianta, S., and Weber, E. U. (2020). Fast track or slo-mo? public support and temporal preferences for phasing out fossil fuel cars in the United States. *Clim. Policy* 20, 30–45. doi: 10.1080/14693062.2019.1677550

Rosenfeld, D. L. (2018). The psychology of vegetarianism: recent advances and future directions. *Appetite* 131, 125–138. doi: 10.1016/j.appet.2018.09.011

Rothgerber, H. (2020). Meat-related cognitive dissonance: a conceptual framework for understanding how meat eaters reduce negative arousal from eating animals. *Appetite* 146, 104511. doi: 10.1016/j.appet.2019.104511

Rude, E. (2016a). *The 'Beefsteak Election': When Meat Changed the Course of American Politics*. Time.

Rude, E. (2016b). *Tastes Like Chicken: A History of America's Favorite Bird*. New York, NY: Simon and Schuster.

Sewell, C. (2019). Removing the meat subsidy. *J. Int. Aff.* 73, 307–318. Available online at: https://www.jstor.org/stable/26872805

Shukla, P. R., Skeg, J., Buendia, E. C., Masson-Delmotte, V., Pörtner, H.-O., Roberts, D., et al. (2019). Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems.

Simon, D. R. (2013). *Meatonomics: How the Rigged Economics of Meat and Dairy Make You Consume Too Much–and How to Eat Better, Live Longer, and Spend Smarter*. San Francisco, CA: Conari Press.

Sintov, N. D., Abou-Ghalioum, V., and White, L. V. (2020). The partisan politics of low-carbon transport: why democrats are more likely to adopt electric vehicles than republicans in the United States. *Energy Res. Soc. Sci.* 68, 101576. doi: 10.1016/j.erss.2020.101576

Skocpol, T., and Hertel-Fernandez, A. (2016). The koch network and republican party extremism. *Perspect. Polit.* 14, 681–699. doi: 10.1017/S1537592716001122

Smith, A. (2021). *The Coming "Meat Vortex": Meat Is the Third Rail of Climate Politics*. The Breakthrough Institute.

Son, J.-Y., Muenich, R. L., Schaffer-Smith, D., Miranda, M. L., and Bell, M. L. (2021). Distribution of environmental justice metrics for exposure to cafos in North Carolina, USA. *Environ. Res.* 195, 110862. doi: 10.1016/j.envres.2021.110862

Springmann, M., Mason-D'Croz, D., Robinson, S., Wiebe, K., Godfray, H. C. J., Rayner, M., et al. (2017). Mitigation potential and global health impacts from emissions pricing of food commodities. *Nat. Clim. Change* 7, 69–74. doi: 10.1038/nclimate3155

Stanley, S. K. (2021). Ideological bases of attitudes towards meat abstention: vegetarianism as a threat to the cultural and economic status quo. *Group Process. Intergroup Relat.* 1–21. doi: 10.1177/13684302211020356

Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M., Rosales, M., et al. (2006). *Livestock's Long Shadow: Environmental Issues and Options*. Food and Agriculture Organization.

Stokes, L. C. (2016). Electoral backlash against climate policy: a natural experiment on retrospective voting and local resistance to public policy. *Am. J. Polit. Sci.* 60, 958–974. doi: 10.1111/ajps.12220

Stoutenborough, J. W., and Vedlitz, A. (2014). The effect of perceived and assessed knowledge of climate change on public policy concerns: an empirical comparison. *Environ. Sci. Policy* 37, 23–33. doi: 10.1016/j.envsci.2013.08.002

Swaim, B., and Nussbaum, J. (2016). *The Perfect Presidential Stump Speech*. FiveThirtyEight.

Sweetser, K. D., Golan, G. J., and Wanta, W. (2008). Intermedia agenda setting in television, advertising, and blogs during the 2004 election. *Mass Commun. Soc.* 11, 197–216. doi: 10.1080/15205430701590267

Tedesco, J. C. (2005). Issue and strategy agenda setting in the 2004 presidential election: Exploring the candidate–journalist relationship. *J. Stud.* 6, 187–201. doi: 10.1080/14616700500057270

Temple, J. (2021). *Bill Gates: Rich Nations Should Shift Entirely to Synthetic Beef*. Cambridge, MA: MIT Technology Review.

Torrella, K. (2022). *How Germany Is Kicking Its Meat Habit*. Vox.

Tubiello, F. N., Karl, K., Flammini, A., Gütschow, J., Obli-Laryea, G., Conchedda, G., et al. (2022). Pre-and post-production processes increasingly dominate greenhouse gas emissions from agri-food systems. *Earth Syst. Sci. Data* 14, 1795–1809. doi: 10.5194/essd-14-1795-2022

Van Boven, L., Ehret, P. J., and Sherman, D. K. (2018). Psychological barriers to bipartisan public support for climate policy. *Perspect. Psychol. Sci.* 13, 492–507. doi: 10.1177/1745691617748966

Vogeler, C. S. (2020). Politicizing farm animal welfare: a comparative study of policy change in the United States of America. *J. Comp. Policy Anal. Res. Pract.* 23, 526–543.

Weathers, S., and Hermanns, S. (2017). Open letter urges who to take action on industrial animal farming. *Lancet* 389, e9. doi: 10.1016/S0140-6736(17)31358-2

White, L. (1967). The historical roots of our ecologic crisis. *Science* 155, 1203–1207.

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., et al. (2019). Food in the anthropocene: the eat–lancet commission on healthy diets from sustainable food systems. *Lancet* 393, 447–492. doi: 10.1016/S0140-6736(18)31788-4

Wolstenholme, E., Poortinga, W., and Whitmarsh, L. (2020). Two birds, one stone: the effectiveness of health and environmental messages to reduce meat consumption and encourage pro-environmental behavioral spillover. *Front. Psychol.* 11, 577111. doi: 10.3389/fpsyg.2020.577111

Wreford, A., Ignaciuk, A., and Gruère, G. (2017). *Overcoming Barriers to the Adoption of Climate-Friendly Practices in Agriculture*. Organisation for Economic Cooperation and Development (OECD).

Wrenn, C. L. (2016). An analysis of diversity in nonhuman animal rights media. *J. Agric. Environ. Ethics* 29, 143–165. doi: 10.1007/s10806-015-9593-4

Wrenn, C. L. (2017). Trump veganism: a political survey of American vegans in the era of identity politics. *Societies* 7, 32. doi: 10.3390/soc7040032

Xu, X., Sharma, P., Shu, S., Lin, T. S., Ciais, P., Tubiello, F. N., et al. (2021). Global greenhouse gas emissions from animal-based foods are twice those of plant-based foods. *Nat. Food* 2, 724–732. doi: 10.1038/s43016-021-00358-x

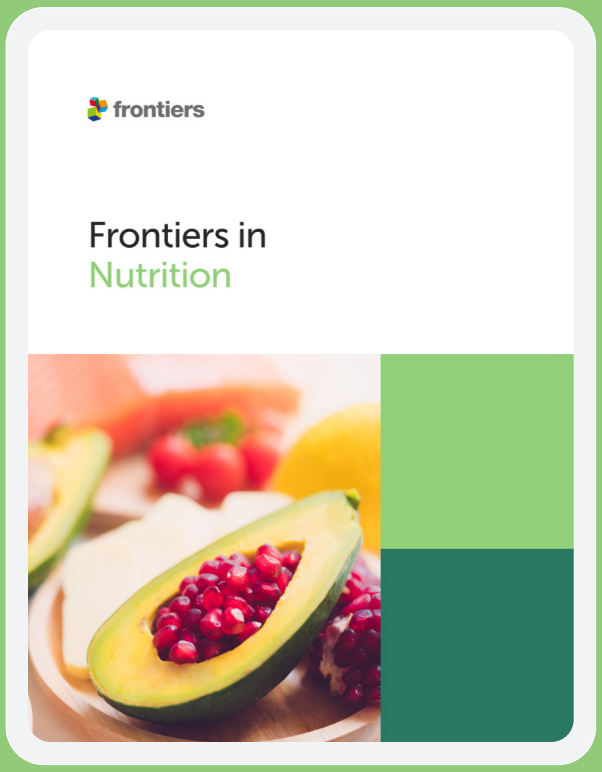
Frontiers in Nutrition

Explores what and how we eat in the context of health, sustainability and 21st century food science

A multidisciplinary journal that integrates research on dietary behavior, agronomy and 21st century food science with a focus on human health.

Discover the latest Research Topics

See more →



Frontiers

Avenue du Tribunal-Fédéral 34
1005 Lausanne, Switzerland
frontiersin.org

Contact us

+41 (0)21 510 17 00
frontiersin.org/about/contact