MIND THE SUSTAINABLE FOOD: NEW INSIGHTS IN FOOD PSYCHOLOGY

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MIND THE SUSTAINABLE FOOD: NEW INSIGHTS IN FOOD PSYCHOLOGY

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Editorial: Mind the Sustainable Food: New Insights in Food Psychology

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Editorial on the Research Topic

Mind the Sustainable Food: New Insights in Food Psychology

SUSTAINABLE FOOD PSYCHOLOGY: AN EMERGING AREA

As the prime connexion between people and the planet, the history of food is as long as that of mankind. Food choices and whole diets have long been influenced by environmental, psychological, sociocultural, and technological factors. Among the various disciplines studying how food choices are closely connected to the biological and sociocultural evolution of humanity, Food Psychology applies psychological theories, and methodology to consider the relationships among food attributes, consumers' characteristics, and sociocultural influences.

Recognising the key role of dietary habits in health, for many decades Food Psychology mainly focused on understanding and promoting healthy eating habits. However, in recent years, a growing focus has been on sustainable food choices. Such sustainable food choices encompass both benefits to human health and protection of the environmental (EEA (European Environment Agency), 2017; FAO, 2018) and was the definition of sustainable food we used here. For example, food choices or whole diets that reduce or even eliminate meat from the diet would meet this definition of a sustainable food choice (e.g., Chai et al., 2019). As Schmidt and Mouristen propose in the present research topic, lacto-ovo-vegetarian or flexitarian diets might allow people to change their dietary habits without replacing food with nutritional supplements, changing fundamental social and ethnic traditions, or being exposed to cravings for umami.

Although researchers have an increasingly good knowledge of the impact of food consumption both on health and the environment, the general public mostly have a relatively poor understanding of what constitutes a sustainable diet. Moreover, understanding sustainable food choices—and even more convincing people to adopt them—still faces many barriers. Among these barriers are those related to complex attributes of the food products, social and psychological limitations, and the small number of ways in which researchers and policy makers can promote sustainable food choices (Cheah et al., 2020; Smiglak-Krajewska and Wojciechowska-Solis, 2021).

INFLUENCES OF FOOD ATTRIBUTES ON SUSTAINABLE FOOD CHOICES

In relation to how food attributes affect consumers' choices, one interesting recent debate is related to the influence of food reputation and country of origin. To considered how the impact of food reputation on food preferences varies across cultural contexts, in the present research topic, De Dominicis et al. validate three context-specific versions of the Food Reputation Map (FRM) to measure food reputation across twenty-three specific indicators, further grouped into six synthetic

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indicators of food reputation in Italian, English, and Chinese populations. More widespread use of the FRM could further our understanding in relation to sustainable food choices. In addition, Bonaiuto et al. analyse the effect of country of origin by identifying a social-psychological profile of "Italian Sounding" products—i.e., the "Italian appearance" of food products irrespective of its country of origin—when compared to both "Made in Italy" products and "Generic Foreign" products across three different countries (Italy, China and USA). Moreover, they show how food reputation mediates the impact of the perception of food as Italian on consumers' willingness to purchase it.

Relatedly, an emerging line of research concerns how new categories of foods, such as so-called "sustainable food alternatives," are perceived by consumers and can facilitate the pursuit of more sustainable diets. In the present special issue, Chriki et al.'s systematic review examines cultured meat as an alternative for consumers who want to be more ethically minded but do not wish to avoid meat altogether. Their review shows that researchers focused initially only on technical aspects of artificial meat, while more recently they took into account how consumers' beliefs (e.g., health value and product acceptance) determine its purchase. Furthermore, in an opinion article, Mouritsen and Schmidt discuss how to increase interest in consumption of seaweed and cephalopods by considering both psychosocial factors preventing one from eating them, and how to generate a more positive image by proposing different words to connotate them.

EFFECTS OF PSYCHOSOCIAL DETERMINANTS ON SUSTAINABLE FOOD CHOICES

Concerning how consumers' beliefs affect their sustainable food choices, Food Psychology could usefully focus on several key determinants, such as cognitive, moral, affective, and personality dimensions. An emerging topic in relation to the cognitive influences related to food choice relates to people's trust toward food production. In this regard, Canova et al. highlight the importance of people's trust in organic products as a meaningful antecedent that boosts the psychosocial processes that are assumed to underlie both purchasing intentions and choice behaviours. Recent studies in this area are also investigating the implications of moral motives related to the choice of sustainable food. For example, Lai et al. investigate the different implications of moral and non-moral motivators for reducing meat intake. Their two studies show the direct impact of health concern and the indirect role of "biospheric values" and descriptive norm (via personal norm). In relation to affective influences on sustainable food choice, Papadakis et al. examined how negative affect influences the relationship between environmental cues to high-calorie snacking and snacking behaviour. Finally, Dijksterhuis et al. draw upon psychological personality theory and propose unique underlying factors that can distinguish among consumers' personalities. They also explore the relationship between the identified factors and consumers' preferences for receiving certain forms of dietary advice/information.

Importantly, even when food products have sustainable attributes and consumers have positive attitude and good intentions toward eating sustainably, often people still do not select sustainable foods or diets (de Ridder et al., 2017). A sustainability gap. Research is necessary to bridge this gap between favourable values, attitudes and actual consumption of more sustainable food products and diets. In this regards, Schäufele and Janssen analysed the value-attitude-behaviour relationship and found that different types of food purchase is driven by the same food-related values but their relative importance differs based on category of product. Starting from the urgent need to reduce this gap, Vermeir et al. propose a comprehensive theoretical framework for future research on this topic, and highlight behavioural solutions for environmental challenges in the food domain from an interdisciplinary perspective.

INTERVENTIONS AIMED AT INCREASING SUSTAINABLE FOOD CHOICES

The above research could form the basis of interventions aimed at increasing sustainable eating. The review by Abrahamse indicates that interventions targeting sustainable food choices can rely on both unconscious or automatic decision-making processes (e.g., nudging), and more deliberative decision-making (e.g., information provision). Relatedly, for interventions leveraging less deliberative decision-making processes, Dijkstra and Elbert evaluated whether inducing voluntary eye movements during the processing of the auditory persuasive information prevented defensiveness and thereby increased the effectiveness of messages aimed to increase fruit and vegetable consumption. In relation to how to promote sustainable food choices via stimulating a deliberative decision-making process, the effectiveness of the information provision can be enhanced by manipulating message content and/or message framing. As an example of how to differentiate the content of the messages, Wolstenholme et al. showed that the nature of the health and/or environmental information provided were effective in reducing red and processed meat consumption compared to a no message control group, with some effects remaining 1-month later. Leveraging the framing of the messages, Carfora et al. found that gain and non-loss messages activated an integrated emotional and cognitive processing of the health recommendation, while loss and non-gain messages mainly activated emotional shortcuts toward attitude and intention.

FUTURE DIRECTIONS: WHERE SHALL WE GO?

To sum up, the present research topic focused on sustainable food and dietary choices that can promote both health and environmental gains. The included papers all address directly how their work can enhance theory, methodology, and communication strategy, which could accelerate advances in

the field of sustainable Food Psychology. Overall, the papers highlight the need to examine various possible moderators and mediators of effects on food choice and also the need to assess long-term effects. Initiating sustainable food choices and diets will have little impact on individual's health or on protecting the environment. It is only long-term changes that will have these effects. We would highlight this as an important and less studied aspect of sustainable food—these changes to food choices and whole diets need to be taken up by large portions of the population and over prolonged periods of time if the population health and environmental benefits are to be realised. It is also worth noting that the methodologies and approaches taken in the papers included in the special issue are heterogeneous. This is perhaps because of the lack of a common conceptual framework to drive work on understanding and promoting sustainable food choices and diet in this area. For example, most of the included papers focused on different types of food choice (e.g., meat reduction or snacking) rather than considering the more difficult question of adherence to a sustainable whole diet, which is key to obtaining health and environmental benefits (de Ridder et al., 2017). Future research and theorising that attempts a more holistic assessment and integration of the multitude of factors that influence food choices would be particularly valuable. Such integration might also usefully focus on the sensory (taste, smell, appearance, and texture of food) and environmental factors (such as salience of food and distractions), aspects that are too often overlooked in the field of sustainable food choice. Finally, future research might also identify the extent to which research on sustainable foods can draw upon existing work on healthy food choices and related area or needs to develop in new directions.

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VC conceived the idea of this editorial. All authors contributed to the Editorial revision, read and approved the submitted version.

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OPINION
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The Solution to Sustainable Eating Is Not a One-Way Street

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By 2050 the Earth has to feed a population approaching 10 billion. The recent report from the EAT-Lancet Commission on Healthy Diets from Sustainable Food Systems (Willett et al., 2019) documents that the conditions for a sustainable, healthy, and nutritious diet for a growing global population can only be established via an acute and major change in the global food systems. This change involves a diet with much more plant-based food than now, including 500 g vegetables and fruit every day and little or no red meat. It is well-known that most people have difficulties eating that much green. The barriers to eating enough vegetables and fruit may be of both psychological, physiological, social, and cultural nature. In addition, plant-based food is lacking in the basic tastes sweet and umami that humans over evolutionary time scales have been primed to crave (Wrangham, 2009). Without confronting these fundamental facts, we may fail in providing for a more green and sustainable future for the planet. In the present Opinion we propose a solution to meet these challenges by the adoption of a holistic flexitarian approach shaped by fundamental insight into taste, and in particular, how to sustain sweetness and umami in a green diet, using only minimal sources from the animal kingdom.

A sustainable diet may be defined as "*a diet comprised of foods brought to the market with production processes that have little environmental impact, is protective and respectful of biodiversity and of ecosystems, and is nutritionally adequate, safe, healthy, culturally acceptable, and economically affordable*" (Pimentel and Pimentel, 2003; Aleksandrowicz et al., 2016; Chai et al., 2019). This is often exemplified as plant-based diets. The literature typically divides plant-based diets into three major groups being flexitarian, vegetarian, and vegan. Common for these diets is that animal-based food, seen in an omnivore diet, is substituted to a smaller (flexitarian), larger (vegetarian), and absolute (vegan) extent. In recent years, an increasing interest in eating more sustainable has been observed and more people are eating a vegetarian and flexitarian diet (Horseman, 2019; Yougov.com, 2019) and sustainability is even described as a megatrend (Mittelstaedt et al., 2014; Hale, 2018). Thus, it may appear that academia (Reijnders and Soret, 2003; Scarborough et al., 2014; Van Kernebeek et al., 2014) as well as some first-mover consumers, are agreeing that meat is not sustainable. However, it must not be forgotten that meat comes in various degrees of sustainability. In addition, meat may often be strongly linked to social and cultural traditions, and it has a high nutritional content and umami taste. Cutting it out of the diet completely may, therefore, pose some significant challenges for some consumers.

The EAT-Lancet report (Willett et al., 2019) points out that the global food systems in the Anthropocene are the main reason for the changes in the Earth's ecosystems, including climate changes. Agriculture is responsible for using 40% of the land (Foley et al., 2005), 30% of greenhouse emissions (Vermeulen et al., 2012), and 70% of freshwater use (Steffen et al., 2015). Fisheries have fully exploited 60% of the wild stock, overfished another 30%, and the global catch has declined in recent decades. The cost of this type of food production has been a great loss in biodiversity, damage to whole ecosystems, as well as the emission of excess nutrients and greenhouse gasses. In addition, crucial global cycles of carbon, phosphorus, and nitrogen have been disturbed. At the same time, food waste from production to consumption is skyrocketing. By adding to this that

820 mio. people are starving and 2 billion people now suffer from diet-related diseases, it is clear that the current global food systems are neither sustainable nor healthy (Harland and Garton, 2015; Searchinger, 2019; Willett et al., 2019).

Based on detailed calculations and projections, the EAT-Lancet report proposes a diet that allegedly is sustainable, nutritious, and healthy and can take us safely toward 2050. This diet consists of mainly vegetables, fruit, whole grain, legumes, nuts and unsaturated fats, only moderate or small amount of fish and poultry, and no or very little red meat, processed meat, added sugars, refined cereals, and starchy vegetables. With this recommendation, it should be possible to meet the United Nations Sustainable Development Goals (United Nations (UN), 2019). However the solution is fragile, and a small growth in the consumption of red meat or dairy products can have catastrophic effects (Willett et al., 2019).

The Eat-Lancet standard for the daily intake of vegetables and fruit is aligned with many countries' national diet recommendations of 500–600 g greens a day. This brings us to the key question: Can we eat that much green? The general observation is that most people's eating habits do not agree with that much green every day. Even if we know that a more green diet is more healthy and more sustainable, we are not going to eat it in the long run if it does not conform with our taste preferences. This brings us to the next question: is a green diet tasty enough? In the present authors' opinion, this is the most critical question. We believe that there are two fundamental reasons why a green diet may not be to our liking. One has to do with the evolution of our species and the other is related to the biology of plants.

Before we attack the challenge of taste and present a possible solution, it should be noted that there can be personal and contradicting issues with, on the one hand knowing or believing that a green diet is more sustainable and healthy, but on the other hand still not succeeding in eating as recommended. This can lead to chronic feelings of guilt and possibly eating disorders (Brytek-Matera et al., 2019). In addition, it is worrisome that some people, in particular children and young people, blindly force themselves to become vegetarian or even vegans without understanding how to compose and supplement a plant-based diet that lacks essential nutrients. Especially for a vegan diet, super-unsaturated fatty acids, vitamin B_{12} and D_3, taurine, creatine, and heme iron may lack as well as contain insufficient amounts of iodine and selenium (Kristensen et al., 2016; Petti et al., 2017). A vegan diet may therefore pose a challenge to accommodate the varying dietary needs that exist across the entire life-span, specifically for vulnerable groups such as children, adolescents, elderly, and sick people.

Let's start noting that plants, in general, do not "want" to be eaten. The roots, the stem, the foliage, and unripe fruits are not supposed to be eaten, and that is why they are often bitter, sour, and poisonous in some cases (McGee, 2004). This is a chemical defense system developed by organisms that are unable to run away from an enemy. Only the ripe fruits are meant to be eaten by animals in order for the plant to reproduce. Hence, these fruits are sweet and some of them have umami taste, like the tomato (due to free glutamate). In the absence of muscles, plants do not have as much ATP as animals, and ATP is s source of free nucleotides (e.g., inosinate) that synergistically act with free glutamate to elicit enhanced umami-taste (Mouritsen and Khandelia, 2012). Hence, green plants generally lack sweetness and umami—two basic tastes humans are born to crave.

The reason for this craving is rooted in human evolution (Wrangham, 2009). Sweetness is a signal of calories, and umami a signal of accessible proteins, both factors that are important for survival. Our distant ancestors, the Australopithecines, were fruit eaters, and their craving for sweetness signaled by the aroma of the ripe fruits have stayed with us. However, for more than two million years and increasingly after humans started using the fire for cooking about 1.9 mio. years ago, we have also been meat-eaters (Wrangham, 2009). This energy and protein-dense diet has been a prerequisite for the evolution of our big and energy-consuming brain. In the present context, meat elicits umami taste as it is rich in free glutamate and free inosinate, which we over time have come to associate with deliciousness (Mouritsen and Styrbæk, 2014).

Faced with the challenge of eating 500–600 g greens a day, we are thus confronted with fundamentals of plant biology and human evolution. We are looking at a large quantity of foodstuff that is not really tasty enough. It simply lacks sweetness and umami. But there is a cure for this and that is what cooking and the culinary sciences are about, and it is not a matter of only adding sugar and MSG.

There are several ways of providing a green diet with sweetness and umami. One is to prepare the food such as vegetables by adding natural ingredients that add sweetness (e.g., fruits) and umami (seaweeds, algae, fungi) or by using extracts and fermented products based on plant material (e.g., fermented vegetables and yeast products). This approach will be fully vegan but can be quite cumbersome. Vegetarians have more options by eating eggs and fermented dairy that supply umami. Flexitarians have many more possibilities by supplementing their green diet with marine foods like fish, mollusks, and shellfish as well as taste-intensive fermented sauces of fish and shellfish, foodstuff that all are umami-rich (Mouritsen and Styrbæk, 2014). Little utilized marine resources such as algae and seaweeds can also be excellent sources of umami taste in addition to contributing high nutritional value (Mouritsen, 2013; Mouritsen et al., 2019).

Another way involves technological improvements, using state-of-the-art food processing as a solution to transfer inedible foods and by-products into edible food, converting plant-based ingredients into umami-tasting foods, e.g., by various fermentation techniques (Mouritsen, 2018). However, consumer attitude toward processed foods is rather negative (Foodnavigator.com, 2019) and negative publicity about processed foods is a problem when not building on factual insight into those processing techniques that can ensure sustainability along with food quality and taste (Rego et al., 2017). As for meat, various degrees of sustainability and quality exist when it comes to processing.

Meat of animal origin is the easiest way of obtaining umami. Hence, it becomes an important issue to differentiate various types of animal-based food sources according to the degree of sustainability, and not only their animal-specific origin. This would favor use of animal-based by-products processed by a

high-quality production processes designed to optimize umami taste, e.g., traditional garum and soy sauce processing (Mouritsen et al., 2017), under-utilized animal resources, e.g., cephalopods (Faxholm et al., 2018; Mouritsen and Styrbæk, 2018), and specific national invasive animal species as the Pacific oyster in Scandinavia. In this perspective, meat may be consciously chosen and applied as a seasoning rather than the main part of a meal.

Strategic approaches made by private organizations, academia, and the government should apply a holistic approach when it comes to recommending sustainable diets in order to be more successful in getting people to eat more plant-based diets. A holistic approach may encounter multiple measures instead of merely excluding meat and processed foods in general. Such a holistic approach may be supported by the findings by Springmann et al. (2018). These authors investigated several options to obtain a global sustainable food system, including plant-based dietary changes, technological improvements, and reduction of food waste and found that no single measure is enough to keep planetary effects in order simultaneously, but that a synergistic combination would be needed (Driscoll, 2019).

We would advocate a lacto-ovo-vegetarian or flexitarian approach, using animal sources as a minor part of a meal or as a means of seasoning, as the most sensible and realistic way of eating sustainably in order to meet the EAT-Lancet Commission's recommendations since rather small amounts of umami-rich foodstuffs from animals can make large volumes of green food delicious for a large population on a daily basis (EAT, 2020). In this way, more people may be prepared to change their diet since they would not have to replace food with nutritional supplements, change fundamental social and ethnic traditions, and most importantly, they may not have to fight against their evolutionary determined cravings for umami. Social and psychological challenges in changing one's diet toward eating more plant based may be less pronounced when applying these recommendations rather that adopting a strict vegan diet.

It should be remarked, that any change in dietary pattern should conform to the general needs for essential nutrients, e.g., amino acids, vitamins, and super-unsaturated fatty acids, as well-account for the unique nutritional status and requirements of the individual, in particular children, elderly, and people with diseases. Finally it should be recognized that there are a number of other social and psychological factors that influence people's food choice and acceptance, such as gender, moral, and attachment to meat (O'Doherty Jensen and Holm, 1999; Ruby and Heine, 2011; Graça et al., 2015; Spencer et al., 2018).

In our view, sustainable eating has to be built on a holistic approach. Asking a major part of the global population for going vegetarian or even vegan is simply not a realistic option neither in the short or in the long run. Sustainable eating on a global scale is not a one-way street.

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OPINION
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A Role for Macroalgae and Cephalopods in Sustainable Eating

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Keywords: food, sustainable eating, seaweeds, squid, octopus, cuttlefish, umami

Since the sea is infinite and of unmeasured depth, many things are hidden . . .
Oppian of Anazarbus: Halieutica
(second century Greco-Roman poet)

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It is well-established that our close ancestors, *Homo erectus*, did not evolve on the dry warm grasslands in Africa, but in coastal regions near the ocean or at great lakes (Crawford and Marsh, 1989; Cunnane et al., 2014). Apart from archaeological testimony, the most crucial argument for this statement is that only with access to plenty of marine food supplies would our ancestors be able to acquire sufficient amounts of those essential fatty acids, the super-unsaturated omega-3 and omega-6 fatty acids, in addition to certain micronutrients, like iodine, iron, copper, zinc, and selenium, which are absolutely critical for building a complex neural system and a brain with the very large brain/body weight ratio (2.1%) that is characteristic for humans (Cunnane et al., 2014; Cornish et al., 2017).

This evolutionary path is important to keep in mind when evaluating which routes to take toward a more sustainable eating behavior that is also healthy in the long run. A sustainable diet has been defined as a diet produced with little environmental impact, and which is protective and respectful of biodiversity and ecosystems, nutritionally adequate, safe, healthy, culturally acceptable, as well as economically affordable (Pimentel and Pimentel, 2003; Aleksandrowicz et al., 2016; Chai et al., 2019). The essential nutrients of marine food and the associated flavors must therefore also be taken into account when proposing a new, sustainable, healthy, and palatable path of eating behavior. According to Sproesser et al. (2019), modern diets are dominated by a high consumption of energy-dense foods, diet drinks and foods, refined foods, animal foods, oils and fats, as well as too much salt, whereas former traditional diets were characterized by consumption of basic foods (i.e., "everyday" foods), plant-based foods, grains, fruit, vegetables, and fiber. An obvious solution to eat more sustainably would be reverting to a traditional diet and include marine foods. However, the general trend of eating behaviors, in particular in the Western world and affluent countries, is that the diet contains less marine food sources than before, and more meat and highly processed plant-based foods and oils (Willett et al., 2019, and references therein).

A little background is in order to appreciate what is at stake: It is universally found in all species with neural systems that the neural membranes, including the brain, contain about 60% fat (dry weight) of which more than half are super-unsaturated fatty acids (Cunnane et al., 2014), in particular omega-6 arachidonic acid (20:4) and adrenic acid (22:4), and omega-3 docosahexaenoic acid (DHA, 22:6) and eicosapentaenoic acid (EPA, 22:5). Even more striking is that the total amount of all omega-6 fatty acids in the brain is almost the same as the total amount of all omega-3 fatty acids, rendering the ratio omega-6/omega-3 in the brain close to 1 (Crawford, 2007). All these fatty acids are essential fatty acids, i.e., our bodies have only insufficient mechanisms to synthesize them and hence they have to be acquired via our food. The access to these fatty acids is therefore considered a determining factor in the evolution of modern humans (Crawford and Marsh, 1989).

Comparison of the diet of earlier populations with present populations reveals many differences, e.g., the content of dietary fibers (Makki et al., 2018), but maybe the most striking difference is the omega-6/omega-3 ratio that now appears to be way out of balance and typically ranging from 5 to 25 and increasing (Simopoulos, 2002; Mouritsen, 2016). This gross imbalance has been suggested to be a main reason for the skyrocketing of neural related diseases, such as depression, bipolar disorders, and a wide range of other mental diseases that is now becoming a major and very costly global burden of human ill health (GBD 2017 Diet Collaborators, 2019). Researchers have raised concerns about this development not least in young subjects, suggesting that the human brain is under siege (Cunnane et al., 2014).

There are several reasons for the raise in the omega-6/omega-3 ratio of the diet (Simopoulos, 2002; Crawford, 2007). One is the growth in production of cheap omega-6-containing plant oils during the second half of the 20th century; another is the stagnation in fisheries and limitations in the growth of aquaculture due to environmental considerations. The requirement for omega-3 fats in the diet poses constraints on the calculations underlying the proposal for a sustainable, healthy, and nutritious diet for a growing global population as outlined in the EAT-Lancet Commission report (Willett et al., 2019).

So where do the super-unsaturated fatty acids come from? They are all synthesized at the bottom of the food web by the algae, both the microalgae and the macroalgae (seaweeds). Only these organisms have the enzyme systems required to produce the super-unsaturated fatty acids from other fatty acids (Cornish et al., 2015). Neither we, other animals, nor plants can do that. The super-unsaturated fatty acids ascend through the food web and become accumulated particularly in marine organisms, such as fish, shellfish, and some mammals. This is where humans would usually source their essential fatty acids like DHA and EPA. However, in the context of sustainable eating behavior, eating from the top of the food web may not be the wisest way to use the global food resources, since typically 90% of the nutrients are lost when the food goes through each trophic level. Eating more sustainably points to eating closer to the bottom of the food web, in particular from the sea (Costello et al., 2019). Eating more sustainable marine food resources also implies considering eating marine species that are currently not exploited, not conventionally considered as food, or simply are only little known by consumers. We shall in the following address these routes to sustainable eating with main focus on macroalgae and mollusks.

Algae constitute a very heterogeneous diverse group of unicellular (microalgae like phytoplankton and cyanobacteria) and multicellular (macroalgae like marine seaweeds, cf. **Figure 1**) organisms. Being photosynthetic, the algae are responsible for producing most of the atmosphere's oxygen and fixating the most carbon dioxide (Chapman, 2013). They are found in all climatic belts on the planet and they can be harvested sustainable in the wild or farmed in aquaculture (Mouritsen, 2013; Pérez-Lloréns et al., 2018). Most seaweeds are considered edible and tasty (Mouritsen, 2017; Mouritsen et al., 2019a) and some with umami flavor (Mouritsen et al., 2019b). Seaweeds are an important part of the diet in many Eastern countries, but only sparsely exploited and eaten in the Western world. We would like to point out that seaweeds have to be an important part of eating more green in the future.

There are about 10,000 different species of seaweeds, and about 500 are exploited as food or food ingredients. The global production, most of which is derived from aquaculture (97%), amounts to about 30 million metric tons (FAO, 2018a). The future scenario of seaweed farming involves multi-trophic cultures covering also fish and mollusks (Ashkenazi et al., 2018). Seaweeds are generally high in both macro- and micronutrients as well as vitamins, and being algae, they synthesize super-unsaturated omega-3 fatty acids, in particular EPA (Mouritsen, 2013; Shannon and Abu-Ghannam, 2019). In relation to economic sustainability, a recent calculation has shown that the economic value of marine vegetation is almost 20 times higher than that of terrestrial forests per hectare (Pérez-Lloréns et al., 2018).

Turning to marine animals, world fisheries are under severe pressure due to overfishing, dwindling and endangered wild populations, as well as severe impact from the industrial fishing methods, although measures have been taken to control and manage wild fish populations (FAO, 2018b). Aquaculture currently account for almost half of the world fisheries (FAO, 2018b), but due to problems with sustainability, pollution, discharge of excess nutrients, and pressure on the natural marine ecosystems it will be difficult to scale up further to meet world demands for fish and shellfish. At the same time, a large volume of scrap fish and bycatch, although getting more tightly regulated by international agencies, are either discarded or processed for feed to livestock and fish farms. Some of the "scrap" fish such as sprat are mostly caught commercially for feed and never directly reach the consumer before it has been turned into pork or farmed salmon, even if sprat actually has high gastronomic value. We are simply not accustomed to eating it. The latter holds also true for other fish or mollusk species, such as Pacific oysters or round goby, which traditionally may not be known in a particular food culture but may have ventured into the local waters as an invasive species adapting to climate changes.

Cephalopods (squid, cuttlefish, and octopus; cf. **Figure 2**) are an example of mollusks that are eaten in some parts of the world and not in others, even if they are abundant in the local waters. In contrast to the dwindling populations of finfish, it was recently reported that the global populations of all fished cephalopod species appear to be on the rise and have been so for the last almost 60 years, possibly having benefited from changes in the ocean (Doubleday et al., 2016). It immediately poses the question: why do we not eat more of them (Mouritsen and Styrbæk, 2018)? Out of the 800 global species, about 30 are used as human food, and the annual catch amounts to 5% of the world fisheries and it is increasing rapidly (FAO, 2018b). Cephalopods are thus a rather unexploited marine crop, despite being high in protein, minerals, trace elements, B_{12}-vitamin, and fair amounts of super-unsaturated fatty acids (DHA and EPA) although the contents of fatty acids are much lower than in fatty fish but similar to that of lean fish.

So, there appears to be good reasons to consider consuming more seaweeds and cephalopods when changing eating behavior

FIGURE 1 | An edible seaweed, dulse (*Palmaria palmata*), a delectable seaweed with a considerable umami potential (Permission to reprint by Jonas Drotner Mouritsen).

FIGURE 2 | Illustrations of the three most common classes of cephalopods that are used for eating: octopus, cuttlefish, and squid (Permission to reprint by Ene Es).

toward more sustainable and healthy eating. But what are the obstacles? Obviously, tradition, culture, and availability are key factors (Mouritsen and Styrbæk, 2018; Pérez-Lloréns et al., 2020) and often also taste and texture are limiting factors. Our opinion is that by addressing precisely these two sensory aspects of impacting eating behavior we may have a chance of stimulating changes. Interestingly enough, often marine flavor is claimed to be a barrier for eating seaweeds, despite of the fact that desirable umami taste often accompanies seaweeds, whereas undesired texture is mentioned as an obstacle for appreciating cephalopods, like squid and octopus (Mouritsen and Styrbæk, 2018). Culinary sciences, gastrophysics, and cooking practices can be invoked to confront these issues (Faxholm et al., 2018).

Umami as a basic taste was first identified in the kind of seaweed (konbu, *Saccharina japonica*) that constitutes a key component in the Japanese soup broth dashi that is associated with deliciousness (Mouritsen and Styrbæk, 2014). Dashi is an aqueous extract of konbu and it can be used to impart umami taste to other ingredients, not least green food like vegetables, which often lacks umami taste (Schmidt and Mouritsen, 2020). "Umamification" of vegetables may be one route to eating more green, either by using dashi or seaweeds as whole foods (Mouritsen, 2013, 2018). In the present authors' opinion, "umamification" is a key to meeting our craving for umami taste, shaped by more than 2 million years of the evolution of humans as meat eaters (Wrangham, 2009).

Turning toward cephalopods as a source of food, they are as much a source of protein as other marine foodstuff and they are rich in those compounds that elicit umami and sweetness (Faxholm et al., 2018). The texture can be challenging due to the abundance and nature of the collagen in cephalopod muscles, but as with other types of meat this can be handled by culinary insight, craftsmanship, and scientific knowledge (Faxholm et al., 2018; Styrbæk and Mouritsen, 2020) as is well-known in the Japanese cuisine. It should be noticed that cephalopods are meat and from animals, even if they are mollusks and invertebrates. As it is becoming clearer that some of the cephalopods, and most certainly octopus, have a very advanced neural system and a brain that may be seat of consciousness like vertebrates (Cambridge Declaration of Consciousness, 2012), some may stay away from eating them. Steps have therefore also been taken to develop methods for humane slaughtering of cephalopods (Fiorito et al., 2015; Holden-Dye et al., 2020). On the other hand, cephalopod meat may be an attractive substitute for meat from land animals for consumers that absolutely want to eat meat but has a keen eye to more sustainable eating. Here the growing and thriving global populations of cephalopods may play an important role. Since cephalopod meat has umami taste, small amounts of this meat could help make a vegetable diet more delectable for flexitarians.

In addition to sensory and physiological factors, there may be social and psychological factors preventing one from eating strange things like seaweeds and cephalopods. The words "weed" or "wrack" that are used for some seaweeds thrown ashore from the sea, lying smelling and rotting at the foreshore, do not give good connotations to food. However, this is very dependent on culture and language. In Western food cultures, attempts have been made to give a more positive image to seaweeds by proposing terms like "sea vegetables," "sea greens," or "ocean greens" and to further boost them by using plus words like "superfood" or "future food." It is likely that the globalization of food, the increasing influence of Eastern food cultures, along with a focus on the health benefits of eating seaweeds are responsible for the current increase in the interest and consumption of seaweeds in both North America and in

Europe (Organic Monitor, 2014; Chapman et al., 2015; Lucas et al., 2019; Pérez-Lloréns, 2019).

Finally, gender differences may play a role in the further move toward more sustainable eating involving seaweeds and cephalopods. Women have showed themselves as an avantgarde regarding adopting an environmentally more sustainable consumer behavior (Iris et al., 2018) including a more green diet (O'Doherty Jensen and Holm, 1999) which also incorporates seaweeds and nutritional microalgae like Spirulina and *Chlorella*. In this respect males are lacking behind. However, here cephalopods may come in as a rescue when used as a condiment and flavoring agent for, e.g., vegetables, conforming to the observation that males tend to consider meat as a masculine form for food (Ruby and Heine, 2011; Graça et al., 2015). In any case, more knowledge and dissemination of scientific knowledge coupled with gastronomic innovation will be important for promoting and substantiating a move toward sustainable eating involving macroalgae and cephalopods (Sørensen and Mouritsen, 2019).

AUTHOR CONTRIBUTIONS

OM conceived the work and wrote the first draft. CV did further literature research for the paper. Both authors completed the manuscript and provided approval for publication of this work.

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REVIEW
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Environmentally Sustainable Food Consumption: A Review and Research Agenda From a Goal-Directed Perspective

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The challenge of convincing people to change their eating habits toward more environmentally sustainable food consumption (ESFC) patterns is becoming increasingly pressing. Food preferences, choices and eating habits are notoriously hard to change as they are a central aspect of people's lifestyles and their socio-cultural environment. Many people already hold positive attitudes toward sustainable food, but the notable gap between favorable attitudes and actual purchase and consumption of more sustainable food products remains to be bridged. The current work aims to (1) present a comprehensive theoretical framework for future research on ESFC, and (2) highlight behavioral solutions for environmental challenges in the food domain from an interdisciplinary perspective. First, starting from the premise that food consumption is deliberately or unintentionally directed at attaining goals, a goal-directed framework for understanding and influencing ESFC is built. To engage in goal-directed behavior, people typically go through a series of sequential steps. The proposed theoretical framework makes explicit the sequential steps or hurdles that need to be taken for consumers to engage in ESFC. Consumers need to positively value the environment, discern a discrepancy between the desired versus the actual state of the environment, opt for action to reduce the experienced discrepancy, intend to engage in behavior that is expected to bring them closer to the desired end state, and act in accordance with their intention. Second, a critical review of the literature on mechanisms that underlie and explain ESFC (or the lack thereof) in high-income countries is presented and integrated into the goal-directed framework. This contribution thus combines a top-down conceptualization with a bottom-up literature review; it identifies and discusses factors that might hold people back from ESFC and interventions that might promote ESFC; and it reveals knowledge gaps as well as insights on how to encourage

both short- and long-term ESFC by confronting extant literature with the theoretical framework. Altogether, the analysis yields a set of 33 future research questions in the interdisciplinary food domain that deserve to be addressed with the aim of fostering ESFC in the short and long term.

Keywords: environmental sustainable consumption, environmental sustainable food, goal-directed, positive value, perceived discrepancy, behavioral intention, goal intention, act

INTRODUCTION

Climate change endangers unique eco-systems, leads to more extreme weather events, reduces biodiversity, and in many ways threatens our current way of living (O'Neill et al., 2017). Household food consumption gives rise to more than 60% of global Greenhouse Gas emissions and between 50 and 80% of total resource use (Ivanova et al., 2016). Thus, making people's eating patterns more environmentally sustainable is becoming ever more important (Springmann et al., 2016; Hartmann and Siegrist, 2017; Magrini et al., 2018; Hedin et al., 2019). Particularly in high-income countries, transforming food consumption is deemed an essential condition for reaching global sustainability goals (UN, 2016). The current review therefore focuses on different behavioral strategies to promote environmentally sustainable food consumption in high-income countries.

Environmentally Sustainable Food Consumption (ESFC) can be defined as the use of food products "that respond to basic needs and bring a better quality of life, while minimizing the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardize the needs of future generations" (Oslo Roundtable on Sustainable Production and Consumption, 1994). Major examples of ESFC include increasing consumption of plant-based (Lea et al., 2006) or insect-based foods (Megido et al., 2016), while decreasing meat consumption (Hoek et al., 2004), and opting for seasonal products (Macdiarmid, 2014). In some but not all instances, buying locally produced (MacGregor and Vorley, 2006) and/or organically produced food (Hughner et al., 2007) may also be more environmentally sustainable.

Food preferences, choices and habits occupy a central role in human cultures and food consumption goes far beyond its functional role as a means to survive. Food habits are notoriously hard to change as they are a central aspect of people's lifestyles (Sonestedt et al., 2005; Flaherty et al., 2018) and their socio-cultural environment (Wright et al., 2001; Carrus et al., 2018; Cairns, 2019). Food choices are also subject to marketing efforts of food companies that have caused changes in dietary norms, in food and drink category preferences (at population level) and in the cultural values underpinning food behaviors (Cairns, 2019). The complexity of food related decisions makes them susceptible to a wide range of social, cognitive, affective, and environmental influences (Bublitz et al., 2010). In sum, efforts to promote ESFC compete with other contextual influences on people's food choices.

Against this backdrop, it is hardly surprising that many consumers express environmental concern but do not consistently act on it. That is, consumer attitudes toward environmental sustainability are mainly positive, but there is a notable gap between favorable attitudes and actual purchase of sustainable food products, i.e., the attitude-behavior gap (Vermeir and Verbeke, 2006; van Dam and van Trijp, 2013; Aschemann-Witzel and Zielke, 2017).

By formulating a comprehensive theoretical framework in which we integrate academic insights and research findings from different disciplines, the current work aims to contribute to behavioral solutions for environmental challenges in the food domain. First, a goal-directed framework for understanding and influencing ESFC is built. The core assumption of the framework is that, like most human behavior, food consumption is either deliberately or unintentionally directed at attaining goals (Otto et al., 2014). From a goal-directed perspective, food consumption can be directed at the goal of minimizing adverse environmental impact, but people also buy and eat food products to satisfy hunger, to achieve sensory pleasure, to signal social status, to comply with norms and reference groups, etc.

Secondly, we critically reviewed the literature on explanatory, underlying mechanisms related to ESFC in high-income countries, and integrated extant research insights in our framework. Our intended contribution is to answer two key questions: What factors prevent or favor ESFC? And what are the most effective strategies to promote ESFC? While our primary focus is on ESFC, we also include research insights on sustainable consumption in general to highlight potential avenues for future research in the domain of ESFC. By confronting the extant literature with the goal-directed framework, we aim to reveal knowledge gaps as well as insights into how to encourage both short- and long-term ESFC.

The current review differs from previous reviews in several respects. First, we combine a top-down conceptualization with a bottom-up literature review. That is, we start from a comprehensive theoretical framework of goal-directed behavior that delineates necessary components that must be in place for ESFC to occur. Next, we evaluate the extant research (based on a structured, narrative literature review) and identify research gaps based on the framework. Most other reviews build their frameworks only on the basis of reviewed studies, or build their frameworks on the basis of commonly applied theories e.g., Theory of Planned Behavior or Value theory (Aertsens et al., 2009), or limited their literature review to these theoretical applications (Bamberg and Möser, 2007), resulting in a kind of research myopia. That is, by putting too much focus on what is already done and known, there is a risk of missing opportunities and shortcomings that have not yet been studied. Because our framework is constructed independently from the screening of the literature, our framework is well positioned to uncover gaps

in research (and thus, to help prioritize future research). This approach can also be used to take stock of the literature on a regular basis, which is essential as the literature on ESFC is growing at an exponential rate (Popescu et al., 2019).

Second, our focus is on identifying research gaps on ESFC. On the one hand, this makes our scope more specific than other reviews concerned with sustainable consumption in general (e.g., White et al., 2019). This allows us to (also, but not only) zoom in on research that may not generalize beyond the context of ESFC. On the other hand, our review is less narrow in scope than other recent reviews that focus, for example, on the transition from meat to plant-based diets (Graca et al., 2019) or on social desirability bias in ecological food research (Cerri et al., 2019). This makes the current review relevant to a broader audience interested in the current state-of-the-art concerning ESFC. Note that we do not study food production, processing, packaging, storage or food waste, for which research/interventions on whole ecosystems are also urgently needed.

Third, many researchers focus either on identifying the "green consumer" segment (Verain et al., 2012) or on specific drivers and barriers of ESFC and their boundary conditions (White et al., 2019). We start from the behavioral process itself by looking into the steps people go through when engaging in goal-directed behavior. We identify for each step interventions that can support people in taking these steps. In doing so, we go beyond work on the predictors of sustainable consumption or behavioral intention (for reviews, see for example Milfont and Markowitz, 2016; Rana and Paul, 2017; White et al., 2019) by suggesting a behavioral process-driven framework that shows how the environment can be influenced via effective interventions as a means to realize enduring behavioral change in ESFC. Hereby we offer both researchers and practitioners a guidance for further research. Notwithstanding the relevance of changes at the macro-level and meso-level (including legislation, taxation, infrastructure, etc., Prothero et al., 2011; Garnett et al., 2015; Reisch and Thøgersen, 2015), the focus of the current review is on micro-level interventions.

A GOAL-DIRECTED FRAMEWORK APPLIED TO ESFC AND INTERVENTIONS TO PROMOTE ESFC

Goals can be defined as desired end states. Hence, goal-directed behavior can be defined as behavior directed at attaining a desired end state (Kruglanski et al., 2015). These definitions imply that for goal-directed behavior to occur, several components need to be in place. Following the work done by Moors et al. (2017) and Moors (2019), we propose a model that posits five components: consumers need to: (1) positively value the environment, (2) discern a discrepancy between the desired versus the actual state of the environment, (3) opt for action to reduce the discrepancy (i.e., goal intention), (4) intend to engage in behavior that is expected to bring them closer to the desired end state (i.e., behavioral intention), and (5) act in accordance with their intention.

First, the end state at which a behavior is directed needs to have a positive value. If an end state is not valued, it will not be pursued. For instance, you are unlikely to reduce your red meat consumption for ecological reasons if you do not want to reduce your ecological footprint. Second, people will engage in goal-directed behavior only when they perceive a discrepancy between the current state and the end state that they value. If there is no perceived discrepancy, there is no reason to act with the aim of reducing the discrepancy. For instance, if you value a low ecological footprint, you are less likely to reduce your red meat consumption to lower your footprint if you think that your ecological footprint is already low. Third, even when there is a perceived discrepancy between the current state and a desired end state, people might choose not to act to accomplish their goal but rather to subjectively devalue the desired end state (so that it is no longer important to pursue this state) or to change their beliefs about the discrepancy between the current and desired state (so that it is no longer necessary to act in order to reduce the discrepancy). For instance, when you know that your ecological footprint is high and you want to lower it by reducing red meat consumption, you might decide that lowering your ecological footprint is not that important in the short term anyway or you might compare your own ecological footprint to people who perform even worse than you, concluding your footprint is actually okay. Fourth, when people do decide to act in order to reduce a perceived discrepancy between the current state and a desired end state, they still need to decide how to act. It is typically assumed that they will choose an action of which they expect that it will bring them closer to the desired end state (e.g., Kruglanski et al., 2015). For instance, people are more likely to lower their red meat consumption than to lower soft drink intake if they expect that lowering red meat consumption is more likely to reduce their ecological footprint than lowering their soft drink intake. Once they have selected a behavior that is expected to bring them closer to the desired end state, we can say that they have formed a behavioral intention, that is, the goal to engage in a behavior that is expected to bring about a desired end state. Fifth, not all behavioral intentions are realized. A first class of hurdles for action relate to the ability of the individual to perform a behavior. If it is impossible to perform the intended behavior, it will not take place. For instance, someone is unlikely to switch to a vegetables-only diet if he/she does not have a clue where to buy such food or how to prepare it. A second reason for not performing an intended behavior relates to other goals that the individual strives for. For instance, it could be that the intended action not only promotes the goal at which it is directed but also hinders the attainment of other goals. If the benefits in terms of one goal are smaller than the costs in terms of other goals, then the intended behavior will not be executed. For instance, you are less likely to lower red meat consumption if you believe that you need the proteins from red meat to strengthen your muscles.

Although many models of goal-directed behavior have been put forward in the literature (e.g., Carver and Scheier, 1981; Locke and Latham, 1990; Bagozzi, 1992; Bagozzi and Dholakia, 1999; Gollwitzer, 1999), we focused on the ideas proposed by Moors et al. (2017) because they provide a uniquely detailed overview of the specific components of goal-directed behavior,

that is, the various decision steps that people go through, starting from when they set their goal until they accomplish it. Moreover, we followed the extension of this framework by Moors and colleagues (Moors, 2019; Köster et al., 2020) in which they provided a systematic overview of the types of problems that can arise in each of the steps of the decision process as well as types of solutions. The specific contribution of the current paper lies in (a) the application of this extended framework to the domain of ESFC as a tool for organizing the literature and (b) highlighting behavioral solutions to promote ESFC. As such, we organize the literature in terms of the different steps put forward by Moors and colleagues and extend previous literature by identifying interventions that can help people to take these steps to accomplish ESFC. When, in the remainder of this paper, we refer to "our framework" or "our conceptual model," we thus refer to the extended framework of Moors (2019) and Köster et al. (2020) as it is applied to ESFC.

For each component of our framework, we highlight which interventions could take place so that all conditions are met for individuals to engage in ESFC. **Figure 1** shows an overview of our framework and the related interventions. An overview of the suggested future research questions can be found in **Table 1**.

We illustrate these interventions with several examples from previous research within the domains of behavioral economics, social and personality psychology, communication and behavioral sciences, and food and agricultural economics. To select the literature, we conducted a structured literature search in Web of Science combining specific keywords indicating the environmental friendly character (e.g., "environmental sustainable," "ecological") with the consumption aspect (e.g., "consumption," "choice") and the food aspect (e.g., "food," "eating"). This resulted in 60268 papers. We refined our search to include food sciences, behavioral sciences, business, psychology, economics, and management journals and papers published between 2010 and 2020. Within the frame of selected papers published between 2010 and 2015, we only selected those that were cited three or more times (indicating the paper's relevance) resulting in 3648 papers. These papers were screened on quality and relevance which were determined through consensus among the authors before inclusion in our analysis. We excluded papers that did not handle ESFC or focused on production methods or technical aspects of ESFC. In line with our focus on high-income countries, we also excluded papers that solely focused on emerging markets (e.g., Brazil, Thailand). We ended up with 339 papers illustrating the literature on ESFC. This set of papers was then read to give us a fair indication whether and how the components in our framework have been tackled in research and which gaps need to be closed. To strengthen the discussion, we complemented these selected papers with papers that offer general theoretical insights from outside the ESFC domain but can be applied to it. The current paper thus offers a structured, narrative review of literature relevant to ESFC.

Step 1: Positive Value

Conceptual Background

The end state at which a behavior is directed needs to have a positive value. If an end state is not valued, it will not be pursued. Consumers will engage in ESFC only if they value the environment and/or the improvement of its state. Hence, an important first step into encouraging ESFC is to promote environmental values. Environmental values encompass the goal to act in an environmental friendly manner, for instance by purchasing environmental sustainable (food) products (Bardi and Schwartz, 2003). The relation between valuing the environment and environmental sustainable consumption has been established in several studies for non-food (e.g., Haws et al., 2014) and food products (e.g., Vermeir and Verbeke, 2008). For example, de Boer et al. (2013) observed a negative relationship between Dutch people's endorsement of care for nature as a value and current meat consumption as well as the willingness to eat one or more meals without meat every week in the future.

Data suggest that the proportion of consumers who engage in environmentally sustainable consumption for environmental reasons in particular, is relatively limited. For example, Mullee et al. (2017) examined the reasons to reduce future meat consumption in Belgium and found that as little as 11.1% of the omnivores and flexitarians would consider eating a more vegetarian diet because of the impact of meat on the environment/climate. Yet, individuals can engage in ESFC for other reasons than its positive effect on the environment. For example, people can buy environmentally sustainable products for functional, social, ethical or emotional reasons (Mullee et al., 2017; Sangroya and Nayak, 2017) like price and health (e.g., nutritional value, food safety) perceptions, sensory appeal (e.g., taste), animal welfare and supporting the local economy (Hughner et al., 2007; Bauer et al., 2013; Banovic et al., 2019).

Interventions to Activate Positive Value for Individuals Who Value the Environment

Even if individuals value the environment, it may still be beneficial to increase the salience of these environmental values at the point of decision making to ensure they positively affect decision making (e.g., Verplanken and Holland, 2002; Dijksterhuis et al., 2005; Verplanken et al., 2008). Several ways have been identified to activate environmentally sustainable values, including priming (Verplanken et al., 2009; Hahnel et al., 2014) and the activation of personal norms (de Groot and Steg, 2009).

Prime environmental values

For people who value environmental goals, priming environmental values (i.e., increasing their accessibility or the ease with which they can be retrieved from memory), or activating other associated constructs in memory (Wheeler et al., 2005), can be used to make environmental values more salient (Chartrand and Bargh, 1996). Loebnitz and Aschemann-Witzel (2016) primed environmental values by instructing their participants to think about five environmental values (e.g., preserving nature, caring for future generations). Once a motivation to pursue a value is activated, goal-directed cognitive and behavioral processes may follow spontaneously and result in goal-congruent choices (e.g., Bargh, 1990), especially when these values are personally relevant (Fazio, 2001). Priming environmental values could also help people to forgo immediate rewards in the present for longer-term payoffs in the future (self-regulation, Baumeister et al., 1998). In a food context, priming environmental values

increases the importance of environmental friendly product attributes (Loebnitz et al., 2015) and increases product (health and quality) expectations for organic-labeled food items (Loebnitz and Aschemann-Witzel, 2016).

Activate personal norms

In addition to priming, activating personal norms (i.e., self-expectations that are based on internalized values, Schwartz, 1977) can indirectly activate environmental values (cf. the Value–Belief–Norm theory; Stern, 2000) and consequently trigger pro-environmental behavior (Lindenberg and Steg, 2007; Steg et al., 2014) for individuals for whom environmental values are central to the self. To activate personal norms one's awareness of environmental issues can be increased, for example, by pointing out the environmental impact of behavior and the fact that these consequences can be averted. As a surplus, providing environmental knowledge to people who highly value the environment strengthens these values. Zepeda and Deal (2009) suggest that increased knowledge on organic and local food production reinforces existing values, which -via changed attitudes- support environmentally sustainable purchase behavior (i.e., local food). Personal norms can also be activated by increasing feelings of responsibility (de Groot and Steg, 2009), by asking people to think about behaviors associated with strong personal norms or by making people solve a word puzzle including sentences like "give your best work," or "meet your own target" which primes personal norms (Chandon et al., 2011). We propose the following Future Research (FR) Question:

→ FR 1. To what extent does activating personal norms strengthen environmental values?

Interventions Targeting People Who Do Not Value the Environment

The interventions discussed in the previous section target people who already have (latent) pro-environmental values. For people who do not have pro-environmental values, other interventions are required. However, most interventions mentioned in this section may also have a positive impact on people who have positive pro-environmental values. If consumers do not value the environment, we distinguish between four possible courses of action: (1) strengthening the relative value of the environment through persuasion; (2) promoting ESFC through harnessing goals unrelated to ESFC; (3) strengthening the relative value of ESFC through punishment of undesirable outcomes of non-ESFC; and (4) evoking immediate behavior.

Strengthening the relative value of the environment through persuasion

Values do not change overnight. As people more clearly experience local impacts and recognize environmental change, the segment of society that sees climate change as a threat is expected to gradually grow (Marshall et al., 2019). To speed up this process, the value of the environment could be strengthened by communication messages focusing on (1) mental imagery of the (negative) consequences of (not) acting sustainably, (2) positive cueing, (3) social norms, or (4) issue severity.

Evoke mental imagery. Gregory and Leo (2003) provide evidence that personal involvement develops when individuals become aware of the consequences of their behavior. Making people think about the future benefits of the sustainable action could make it more desirable in the present (Reczek et al., 2018). When the aversive consequences of failing a subgoal (e.g., failing to

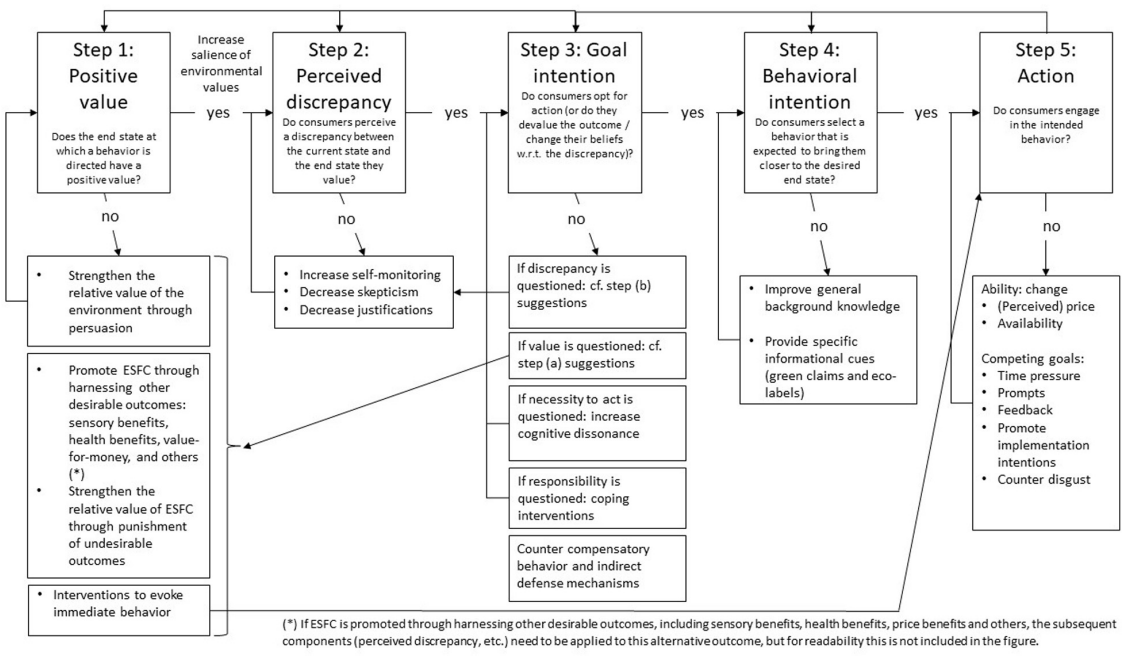

FIGURE 1 | A Goal-Directed Framework Applied to ESFC.

TABLE 1 | Overview of future research questions.

Positive value	(1) To what extent does activating personal norms strengthen environmental values? (2) Which verbalizations and visualizing techniques increase the value of the environment? (3) When does positive cueing increase the value of the environment? (4) To what extent and when do interventions activating social norms affect the value of the environment? (5) To what extent and under what conditions can fear appeals enhance value of the environment? (6) What is the interplay between interventions strengthening the relative value of the environment and how do they call upon people with either negative/absent/latent/salient pro-environmental values? (7) To what extent, when and why does stressing sensory aspects or using anthropomorphic techniques increase ESFC? (8) Under which conditions can interventions stressing health benefits increase ESFC? (9) To what extent can ESFC be increased by stressing value for money? (10) Which non pro-environmental (perceived) benefits can act as potential reasons for engaging in ESFC? (11) To what extent can ESFC be increased by providing (non-) financial incentives? (12) Which conditions or interventions can create solid consumer support for taxes on non-ecological alternatives? (13) Which nudging interventions positively affect ESFC; to what extent do nudging interventions influence ESC by increasing public awareness or environmental values?
Perceived discrepancy	(14) Which interventions decrease skepticism toward environmental issues? (15) To what extent and how can justifications be minimized?
Goal intention	(16) To what extent can increasing cognitive dissonance increase goal intention? (17) To what extent can evoking guilt or pride or stressing coping mechanisms increase an individual's sense of personal responsibility and goal intention? (18) How can compensatory beliefs, licensing and the negative footprint illusion be countered? (19) Which indirect defense mechanisms do people use and how can they be reduced?
Behavioral intention	(20) Which typology of labels can bring structure to the labeling literature? (21) What is the moderating effect of labeling characteristics on their effectiveness? (22) How to effectively communicate (multiple) environmentally relevant product attributes (other than organic)? (23) How do different eco-labels interact and how do eco-labels interact with other types of labels and other information?
Action	(24) Which interventions decrease prices and price perceptions? (25) Which interventions are effective for less affluent target groups? (26) How can digital displays, mobile apps, gamification and social media trigger ESFC? (27) How can implementation intentions increase the probability that behavioral intentions are translated in actual ESFC actions? (28) Which behavioral interventions can counter disgust reactions to environmental sustainable foods that are perceived as (visually) unappealing?
General directions for future research	(29) Investigate whether combining different interventions aimed at enhancing ESFC produces add-on effects. (30) Test the long term effects of interventions and how interventions should be adapted to have long-term effects. (31) How to assess sustainability of a food product and how to clearly communicate this environmental impact to customers? (32) Do implicit attitudes predict other sustainable behaviors than explicit attitudes and how can both types of attitudes be changed using the same or different interventions? (33) How to measure attitudes that more closely align to the more concrete level at which actual food choices are being made by consumers in their daily lives?

recycle a newspaper) are shown, the perceived importance of the related end goal (e.g., sustaining the natural environment) increases (Devezer et al., 2014). Communications focusing on the negative consequences of failing an environmental subgoal can make the benefits of pro-environmental behaviors more concrete, visible and feasible so that they outweigh the costs of sustainable behavior (Guthrie et al., 2015). Devezer et al. (2014) suggest that individuals could be stimulated to find environmental values more important when they can easily visualize this end goal. Messages should explain precisely how a behavior change should occur (White et al., 2011) and what the outcome could be, and this explanation should be vivid and involving without having vivid and distracting additional information (Bator and Cialdini, 2000). Also, messages that relate immediate impact of pro-environmental behavior to a specific location (Scannell and Gifford, 2013) or to the self (Spence et al., 2012; Reczek et al., 2018) can make environmental sustainable actions more tangible and relevant. Messages could encourage individuals explicitly to mentally simulate the portrayed outcome (e.g., "imagine a world without pollution"), present outcomes in a concrete way (e.g., by showing a clear sky free of smog), use easily interpretable verbal stimuli (e.g., "help build a clean world with clean skies"), or stimulate the immediate interpretation and elaboration of the presented outcome (e.g., "Think right now on the consequences of . . ."; also see "mental contrasting," discussed under "Competing Goals"). What is important here, is concretization of abstract risks, since this motivates action more than analytic understanding (Marx et al., 2007). An important related question pertains to the extent to which environmental issues can be represented by concrete, countable, tangible representations (e.g., a pile of waste, a cloud of exhaust, a deforested area,. . .).

→ FR 2. Which verbalizations and visualizing techniques increase the value of the environment?

Use positive cueing. Cornelissen et al. (2008) use positive cueing to engender pro-environmental self-perceptions and increase the feeling of moral obligation to act pro-environmentally. People often dismiss more common ecological behaviors like avoiding food waste or buying seasonal produce as non-diagnostic for their environmental conscious self-image and hence they fail to see themselves as environmentally conscious consumers (Cornelissen et al., 2008). Positive cueing entails cueing common environmental behaviors like avoid wasting food and buying seasonal produce as environmental so that this behavior becomes diagnostic for one's environmental conscious self-image (Cornelissen et al., 2008). This can be done, for instance, by framing common behaviors as pro-environmental in a questionnaire (e.g., by asking questions like "Which of the following pro-environmental actions do you usually engage in?"). This leads consumers to view themselves as concerned with the environment, subsequently resulting in more environmentally friendly food choices. Positive cueing could boost the importance of environmental values as it makes people see themselves as "someone who is willing to do an effort for the environment" and hence internally motivated to act upon that self-perception (Osbaldiston and Sheldon, 2003).

→ FR. 3. When does positive cueing increase the value of the environment?

Activate social norms. Social norms about eating have a powerful effect on both food choice and amounts consumed (Higgs, 2015). Social norms (i.e., the rules that guide, regulate and proscribe social behavior in particular contexts, Burchell et al., 2013) show people how they "should" behave. Behavioral choices are based on evaluations about what is right or wrong (Lindenberg and Steg, 2007). By showing social norm messages, social norms can be activated (Schwartz, 1977) and feelings of moral obligation could set in. These feelings are related to the beliefs and values that people adhere to (cf. Value-Belief-Norm theory, Stern, 2000) which suggests that environmental values could increase when seeing messages that activate social norms. Note, however, that social norms can also lead to ESFC when ESFC is seen as a way to achieve the alternative goal of behaving in line with social norms (Moors et al., 2017). Interventions using cues that suggest specific social norms or provide feedback on one's own behavior in comparison to the behavior of relevant others have been shown to effectively influence pro-environmental consumption behavior (Biel and Thøgersen, 2007; White et al., 2009; Kormos and Gifford, 2014; Onel, 2017) especially in social or public situations (Griskevicius et al., 2010; White et al., 2014). Demarque et al. (2015), for example, found that shoppers in an experimental online store bought more eco-labeled products when they received information on how many percent of previous shoppers bought ecological products (cf. norm activation model, Cialdini, 2003). As a downside, using a descriptive norm message could cause a boomerang effect if people think that non-environmental friendly behavior is the norm (Cornelissen et al., 2008). Hence, interventions that activate social norms could both encourage people to value or disvalue the environment.

→ FR 4. To what extent and when do interventions activating social norms affect the value of the environment?

Increase issue severity. Obermiller (1995) found that presenting a problem as severe or threatening should increase attention to messages and result in favorable attitudes toward the actions proposed in that message, especially when an environmental issue is considered as relatively unimportant. He suggests that (environmental) concerns can increase for people who value the environment less and who believe the claims put forward in the threat message. Relatedly, Cucchiara et al. (2015) found that interventions increasing awareness that the environment is under threat especially impact consumers who believe that their consumption choices will not make a difference and who minimize the negative environmental impact of human consumption practices. Furthermore, optimal results were found when both the severity of the problem was highlighted and information how to act upon it (cf. threat and coping appraisal, protection motivation theory, Rogers, 1975). On the other hand, research on fear appeals shows that they may be ineffective (Hastings et al., 1995), as evoking too much fear can have opposite effects. O'Neill and Nicholson-Cole (2009) also suggest that personal engagement with an environmental issue can decrease when confronted with fearful representations of climate change. Future research could investigate which degree of fear can increase the value of the environment and whether information on how to solve the issue in the threat appeal should be available to optimally enhance value of the environment. If not, inducing fear could possibly evoke defense reactions that negatively affect the value of the environment and environmentally sustainable food choices.

→ FR 5. To what extent and under what conditions can fear appeals enhance the value of the environment?

Different interventions can strengthen the relative value of the environment. Yet, several mechanisms may interact either negatively (e.g., fear appeals and positive cueing) or positively (e.g., positive cueing and descriptive social norms, i.e., norms describing what people usually do, or injunctive social norms, i.e., norms that indicate what people ought to do).

→ FR 6. What is the interplay between interventions strengthening the relative value of the environment and how do they call upon people with either negative/absent/latent/salient pro-environmental values.

Promoting ESFC through harnessing other desirable outcomes

If people do not value the environment (much), or if they have other, more dominant values, they can also be triggered into buying sustainable products as a way of attaining goals that they value more positively (e.g., buying more expensive organic food as a status symbol; van der Wal et al., 2016). Hence, the goal-directed perspective captures the fact that similar types of sustainable consumption can be motivated by different goals (e.g., saving money, achieving higher social status, eating healthier, acting ethically, . . .). As such, tapping into personal rather than environmental benefits could induce greener purchasing behavior in some instances (White and Peloza, 2009; Gifford, 2011; Green and Peloza, 2014; Feldmann and Hamm, 2015) as it may demonstrate that ESFC is consistent

with values, goals and beliefs that people who do not value the environment (much) adhere to Lindenberg and Steg (2007), Von Borgstede et al. (2014).

Highlight sensory benefits. People may seek sensory benefits from ESFC. Superior sensory appeal and taste are influential drivers for buying organic products for example (Renko et al., 2011). Research also found that sensation seeking is an important antecedent for acceptance of novel products (e.g., Lammers et al., 2019). The dominant approach to market novel food products is highlighting health or environmental benefits (Berger et al., 2018). This is surprising because emphasizing hedonic aspects like, for instance, the taste of insect-based foods would fit better with the underlying sensation seeking motive, and would also be more effective (Berger et al., 2018). Hedonic claims also outperformed health claims for atypically shaped vegetables of which taste expectations and naturalness perceptions are often negatively evaluated (Turnwald et al., 2017). Hedonic claims could also decrease feelings of disgust and consideration of unnaturalness that are an important barrier to consume cultured meat (Verbeke et al., 2015a; Anderson et al., 2019; Circus and Robison, 2019; Shaw and Iomaire, 2019). However, overruling spontaneous negative feelings (disgust, fear, ...) triggered by (visually) unappealing foods will be difficult. This calls for more research into the potential of interventions to stress the pleasurable sensory aspects of environmental friendly foods such as misshapen vegetables, cultured meat or insect-based foods. Current insights highlight, for example, the potential of anthropomorphic techniques (e.g., displaying misshapen produce with a smiling face and presenting shape abnormalities as body parts) to activate pleasurable feelings and stimulate the consumption of visually unappealing food (Cooremans and Geuens, 2019).

→ FR 7. To what extent, when and why does stressing sensory aspects or using anthropomorphic techniques increase ESFC?

Emphasize health benefits. Since people could engage in green consumption as a way to improve health (Bostrom et al., 2013; Howell, 2013; Bullock et al., 2017; Witek, 2017), future research can test interventions highlighting health benefits of ESFC. Framing ESFC as a health issue could even induce feelings of hope (Myers et al., 2012) which can increase ESFC (Feldman and Hart, 2018). Health-related concerns are particularly relevant drivers of organic food consumption (Janssen, 2018) and reduced meat consumption (Malek et al., 2019). For now, there is little evidence on consumer perceptions of health-related beliefs concerning insect-based foods and seasonal produce.

→ FR 8. Under which conditions can interventions stressing health benefits increase ESFC?

Point out value for money. Although price concerns can be an important barrier to ESFC (Verain et al., 2012; Aschemann-Witzel and Zielke, 2017), the perceived value of these products can also increase as higher prices can indicate higher "acceptable quality" (Sangroya and Nayak, 2017). Higher prices can also signal trustworthiness (Gottschalk and Leistner, 2013). Hence interventions could stress the utilities and benefits individuals can obtain from environmentally sustainable products despite possible price premiums.

→ FR 9. To what extent can ESFC be increased by stressing positive signals related to higher prices?

Point out other non-environmental benefits. In addition to sensory, health or value-related benefits, other non-environmental benefits might be linked to ESFC. For example, if hedonic goals are prevalent, messages could demonstrate how acting pro-environmentally can make people feel good. Also, Tezer and Bodur (2020) show that people who use a green product without being responsible or accountable for the decision to use the product (for example, they get recycled 3D glasses in the cinema) experience higher enjoyment of the accompanying consumption experience. This "green consumption effect" is driven by an increase in perceived social worth which results in a warm glow. Future research needs to investigate in a structured way which different benefits can act as a "feel good" factor that adds value to the overall product (Wong et al., 1996) and can hence be potential reasons for engaging in ESFC. Also the role of social norms could be examined from this perspective as social norms relate to the goal of getting approval from others.

→ FR 10. Which non pro-environmental (perceived) benefits can act as potential reasons for engaging in ESFC?

Provide incentives. Financial incentives can lift the price barrier that is often limiting ESFC. Both financial and non-financial incentives have been shown to be effective in changing eating patterns (Purnell et al., 2014; De Marchi et al., 2019). Caird et al. (2008), Lin and Huang (2012) found that discounts, incentives and subsidies can enable individuals to participate in environmentally friendly consumption. Non-financial incentives (e.g., gadgets) can also be successful in increasing vegetable consumption in a sample of 11−14 year-old children, an effect that can even persist several weeks after the provision of the incentives ends (De Marchi et al., 2019). In addition, van Horen et al. (2018) showed in a student sample that competition can be an incentive to motivate pro-selves (i.e., people who are more concerned about taking care of the self and hence less engaged with climate, Corner and Randall, 2011) and pro-socials (i.e., people who are socially conscious and already committed to the sustainability agenda, Balliet et al., 2009) to act in a pro-environmental way by having them compete to realize pro-environmental objectives. The success of this approach is explained by the fact that pro-socials are motivated to act in a pro-environmental way (regardless of the competition), while pro-selves are motivated by competition (regardless of the pro-environmental aspect). Other research argues that the mere use of economic incentives (i.e., material rewards) is unable to lead to a sustained diffusion of eco-friendly alternatives in the market, because purchasing behavior returns to baseline levels after the reinforcement is terminated (Cairns et al., 2010; Oliver and Rosen, 2010; Steg et al., 2014). Also intrinsic motivation to engage in a behavior can be reduced when this behavior is incentivized (Gneezy et al., 2011; Kamenika, 2012), by which incentives may decrease food preferences (Newman and Taylor, 1992). This leads to an important paradox that requires further investigation, as

on the one hand, incentives may decrease pro-environmental food preferences, but on the other hand they can lower the price barrier often limiting ESFC.

→ FR 11. To what extent can ESFC be increased by providing (non-) financial incentives?

Strengthening the relative value of ESFC through punishment of undesirable outcomes of non-ESFC

Impose taxes. Even when people do not value the environment, they could be triggered into buying sustainable products, for instance through the imposition of taxes on non-ecological alternatives. Hagmann et al. (2019) recently suggest that taxes and subsidies could be the most effective policies for reducing carbon emissions. Research indicates that meat carbon consumption taxes have the potential to reduce household demand for meat products, with greenhouse gas emission reduction estimates in the range of 10.5% (in Scotland; Chalmers et al., 2016) to 12% (for a tax on meat and dairy in Sweden; Säll and Gren, 2015). Nordhaus (2001) also suggested that policymakers should consider harmonized environmental taxes on carbon as powerful tools for coordinating policies and slowing climate change. Taxes can especially be effective in domains that involve strong habits (Krause, 2009) but they can induce negative effect and defense responses (e.g., Steg and Vlek, 2009).

Interestingly, Hagmann et al. (2019) show that support for a carbon tax diminishes when individuals also get the possibility to choose for a green nudge (see "Interventions to Evoke Immediate Behavior" for an explanation of a nudge) even if people know that this nudge is less effective than a tax (Hagmann et al., 2019). However, informing the public that nudges are not a substitute for more substantive policies, even if they are cost-effective, increases support for taxes without diminishing support for nudging interventions (Hagmann et al., 2019).

→ FR 12. Which conditions or interventions can create solid consumer support for taxes on non-ecological alternatives?

Interventions to Evoke Immediate Behavior

Nudge

Instead of explicitly increasing the (salience of the) value of the environment or promoting ESFC through harnessing other desirable outcomes of environmentally sustainable food products, people can also be nudged into choosing an environmentally sustainable food product in the context in which they make their decision, irrespective of their values. Nudging aims to change people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives (Thaler and Sunstein, 2008). Nudging does not necessarily aim to change the importance of individual's values or behavior, but can also evoke immediate behavior without increasing the value of sustainable consumption. Since food choices are often guided by fast, automatic and/or cognitively effortless responses to environmental stimuli, nudging interventions that urge action without necessarily evoking thoughts about value-action discrepancies could be an easy and cheap solution. Changing the decision context (i.e., by optimizing the choice architecture, Thaler, 2018), can change the salient cues that affect cognitive responses to a situation and the resulting behavior. By adapting elements in the choice environment such as the way products are positioned, their visibility or packaging, choices are affected.

Several studies have shown the effectiveness of nudging interventions to steer individuals to more ESFC (Ferrari et al., 2019), for example, by decreasing portion sizes of less sustainable meat (Vandenbroele et al., 2018), or by increasing visibility of meat substitutes (Vandenbroele et al., 2020a) or more sustainable meat (Coucke et al., 2019). Nudges for ESFC at the point of purchase can be categorized according to whether the nudge exerts an influence on consumers' cognition (i.e., consumer knowledge), affect (i.e., consumers' feelings) or behavior (i.e., motor responses) (Cadario and Chandon, 2019), as reviewed in Vandenbroele et al. (2020b). Vandenbroele et al. (2020b) discuss several future research areas that could be worthwhile investigating like the effect of interventions increasing the availability perceptions of environmentally sustainable food products. Increasing the perceived availability of eco-labeled products might not only trigger immediate choice but could also influence goal-pursuit, for instance by increasing public awareness of the environmental impact associated with food production or even increasing environmental values. More generally, it is important to realize that nudging interventions could influence behavior via their impact on goal-pursuit.

→ FR 13. Which nudging interventions positively affect ESFC; to what extent do nudging interventions influence ESFC by increasing public awareness or environmental values?

Step 2: Perceived Discrepancy

Conceptual Background

People will engage in goal-directed behavior only when they perceive a discrepancy between the current state and the end state that they value (Moors et al., 2017). For instance, even people who value the environment are not likely to engage in ESFC if they believe that the environment (or environmental aspects they consider to be important) is not under threat. For instance, people might dismiss global warming as a threat because they believe that it will improve the climate at the location where they live.

Gifford (2011) found that denial of climate change can be led by fear. Terror management theory (e.g., Goldenberg et al., 2000) suggests that people may deny this problem because it is a reminder of their mortality (Vess and Arndt, 2008). de Boer et al. (2013) showed the relation between the experience of a discrepancy (i.e., an environment that is under threat) and sustainable food consumption with regard to meat consumption (de Boer et al., 2013). The more consumers showed climate skepticism the less they were willing to reduce their meat consumption.

Interventions That Can Increase Perceived Discrepancy

Increase self-monitoring

Previous research has shown that monitoring progress toward a goal has a robust effect on goal attainment as it identifies the discrepancy between the current state and the desired state (Harkin et al., 2016). It enables people to identify how best to allocate effort among salient goals (Carver and Scheier, 1981; Louro et al., 2007) and whether they should exert more effort

or self-control (Myrseth and Fishbach, 2009). Self-monitoring could also make people less capable of avoiding information which indicates that they were not progressing toward their goal (Webb et al., 2013). A way to increase self-monitoring is to ask a person to keep a diary of their environmental sustainable consumption or compare their current ESFC to their previous ESFC (Harkin et al., 2016). We note that self-monitoring has received more attention as an intervention in a health context (Burke et al., 2011) than in the context of ESFC, probably because environmental food related outcomes are harder to operationalize.

Decrease skepticism

Further research could identify ways to decrease skepticism (disbelief) toward environmental issues by, for example, enhancing perceptions of collective efficacy (Fritsche et al., 2018). Also, since skepticism has been linked to specific social groups (e.g., political conservatives), interventions could be aimed at framing environmental goals as compatible with the goals of these groups (e.g., focus on environmental action as an act of conservation) or by motivating people to identify with a self-identity at a more collective level like "humanity" (thus superseding identification with the skeptical group) (Fritsche et al., 2018). An important question in this regard is whether social groups that tend to be skeptical are open to such collective-level identifications as these types of identification may be more in line with progressive, prosocial self-perceptions, and may consequently backfire.

→ FR 14. Which interventions decrease skepticism toward environmental issues?

Decrease justifications

In general, people prefer making choices that can be easily justified (e.g., Shafir et al., 1993). People sometimes use system justification (i.e., the tendency to defend and justify the societal status quo) which results in ignoring or denying environmental problems and perpetuating harmful behaviors (Feygina et al., 2010). System justification can be reduced by portraying the necessary increase in ESFC as being part of the system rather than a consequence of the system (Feygina et al., 2010). Other justification mechanisms include perceived inequity ("why should I change if others won't change?" Gifford, 2011), uncertainty (disregarding likelihood of climate change by phrasing "it is likely" rather than "it will happen"; Budescu et al., 2009); judgmental discounting ("it is worse in places other than my own"; Gifford et al., 2009); optimism bias ("my environment will not deteriorate as much as another place"; Gifford et al., 2009); believe in supra-human powers ("Mother nature or God will save us"; Mortreux and Barnett, 2009); technosalvation ("new technologies will save us"; Lorenzoni et al., 2007) and denial ("human activity does not cause climate change"; McCright and Dunlap, 2010). In the context of meat consumption, there is solid evidence showing that meat-eaters engage in a variety of psychological defense mechanisms to justify their behavior (e.g., Rothgerber, 2013). Some meat-eaters argue, for example, that "meat is essential for strong muscles" (i.e., health justification) or that "God intended for us to eat meat" (i.e., religious justification). Each of these justifications may help to minimize the importance of reducing meat intake, even in individuals who otherwise attach great value to the environment, the climate, healthy eating, and/or animal welfare. Hence, the use of these justifications should be minimized.

→ FR15. To what extent and how can justifications be minimized?

Step 3: Goal Intention

Conceptual Background

When confronted with a perceived discrepancy between the desired versus the actual state of the environment, several responses are possible. Ideally, consumers may decide that they need to act to reduce the discrepancy. People could form an intention to act on their experienced discrepancy or a "goal intention" thereby committing themselves to the execution of actions needed to achieve this goal (Bagozzi and Dholakia, 1999). A goal commitment entails the self-realization that actions are required to achieve the goal but does not specify the actions that need to be executed for goal achievement (Bagozzi and Dholakia, 1999). A multitude of research focused on the factors influencing goal intentions (e.g., Perugini and Conner, 2000; Armitage and Conner, 2001; Rodgers et al., 2010). Bagozzi and Kimmel (1995) compare several of these theories on their ability to predict intentions and behavior. Several researchers furthermore investigate what factors influence intentions and behavior in a sustainable (food) context (e.g., Hines et al., 1987; Axelrod and Lehman, 1993; Mainieri et al., 1997; Tanner, 1999; Han and Hansen, 2012; Tripathi and Singh, 2016). But alternatively to intending to act on their goal, consumers may question the perceived discrepancy (e.g., "Is this threat really that big?"), by disengaging from the issue, for example by devaluing the need for a healthy environment at this moment in time (e.g., "I don't care because I'll be dead by the time the problems really start"; "It is OK to continue polluting because future generations will manage to create technology to clean up"). They might also change their beliefs about the necessity of acting by, for example, believing people who claim that the problems with the environment are not that bad anyway. People often exhibit self-defensive reactions when they learn that their behavior can have negative environmental impact (Feygina et al., 2010) and display motivated biases like the tendency to seek out information that confirms preexisting views (Weber, 2016). Experiencing a discrepancy between one's actual and desired state may cause cognitive dissonance (i.e., experiencing discomfort when behaving inconsistently with one's attitudes, Festinger, 1957). Cognitive dissonance is often more easily resolved by changing one's mind ("eating red meat is not really causing the problem") than by changing one's behavior (by eating less or no meat). For those who do change their beliefs and hence no longer experience dissonance, it is imperative that this discrepancy is re-evoked. This component of the framework captures why it is important to educate people about the ways in which the environment is under threat and why those threats matter.

Interventions to Make People Intend to Act on Their Goal Intention

In case the value of the environment is questioned, interventions mentioned in "Interventions Targeting People Who Do Not Value the Environment" apply, whereas in case consumers question the discrepancy between the actual and desired state of the environment, we refer to the suggestions discussed in "Interventions That Can Increase Perceived Discrepancy."

Increase cognitive dissonance

When people react to perceived discrepancy by changing the belief that it is necessary to act, interventions could be aimed at increasing cognitive dissonance and, hence, the likelihood that consumers access pre-existing beliefs or attitudes that promote sustainable food consumption (Osbaldiston and Schott, 2012). Cognitive dissonance can be increased by questioning one's moral standards (cf. increasing salience of the discrepancy between one's norms and one's behavior, Aronson and Carlsmith, 1962; Thøgersen, 2004) by for example letting people make a speech for engaging in pro-environmental behavior and then remind people of the times they failed to engage in pro-environmental behavior (cf. Aronson et al., 1991), or pointing out to people that they use biased assimilation (i.e., denying the validity of information that is inconsistent with an existing belief; Ahluwalia, 2000).

→ FR 16. To what extent can increasing cognitive dissonance increase goal intention?

Increase personal responsibility

Very little research on sustainable food choices has addressed the issue of personal responsibility. While consumers may be aware and convinced of the necessity to adopt environmentally friendly behavior, in order for them to act they may still need to be convinced of their personal role in solving environmental problems. Only few studies on sustainable food choice have explored potential interventions in this respect. As an exception, Antonetti and Maklan (2014) focus on the self-conscious emotions "guilt" and "pride" and find that experiencing guilt or pride makes consumers see themselves as contributing to solving environmental issues. These feelings reduce the use of neutralization techniques that would otherwise rationalize away consumers' responsibility. Hence interventions could stress, for example, guilt or pride to evoke environmental sustainable choices. Related to this, individuals can resolve their internal discrepancy using coping mechanisms (i.e., "cognitive and behavioral efforts made to manage external and internal demands and conflicts among them") (Lazarus and Folkman, 1984). Moruzzi and Sirieix (2015) identify coping mechanisms in the context of sustainable consumption where French and Italian consumers either ignore, neglect or distance themselves from sustainable products or labels or search for labels or information from trusted known sources (such as relying on word-of-mouth spread by acquaintances). Hence, interventions could point out to consumers that they use coping mechanisms in order to act on their discrepancy.

→ FR 17. To what extent can evoking guilt or pride or stressing coping mechanisms increase an individual's sense of personal responsibility and goal intention?

Counteract compensatory behavior

Consumers may also show reduced goal intention once they have already engaged in sustainable behavior. That is, consumers have a tendency to compensate sustainable behavior in one domain with increased unsustainable behavior in the same or another domain (Otto et al., 2014), in part because performing a sustainable act can make people feel less obliged to perform subsequent sustainable choices (Thøgersen and Olander, 2003) and can license unsustainable behavior (Nilsson et al., 2017). Consumers have been found to endorse compensatory green beliefs (Kaklamanou et al., 2015; Hope et al., 2017), such as "You do not need to worry about which country your food comes from if you use energy-efficient appliances in the home" or "Composting food waste can make up for buying imported food."

A related (yet distinct) phenomenon is the negative footprint illusion: even though adding an ecological to a non-ecological food product increases the total footprint of the menu, consumers sometimes mistakenly estimate the total footprint of the combination of the ecological and the non-ecological product lower than the same non-ecological product alone (Gorissen and Weijters, 2016). So, for instance, consumers may erroneously have the impression that adding an organic apple to a beef burger menu reduces the footprint of their overall menu.

An important topic for future research relates also to the question how compensatory beliefs, licensing, and the negative footprint illusion can be countered. After all, if consumers engage in ESFC only to compensate that behavior afterward by indulging in more unsustainable behavior in some other decision, little has been gained. It is currently not sufficiently clear how these phenomena can be successfully countered and more research is needed to establish under what conditions they occur.

→ FR 18. How can compensatory beliefs, licensing and the negative footprint illusion be countered?

In addition, more indirect defense mechanisms may be at play. For example, (female) meat-eaters tend to underestimate their objective meat intake as a way to minimize one's own impact on climate change, and hence underestimate the need for personal behavioral change (Rothgerber, 2019). It is well-documented that people tend to interpret evidence in a self-serving manner, which leads people to exaggerate their contribution to environmental protection (Pieters et al., 1998) but minimize their contribution to environmental problems. These direct and indirect defense mechanisms devalue the outcome (cf. "Interventions Targeting People Who Do Not Value the Environment"), question the discrepancy between the actual and desired state of the environment (cf. "Step 2: Perceived Discrepancy"), or reduce the goal intention itself.

→ FR 19. Which indirect defense mechanisms do people use and how can they be reduced?

Step 4: Behavioral Intention

Conceptual Background

When people decide to act on their goal intention in order to reduce a perceived discrepancy between an actual state and a desired end state, they still need to decide *how* to act.

When people have selected a behavior that they intend to perform, they are said to have formed a behavioral intention. It is typically assumed that people will choose an action of which they expect that it will bring them closer to the desired end state (Kruglanski et al., 2015; Moors et al., 2017). In those cases where ESFC is driven by pro-environmental goals, sustainable consumer behavior therefore crucially depends on subjective beliefs about which behaviors promote or burden the environment. Hence, in order to encourage consumer behavior that is objectively sustainable, it is vital to promote correct expectancies about the environmental impact (but also other effects) of specific consumer choices. This can primarily be done (a) by promoting general background knowledge and/or (b) by providing specific informational cues at the point of purchase.

Interventions to Guide and Strengthen Behavioral Intentions

Increase background knowledge

In terms of general background knowledge, it is key to align expectancies related to environmental effects of food choices as well as potential side-effects of ESFC with reality. As to the latter (expected side-effects of ESFC), perceived risk has been identified as a deterrent to the adoption of eco-consumption (Boivin et al., 2011). For example, some individuals associate eating vegan with a physical risk (e.g., "I will not get all necessary nutrients") or social risk (e.g., "others will talk about me"). Informing people about the minimal risks involved in ESFC can reassure them and trigger sustainable behavior.

Some research has identified inaccurate or incomplete environmental expectancies. For instance, many consumers are unaware of the impact of eating meat on the environment (e.g., only about a third of respondents linked cattle farming to climate change; Hartmann and Siegrist, 2017; Mullee et al., 2017). Even if these consumers care for the environment, they will not reduce their meat consumption. Relatedly, lack of environment-related information is a key hurdle in the purchase of insect-based food products (Lammers et al., 2019). Hence, for individuals who do not have correct beliefs about the environmental impact of certain food choices, interventions should be set up to increase their knowledge about which behavior is sustainable (Gifford and Nilsson, 2014).

Importantly, past research needs to be interpreted with caution, as consumer awareness may be rapidly evolving. For instance, in a large-scale longitudinal panel study, Siegrist et al. (2015) found that participants evaluated eating less meat (maximum of once or twice per week) as substantially more beneficial for the environment in 2014 compared with 2010, and it is plausible that consumer perceptions have continued to shift since then.

Provide specific informational cues

One important type of informational intervention provides cues on the environmental impact of food products at the point of purchase (or on product packaging). This type of intervention includes the use of green claims and eco-labels. As to the former, consumers prefer products with green claims over those with neutral (control) claims, and products with emotional green claims over those with rational green claims, even though this effect is moderated by participants' environmental commitment, information processing ability and by distraction (Aagerup et al., 2019).

As a somewhat more structured type of intervention, various eco-labels have emerged with the aim of communicating the ecological merits of products (Delmas and Lessem, 2017; Yokessa and Marette, 2019). Eco-labels using logos have been found to capture visual attention more than text (Rihn et al., 2019). Familiar and trusted labels generate positive perceptions (Cornelissen et al., 2008; Sirieix et al., 2013), and adding eco-labels to novel, sustainable food products has been found to increase choice likelihood (in the context of aquaculture foods; Schacht et al., 2010; Banovic et al., 2019). But even though consumers' understanding of a set of selected labels (Fair Trade, Rainforest Alliance, Carbon Footprint, and Animal Welfare) is good, these labels do not play a major role in consumers' food choices (Grunert et al., 2014). More worryingly, consumers face an ever increasing number of sustainable food labels, some of which may be complementary, while others add to the growing competition of product information in consumers' minds (Sirieix et al., 2013), resulting in consumer confusion, distrust, and dissatisfaction (Moon et al., 2017). The complexity and the proliferation of eco-labels thus hamper their efficiency in promoting ESFC (Yokessa and Marette, 2019).

Research on the effectiveness of eco-labeling points toward the following recommendations. First, consumers in general (i.e., in a context not limited to food) attach credibility to ecolabels that they trust, which typically includes ecolabels certified by third parties like governments or environmental NGOs (Darnall et al., 2018). Consistent with this, eco-labeling in the context of organic coffee is more impactful when certified by a public authority (Thøgersen and Nielsen, 2016). Second, labeling choice options that should be avoided (i.e., using a negative frame) is likely more effective than only labeling the environmentally preferable options (Grankvist et al., 2004; Van Dam and De Jonge, 2015). Third, eco-labels work best if they are informative yet easy to interpret. Traffic light labels (with green-yellow-red codes indicating good to bad environmental friendliness) have been found to be effective in grocery shopping in general (Wiese et al., 2015), as well as in specific categories like coffee (Thøgersen and Nielsen, 2016) and seafood (Hallstein and Villas-Boas, 2013).

A lot of research has studied consumer responses to different eco-labels on food products, but several important research questions have not been addressed in sufficient detail. For one, the organic label in particular has received a lot of research attention (Bauer et al., 2013; van Doorn and Verhoef, 2015; Aschemann-Witzel and Zielke, 2017). However, organic labeling has particular effects, like halo effects suggesting a host of personal benefits to the consumer (health, taste, safety, nutritional value, etc.). Such halo effects are unlikely to be generalizable to other eco-information schemes that are often more closely aligned with primary environmental outcomes, like carbon labeling (Röös and Tjärnemo, 2011). Eco-labeling research needs to investigate which insights gleaned from organic labeling research can be extrapolated to other labels. For this quest to be successful, it

will be necessary to define a typology of eco-labels that allows researchers to systematically link eco-label characteristics to eco-label effects.

→ FR 20. Which typology of labels can bring structure to the labeling literature?

Relatedly, practitioners and researchers have also studied alternative eco-information schemes that employ ratings or metrics, including carbon footprint labeling (Lee et al., 2012) and food miles (MacGregor and Vorley, 2006; Schnell, 2013). However, given the dearth of comparative research, it is not clear which types of eco-information schemes are more effective.

→ FR 21. What is the moderating effect of labeling characteristics on their effectiveness?

Some product attributes that are environmentally relevant have not been consistently communicated to consumers and (partly as a result) have not been researched in a very systematic way. For instance, there is currently a lack of a standardized labeling approach for identifying local food, which makes it difficult for consumers to identify local food products (Feldmann and Hamm, 2015).

→ FR 22. How to effectively communicate (multiple) environmentally relevant product attributes (other than organic)?

Consumers have been found to be confused by the presence of multiple labels (Moon et al., 2017). This raises the question how different types of (eco-related) labels interact. In one interesting initial study in this direction, Sörqvist et al. (2016) explored how consumers in a Swedish and a United Kingdom sample respond to combinations of eco-labeling and Genetically Modified Organism (GMO) labeling in terms of judgments of taste, health consequences and willingness to pay for raisins, and found that the GMO-label removes the psychological benefits of the eco-label (especially among Swedish participants). Thøgersen et al. (2017) reviewed the literature to shed light on the possible interaction between the effects of organic and country-of-origin labeling on consumers' food preferences and choices. Building on this type of research, more studies are needed on the joint use of different types of eco-labels with other types of (eco-) labels. Relatedly, consumers perceive better product quality and more credible environmental information when there are both elaborated self-declared environmental claims and environmental labeling cues on product packaging (Ertz et al., 2017). Further research is needed to investigate when and how different types of info may interact with eco-labeling.

→ FR 23. How do different eco-labels interact and how do eco-labels interact with other types of labels and other information?

Step 5: Action

Conceptual Background

If a behavioral intention has been formed, consumers still need to act on it. Not all behavioral intentions are realized. A considerable amount of research investigated the intention-behavior gap (e.g., Pieters and Verplanken, 1995; Davies et al., 2002; Sheeran and Abraham, 2003; Conner and Godin, 2007; Cooke and Sheeran, 2010; Conner et al., 2016) Intentions to consume in a sustainable manner will only be realized if the individual is able to act in the intended manner and perceived benefits for the goal of improving the environment are not outweighed by the perceived costs in terms of other goals. The framework captures the fact that ESFC, like any other goal-directed behavior, always needs to be situated in a broader context that takes into account the full range of abilities and goals of the individual. A first class of hurdles for action relate to the ability of the individual to perform a behavior. If it is impossible or extremely difficult (in reality or as perceived) to perform the intended behavior, it will not take place. For instance, buying an organic food product can be impossible if it is not available or if someone simply does not have the money necessary to buy it. A second reason for not performing an intended behavior relates to other goals that the individual strives for. For instance, it could be that the intended action not only promotes the goal at which it is directed but also hinders the attainment of other goals. If the benefits in terms of one goal are smaller than the costs in terms of other goals, then the intended behavior will not be executed.

Also here, what matters are the subjective beliefs about abilities, costs, and benefits that are often as impactful as objective ones. Sustainable products are often perceived as less aesthetic (Luchs and Kumar, 2017), less performant (Luchs et al., 2010), more effortful (Johnstone and Tan, 2015), and less affordable (Hughner et al., 2007; Gleim et al., 2013). After all, consumers who think they cannot afford organic food products or who think that costs of organic products outweigh the benefits will not buy them. As another example, if consumers eat a specific product primarily because of the joy it brings (e.g., chocolate), they will not be willing to renounce enjoying their regular chocolate by replacing it with insect-based chocolate, unless it brings comparable joy (Lombardi et al., 2019).

Interventions to Stimulate Action

Ability

Decrease (perceived) price. Perceived and actual prices are still a major barrier for ESFC. As a key example, organic food products are generally more expensive than non-organic alternatives (Bezawada and Pauwels, 2013; van Doorn and Verhoef, 2015; Aschemann-Witzel and Zielke, 2017). Held and Haubach (2017) estimate that in the German market, households with a below-median net equivalent income cannot afford to purchase solely organic food products without getting into debt.

Future research could be set up to actually decrease prices of sustainable products or to change price perceptions. In this light, an evolution that offers interesting opportunities for future research, is the growing extent to which food retailers are marketing organic foods as private label foods and the question how organic labeling interacts with (retailer) brand positioning (Jonas and Roosen, 2005; Bauer et al., 2013; Ellison et al., 2016; Konuk, 2018). Here, interdisciplinary research between experts in economics, agriculture, nutrition and psychology would be beneficial to reach a more holistic understanding of the food system and the role of different stakeholders within it.

→ FR 24. Which interventions decrease prices and price perceptions?

The focus of the current review is on high-income countries, but even in these countries, many consumers face financial limitations (Held and Haubach, 2017). Most research (often implicitly) addresses a narrow target group of individuals who are financially able to engage in green consumption. Economic barriers like higher prices and barriers resulting from market imperfections (e.g., limited access to products, lack of information) (Gorynska-Goldmann, 2019) could limit especially the ESFC of less affluent groups. Less affluent consumers may not only have different purchase motives, they also have less access to outlets that offer a wide variety of affordable organic food (Mirsch and Dimitri, 2012). Knowledge on how to get less affluent consumer groups on board is lacking but is a key condition for scaling up sustainable food consumption.

→ FR 25. Which interventions are effective for less affluent target groups?

Increase availability. Another barrier to ESFC pertains to perceptions of limited availability of sustainable products (e.g., Feldmann and Hamm, 2015). When it comes to meat consumption, a study showed that almost half of the population (46.3%) considers a vegetarian lifestyle unachievable (Mullee et al., 2017). Specific reasons for not adopting a vegetarian diet included "insufficient vegetarian options" (14.7%), and "insufficient personal cooking skills" (12.3%), although other studies only partially replicated these findings (e.g., Reipurth et al., 2019). Limited accessibility has also been identified as a barrier to buying organic food (Turk and Ercis, 2017).

Competing goals

Instead of acting in an environmentally sustainable way to benefit society in the long-term, consumers also want to save money, indulge, or look for a convenient and comfortable way of living in the short-term (Gleim et al., 2013; White and Simpson, 2013; Lanzini and Thøgersen, 2014; Tate et al., 2014). Engaging in ESFC often means setting aside immediate and proximal individual interests for behavior that has consequences for others and are only realized in the future (Spence et al., 2012).

Although people may value the environmental impact of their food choices, at decision time, they can willingly ignore relevant information available to them on the basis of their own feelings toward the object (Gawronski and LeBel, 2008). For instance, consumers can "forget" the environmental impact of red meat because they like eating it.

Decrease time pressure. Time pressure could be another barrier of ESFC, even for consumers who report strong environmental concerns (Young et al., 2010). This is especially the case for local food because it may take more time to buy these products (Feldmann and Hamm, 2015). When more automatic processes prevail (for example, when people experience time pressure), consumers are particularly sensitive to both brand information and brand value and are less prone to choose organic/eco brands (Beattie and McGuire, 2016).

Provide prompts. Prompts are messages that are given before the behavior occurs to remind the consumer what the desired sustainable behavior is (Lehman and Geller, 2004). Even when individuals feel they have the ability to engage in ESFC, prompts like a sticker on a shopping trolley reminding people to buy seasonal produce, can be a valuable tool to remind motivated people to not forget to act sustainably in line with their sustainability goals. A simple daily text message reminding people of the health or environmental benefits of eating less red meat or processed meat was effective in decreasing consumption (Carfora et al., 2019). Prompts typically contain simple reminders rather than persuasive appeals and work best when people are already motivated to engage in the behavior and for simple behaviors that require very few steps or effort (Gifford, 2011; Osbaldiston and Schott, 2012).

Provide feedback. Food choices are often habitual (Neal et al., 2012) in the sense that they occur frequently and automatically in certain contexts (De Houwer, 2019). Berger (2019) proposes to provide immediate digital normative feedback that signals approval about an action at the point of decision making to attempt to break food habits, for example using a "GreenMeter" which graphically displays the cumulative eco-friendliness of food choice immediately after a product is added to the cart. Peloza et al. (2013) also found that reminding people of a time when their behavior was inconsistent with a personally held value leads to subsequent value-consistent behavior. Providing information on how individuals are performing can strengthen people's beliefs about their capabilities of engaging in a behavior (Bandura, 1997) and has been identified as an effective social influence approach for encouraging environmental behavior (Abrahamse and Steg, 2013), especially when feedback is presented clearly, in real time and over an extended period of time (Chiang et al., 2014). Harkin et al. (2016) show in their meta-analysis that progress monitoring has a robust effect on goal attainment. In this digital era, interactive displays and mobile aps (Flaherty et al., 2018) can become suitable instruments to provide consumers with the information they need at the point of purchase. The interactive nature provides consumers with the control over the information they want to consult while enabling supermarkets to steer consumers by selectively presenting content (van Giesen and Leenheer, 2019). Digital displays with sustainability information increase the time spent in the supermarket and lead to more extensive product comparisons, without necessarily increasing the importance of sustainability cues (van Giesen and Leenheer, 2019). Since consumers are often pressed for time, interactive displays and mobile apps could offer easy and quick access to information in an engaging way. Gamification seems promising as it combines engaging and rewarding aspects of games (Koivisto and Hamari, 2019). Social media could further decrease consumers reluctance to choose eco-products through, for example, user generated content (Kane et al., 2012).

→ FR 26. How can digital displays, mobile apps, gamification and social media trigger ESFC?

Facilitate implementation intentions. Forming implementation intentions (i.e., thoughts about what steps to take to engage in action, Gollwitzer, 1999; Kurz et al., 2014) seems a promising tool to increase the probability that behavioral intentions lead to

action. Papies (2017) argues that formation of implementation intentions can change the situated conceptualizations that are triggered by situational cues and therefore change behavior. Fennis et al. (2011) showed a positive effect of implementation intentions (e.g., explicitly listing when, where, and how to use a pocket-guide listing sustainable products for a variety of product categories) on sustainable food-purchasing habits. If people identify and imagine a desired future and address potential obstacles with concrete if-then plans that specify when, where, and how to act (a technique called mental contrasting), behavioral intentions clearly translate into actual behavior change (as demonstrated with regard to reduced meat consumption; Loy et al., 2016). Rees et al. (2018) found preliminary evidence that self-monitoring could underlie the effectiveness of implementation intentions (i.e., forming an implementation intention increased the salience of a meat consumption reduction goal).

→ FR 27. How can implementation intentions increase the probability that behavioral intentions are translated in actual ESFC actions?

Counteract disgust. Emotional factors are also likely to play a role in acting sustainably and could overshadow environmental goals at the point of purchase. An important barrier to the consumption of cultured meat are feelings of disgust and perceptions of unnaturalness (Verbeke et al., 2015b; Anderson et al., 2019; Circus and Robison, 2019; Shaw and Iomaire, 2019). Also, disgust propensity negatively affects willingness to pay for environmentally sustainable food products like insect-based food products and atypically shaped fruit and vegetables (Powell et al., 2019). Tasting insect-based food can even evoke a state of disgust, reducing taste perceptions (Barsics et al., 2017). Future research could draw from work in developmental psychology that has identified behavioral interventions to counter food neophobia in children (Dovey et al., 2008).

→ FR 28. Which behavioral interventions can counter disgust reactions to environmental sustainable foods that are perceived as (visually) unappealing?

FURTHER CONSIDERATIONS

The interventions that we put forward in the previous part have all been related to a specific component of the model. However, some interventions sway several components in the goal-directed behavioral process and hence could be deemed more effective (Cadario and Chandon, 2019). Information appeals, for example, pointing out the environmental impact of behavior, can activate personal norms for people who value the environment, can increase environmental values for people who value the environment less or can reassure people and trigger behavioral intentions. As another example, social norm appeals can both increase environmental values, promote ESFC (through the goal of getting approval) and increase perceived discrepancy (through skepticism).

After having reviewed these interventions, we can now formulate some general recommendations for future research investigating interventions that can encourage both short- and long-term ESFC that do not relate to a specific component in the psychological model that we used to structure our review.

First, all efforts need to be part of an integrated approach in order to be optimally effective (Stern, 2000). Berger (2019) found that an approach that combines gamification elements with norm-based feedback (especially feedback based on injunctive norms) effectively steers consumers toward more sustainable food choices. Yokessa and Marette (2019) conclude that it is usually best to combine eco-labeling with other regulatory tools such as standards banning polluting products and including tax mechanisms. On the contrary, Hagmann et al. (2019) suggest that interventions (such as nudges and taxes) can counteract so that people are less willing to support a carbon tax when they get the possibility to be nudged.

→ FR 29. Investigate whether combining different interventions aimed at enhancing ESFC produces add-on effects.

Long-term effects of interventions have not been studied systematically. ESFC will only impact the environment when it is maintained over time (cf. behavior change maintenance in a health context; Conner, 2008; Schwarzer, 2008; Kwasnicka et al., 2016). Earlier studies showed that consumers who consider alternative (in this case local) food purchases develop stronger attitudes, and thus get more interested and search for more information on (local) food (Feldmann and Hamm, 2015). Papies (2017) also argues that interventions can result in learning processes triggered by repeatedly performing a new behavior in a given situation or simply from the intervention being present over the long term. The finding that an initial act triggers subsequent similar acts has also often been attributed to changes in self-perception (Burger and Caldwell, 2003; Cornelissen et al., 2008; Van der Werff et al., 2014), environmental values (Sparks et al., 2010; Prooijen and Sparks, 2014) and self-efficacy (Lanzini and Thøgersen, 2014; Lauren et al., 2016). Initial personal commitment especially enhances subsequent sustainable behavior when commitments are made in writing (Lokhorst et al., 2013) or in public (Baca-Motes et al., 2012).

Testing whether nudging could lead to a long-term behavioral change in food consumption also deserves attention (Gifford et al., 2011; Devezer et al., 2014). Loebnitz et al. (2015) suggest that nudging interventions that increase (perceived) availability, for example, could lead to enhanced consumption in the long-run even when the behavioral intervention is taken away, since increased exposure is likely to increase acceptance of unfamiliar or odd products. Future research can test whether keeping nudging interventions longer in place will lead to long-term behavioral change or whether effectiveness will eventually fade away (cf. two-factor theory of Berlyne, 1970). Future research can also test whether variations of nudging interventions are necessary to optimally affect ESFC in the long-run.

Interventions that stimulate buying environmentally friendly products for non-environmental reasons may also affect self-perceptions (cf. positive cueing, Cornelissen et al., 2008) or can crowd out pro-environmental motivations (Schwartz et al., 2015). However, de Groot and Steg (2009) showed that interventions that play on hedonic goals will only stimulate pro-environmental

behavior as long as it is pleasurable to do so. Hence, it will also be important to investigate long-term effects of these types of interventions (Albarracin and Wyer, 2001). This long-term effect could be enhanced by giving people a sense of agency (i.e., allowing people to perceive themselves as the causal agents of behavioral outcomes) which could motivate them further to achieve a sustainable goal (van der Weiden et al., 2013).

Similarly, the long-term effect of informational campaigns is also not straightforward. Do people still give attention to these campaigns once they have seen them a couple of times? When is the knowledge provided in these campaigns deep-rooted enough to have an influence in the long-run? Furthermore, it could be tested whether information on (especially) disgust evoking sustainable options takes some time to assimilate and therefore will especially be effective for changing behavior in the long run (Rozin, 2008; Athey et al., 2015; Barsics et al., 2017). Also for economic incentives, research suggests that people get accustomed to price levels, which would decrease the effectiveness of taxes for unstainable products in the long term. Other types of extrinsic incentives could also backfire in the long run (Deci et al., 1999; Evans et al., 2013; Exley, 2017; De Marchi et al., 2019). It may also be optimal to combine different interventions to engender long-term effects (White et al., 2019).

→ FR 30. Test the long-term effects of interventions and how interventions should be adapted to have long-term effects.

Relatedly, some evidence suggests feedback loops from the last step in our model (i.e., action) to the previous steps (see **Figure 1**), but these feedback loops need to be investigated in a more structured way, both in terms of their prevalence and strength. The current review focused on the psychological side of the ESFC question. Many researchers in the domain of eco-consumption of food, make assumptions about what is and what is not environmentally sustainable. But oftentimes, this question cannot be answered unambiguously. Take organic food: in a critical review, Rosen (2010) points out that the organic food industry has a large financial stake in convincing consumers that organic food is not just organic (which means it is certified to meet a given set of criteria related to the production of the food), but also healthier, tastier, and better for the environment; the latter is, however, not necessarily and unconditionally true. Organic food has the potential to help solve multiple social, economic and ethical problems, but it comes at a higher financial cost and decreases other industries like genetic engineering or artificial add-in production (Toma et al., 2017), which themselves may offer environmental benefits in some circumstances (Adenle et al., 2020). Objective knowledge on the impact of different eco-strategies is needed (local vs. international; in season and international vs. out of season and local). In sum, a simple good vs. bad dichotomy often does not capture the multifaceted reality about the environmental sustainability of food, and in order to move forward, we need to take into account the complex of interrelated stakeholders that together form the global food system (Magrini et al., 2018).

→ FR 31. How to assess sustainability of a food product and how to clearly communicate this environmental impact to customers?

Some future research ideas can be formulated concerning the measurement of ESFC. Beattie and McGuire (2016) argue that human beings have a "divided self" when it comes to the environment and climate change, and this underlying "dissociation" in attitude (implicit versus explicit) might be critical to their behavior as consumers. Future research could investigate the specific relation between implicit and explicit attitudes and ESFC. Implicit and explicit measures toward sustainable products have often been found to be related (Greenwald et al., 2009), although some studies show no correlation (Beattie and McGuire, 2016). Mixed results exist on the predictive nature of implicit and explicit measures (Songa et al., 2019). For example, implicit (rather than explicit) attitudes have been found to influence the use of color-coded carbon footprint information in choosing products while explicit attitudes were not predictive of behavior (Beattie and McGuire, 2016). On the other hand, Panzone et al. (2016) found that Implicit Association Test scores do not significantly predict sustainability of food baskets. Non-vegetarians and vegetarians differ in terms of their implicit attitudes toward plant-based and meat-based foods (Barnes-Holmes et al., 2010; see also De Houwer and De Bruycker, 2007). At this point, however, the exact nature of this correlation (i.e., known-groups approach) is unclear. However, if future research would establish the causal nature of this relationship, one might hypothesize that positive implicit attitudes toward meat could hinder an individual to translate an explicit intention to consume less meat into actual behavior, especially under conditions of automaticity (see Moors and De Houwer, 2006).

The role of implicit attitudes might be expected to be much stronger in food markets, which are characterized by significant time pressure and automaticity (Verplanken and Aarts, 1999; Wood and Neal, 2009). Conversely, Panzone et al. (2016) suggest that explicit attitudes play a more prominent role than implicit attitudes in predicting aggregate measures of consumer behavior supporting earlier research showing that explicit environmental motives are important drivers of behavior change (Thøgersen, 2013).

→ FR 32. Do implicit attitudes predict other sustainable behaviors than explicit attitudes and how can both types of attitudes be changed using the same or different interventions?

Consumers often overestimate their behavior in self-reports (Armitage and Conner, 2001) and self-reports are often unrelated to actual behavior (Moser, 2016). van Dam and van Trijp (2013) show that consumers' self-reported importance of sustainability is driven by abstract considerations that may be less predictive of actual buying behavior as compared to more realistic, choice-based measures (which tap into what the authors label "determinance"rather than the more abstract "relevance"). The latter finding also resonates in the results reported by Grunert et al. (2014), where respondents expressed relatively high levels of concern with sustainability issues at an abstract level, but lower levels of concern in the context of concrete food choices.

→ FR 33. How to measure attitudes that more closely align to the more concrete level at which actual food choices are being made by consumers in their daily lives?

CONCLUSION

It has been widely documented that food preferences, choices and eating habits are hard to change, and likewise, that a substantial gap between favorable attitudes and actual purchase and consumption of more sustainable food products remains to be bridged. By identifying and underpinning a future research agenda, the present review aimed to contribute to tackling the challenge of convincing people to change their eating habits toward more ESFC. First, assuming that food consumption is deliberately or unintentionally directed at attaining goals, a comprehensive theoretical framework of goal-directed behavior was presented as a stepping stone for the proposed research agenda. Second, a critical review of the literature on mechanisms that underlie and explain ESFC (or the lack thereof) in high-income countries was presented and integrated into the goal-directed framework. The resulting types of interventions range from for instance priming and activating personal norms as means to activating environmentally sustainable values, to the use of prompts, feedback, implementation intentions and the countering of disgust and food neophobia as means to foster the enacting of the intended ESFC. Altogether, this analysis yielded a set of 33 future research questions in the interdisciplinary food domain that deserve to be addressed with the aim of fostering ESFC. It offers both researchers and practitioners a guidance for research to untangle the complexity of food-related decisions and to bridge the attitude-behavior gap in ESFC.

AUTHOR CONTRIBUTIONS

IV initiated the project and coordinated the review and writing process. JD formulated the conceptual model in cooperation with IV and BW. IV, BW, AV, HD, MG, AS, and WVL reviewed the literature. IV and BW wrote the first draft of the manuscript. All authors wrote sections of the manuscript and contributed to the manuscript revision, read, and approved the submitted and final version.

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Food Reputation and Food Preferences: Application of the Food Reputation Map (FRM) in Italy, USA, and China

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Given the food challenges that society is facing, we draw upon recent developments in the study of how food reputation affects food preferences and food choices, providing here a starting standard point for measuring every aspect of food reputation in different cultural contexts across the world. Specifically, while previous attempts focused either on specific aspects of food or on measures of food features validated in one language only, the present research validates the Food Reputation Map (FRM) in Italian, English and Chinese over 2,250 participants worldwide. Here we successfully measure food reputation across 23 specific indicators, further grouped into six synthetic indicators of food reputation. Critically, results show that: (a) the specific measurement tool of food reputation can vary across cultural contexts, and that (b) people's reputation of food products or categories changes significantly across different cultural contexts. Therefore, in order to understand people's food preferences and consumption, it is important to take into account the repertoire of cultural differences that underlies the contexts of analysis: the three context-specific versions of the FRM presented here effectively deal with this issue and provide reliable context-specific insights on stakeholders' interests, perspectives, attitudes and behaviors related to food perceptions, assessment, and consumption, which can be effectively leveraged to foster food sustainability.

Keywords: food reputation map, reputation, food preferences, consumer behavior, cultural differences, food choices, measure, food behavior

INTRODUCTION

The worldwide crisis regarding food and obesity poses a series of challenges to individuals, scholars, practitioners, policy makers, and society in general (Hawkes et al., 2015). For example, to face obesity, which is predicted to affect 51% of the population by 2030, interventions are required that can generate improvements at a systemic level (Finkelstein et al., 2012). Among other possibilities,

a social-psychological approach aimed at understanding why and how consumers make certain food choices could be a promising tactic to initiate such interventions. Based on collectively shared judgements about a given entity (Moscovici, 1988), the concept of reputation may shed light on a series of social-psychological processes that individuals use in their transactions with food. Because reputation is a concept that affects and orients knowledge, trust, attitude, and choices toward a specific object, it can be considered both a social process and the product of such a process (Bonaiuto et al., 2017). Reputation is defined as the "the distribution of opinions about a person or other entity, in a stakeholder or interest group" (Bromley, 2001, p. 154), and, critically, it can be used to refer to any entity, such as individuals (Emler, 1990), groups (Bromley, 2001), organizations (Riel and van Fombrun, 2007), and even food (Bonaiuto et al., 2012b, 2017).

Past research has shown that perceived characteristics of food (related to food reputation), rather than objective ones (related to information), might exert a stronger effect on consumer choices (e.g., Carfora et al., 2019). Therefore, studying food reputation can potentially provide promising insights to implement systemic interventions that would help tackling the aforementioned food and obesity crisis, among other issues. Furthermore, the conceptualization of food as a social agent implies that food should be considered as a place-specific agent: food is basic, and as such it regards biology (physiological experience), psychology (individual experience), and culture (social experience) (Rozin, 2007).

According to this logic, the general contribution of the present work is 2-fold. First, drawing upon previous results (Bonaiuto et al., 2012b, 2017), it further refines the existing scale for measuring food reputation (the Food Reputation Map; Bonaiuto et al., 2017), helping the work in the understanding of food reputation. Second, in the current research FRM is validated in three languages—Italian (its original version), English, and Chinese, across their three respective cultural settings—contributing to the understanding of food as a social agent within cross-cultural lenses (Rozin, 2007). The present work could potentially inform future research on both individual and socio-cultural factors that drive food consumption and consequently stimulate discussion, applications and interventions toward a more sustainable and ethical food consumption (Vermeir and Verbeke, 2006).

Defining Food Reputation

The rationale behind food reputation lies in the conceptualization of food as a social agent, since its features integrate both individual and collective processes (Conner and Armitage, 2002). Such a wide and open perspective, appropriate to understand food reputation, defines food features along three main areas (Bonaiuto et al., 2012b): (1) features linked to food (physical-chemical features and nutritional content); (2) features linked to the environment (economical, social and cultural features); and (3) features linked to the effects on the individual (sensorial, physiological and psychological effects). As such, food reputation can be considered both the social process of creating shared meaning around the concept of food and the result of such a process (Bonaiuto et al., 2017). Therefore, food reputation is defined as the whole set of beliefs (representations, attitudes, direct and indirect knowledge, etc.) that individuals hold about food. It includes beliefs about its antecedents and consequences (i.e., its production and its effects), its present features, its overall attractiveness (based on past direct and indirect experiences), and the future expectations related to its usage and consumption (Bonaiuto et al., 2012b, 2017). Based on this definition, an integrative model has been developed to operationalize food reputation's various facets. Established via a series of studies (qualitative, quantitative, and experimental) which indeed employed an international pool of experts (e.g., focus group) and participants (e.g., RCT experiment; see Bonaiuto et al., 2012a,b, 2017), the Food Reputation Map (henceforth, FRM) integrates the intrinsic characteristics of food, its effects on the environment, and its effects on the individual encompassing six main areas (second-order factors), namely "Synthetic Indicators" of food reputation: Essence, Cultural Effects, Economical Effects, Environmental Effects, Physical Effects, and Psychological Effects. These areas are further articulated into 23 specific areas (first-order factors), namely "Specific Indicators" of food reputation: Composition, Genuineness, Life time, Recognition, Territorial identity, Tradition, Familiarity, Innovativeness, Context, Price, Preparation, Social and environmental responsibility, Traceability, Proximity, Safety, Ability to satisfy, Digestibility, Lightness, Organoleptic perception, Personal memories, Psycho-physical well-being, Conviviality, Group belongingness.

On the basis of a series of different studies encompassing different methodological approaches—qualitative and quantitative, correlational and experimental (Bonaiuto et al., 2012a,b, 2017), these areas represent all the known possible features of food reputation.

Food Reputation in Different Cultures

It is no secret that food and its processes vary dramatically across cultures (Rozin, 2007). The simple fact that cultural anthropology is the central discipline in the field of food and culture (Counihan and Van Esterik, 2013) exemplifies the relevance and complexity of this topic. Furthermore, considering that in the past 20 years, an enormous amount of research, scientific publications, books, websites, policies, and applied interventions have been dedicated to the social and cultural aspects of food and its consumption (Counihan and Van Esterik, 2013), it appears to be a matter of fact that any consideration related to the concept and processes of reputation cannot overlook the cultural differences that would affect it. Similarly, because of food's social agent nature (Bonaiuto et al., 2017), research on food, the individuals choosing it, food choice environments and food related processes cannot overlook the changing processes that food continuously undergoes (Devine, 2005).

Based on this reasoning, a fundamental question therefore inquires whether food reputation, as defined by the FRM model, would be different across different cultural settings. To test this, and to further validate the FRM model internationally, a series of three studies in three different cultural settings have been conducted.

The Present Research

Drawing upon the FRM model (Bonaiuto et al., 2017), the present research validates the FRM questionnaire in three different cultural contexts. The resulting three validated versions of the FRM, namely FRM-ITA, FRM-ENG, and FRM-CHI (in Italian, English, and Chinese, respectively) are reported in **Appendix 1**. Three studies are presented. They were conducted between 2013 and 2016, in Italy first, and then in the U.S. and in China. In the three studies, the FRM has been tested with reference to the same three different goods—vegetables, peeled tomatoes and citrus fruit—chosen because they represented the three major food categories within the Italian economy (Castiglione et al., 2007; Zaccarini Bonelli, 2012) and to keep a comparable set of products.

Aims and Hypotheses

The aim of the three reported studies is to validate the measurement model for each language-specific version of the FRM initially presented by Bonaiuto et al. (2017), through a Confirmatory Factor Analysis performed via Structural Equation Modeling (SEM). Analyzing the factorial structure of the FRM using a CFA allows for testing both convergent and discriminant construct validity (Bagozzi et al., 1991; Corral-Verdugo, 2002). According to the presupposition that individuals' perceptions of food are culturally defined (Conner and Armitage, 2002; Rozin, 2007), we assume that the specific facets that operationalize food reputation (i.e., the most appropriate item-markers measuring the Specific Indicators) can differ across different cultures.

Operative Hypotheses

To verify such assumption, the operative hypotheses of Study 1, Study 2 and Study 3 concerned the adequacy of:

H1. The model fit indexes for each Synthetic Indicator of Food Reputation, which were modeled on the basis of both the initial theoretical constructs that generated the Specific Indicators of Food Reputation (Bonaiuto et al., 2012b, 2017) and the results of the principal component analyses in present and previous data (Bonaiuto et al., 2017);

H2. The correlations among Specific Indicators of Food Reputation (i.e., latent variables), in terms of size/statistical significance.

H3. The lambda coefficients connecting items (observed variables) and Specific Indicators of Food Reputation (latent variables), in terms of size/statistical significance.

Data Analysis

Reverse items were recoded such that higher scores always mean a positive reputation content. Then, data were analyzed through Confirmatory Factor Analysis via Structural Equation Modeling, to provide evidence for convergent and discriminant construct validity (Fornara et al., 2010). All analyses were conducted using the software STATA-14.

Across the three studies, the structural models performed to conduct the various CFAs validate the FRM-ITA, FRM-ENG, and FRM-CHI for each of the six Synthetic Indicators of food reputation. Following the approach of Hu and Bentler (1999) and Schreiber et al. (2006), three indexes to examine the model's goodness of fit are used here: the RMSEA, the SRMR, and the CFI, respectively with cut off values of 0.08, 0.08 (0.06 for close fit), and 0.95. Following previous research (Fornara et al., 2010), the RMSEA value was prioritized when deciding whether to accept the model. For each Synthetic Indicator of food reputation, a step-by-step iterative procedure was followed to modify the initial solution, including all items loading only on the expected factor (according to results of Bonaiuto et al., 2017). Both conceptual criteria (i.e., the retained sets of items reflected high content validity; see Fornara et al., 2010) and statistical criteria (i.e., statistical confirmation was provided by modification indexes analysis; Chou and Bentler, 1990) led to the emergent factorial solutions presented in the results section of each study. To ensure that the SEMs were identified, a constraint was added to the first indicator for each latent variable.

STUDY 1: FRM-ITA

Aims and Hypotheses

Study 1 applies the aims and hypotheses reported in section Aims and Hypotheses in the Italian context and therefore concerns the validation of the Italian version of the FRM, henceforth FRM-ITA.

Methods

Participants and Procedure

The paper-and-pencil survey was administrated to a total of about 1,500 participants, from June to December 2013. Using a stratified sampling procedure, participants were recruited in public areas across Italy where they were individually asked to fill-in a 10–15-min survey about food for research purposes. Randomly, each participant was assigned to one of the three possible conditions (either vegetables, peeled tomatoes, or citrus fruit, as target food object). After a preliminary data screening (incomplete survey, response set, missing data), a finalized sample of $N = 1{,}337$ was used for data analysis. The finalized sample was evenly distributed across conditions (vegetables: 32.7%; peeled tomatoes: 34.3%; citrus fruit: 33%) and composed of: women 60.4%; Italians from North (26.4%), Center (31.4%), South (34.2%) and Major Islands (9.8%) of Italy; average age: 38.3 years (*SD*: 14.6); lower education (9.8%), high school (53.9%), university degree (31.2%), post-graduate education (2.2%). Importantly, participants' Body Mass Index (underweight: 4.5%; healthy weight: 66.7%; overweight: 24.4%; obese: 4.4%) was similar to a comparable sample of Italians (ISTAT, 2019), meaning that our sample is not biased about a food-related relevant index.

Measures

The FRM-ITA survey consists of 102 items measured on seven-point Likert-type scales (from "Completely disagree" to "Completely agree"); it was administrated in Italian. More specifically, the FRM-ITA tool includes 10 *General Food Reputation* items (Bonaiuto et al., 2017), the first of which focuses on the general reputation of the evaluated product, and the remaining on product (the target object) and process (how it is created) reputation. The FRM-ITA also includes 92 items devoted

TABLE 1 | CFA on food reputation's synthetic indicators of FRM-ITA–Study 1.

Goodness of fit indexes	Chi^2	df	*p*	RMSEA	SRMR	CFI
Essence	354.71	46	<0.001	0.071	0.051	0.950
Cultural effects	274.86	56	<0.001	0.055	0.046	0.959
Economic effects	126.72	43	<0.001	0.080	0.070	0.960
Environmental effects	350.38	54	<0.001	0.065	0.064	0.949
Physiological effects	238.99	28	<0.001	0.076	0.043	0.953
Psychological effects	881.85	118	<0.001	0.071	0.068	0.943

CFA, confirmatory factor analysis; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; CFI, comparative fit index.

to measure the 23 Specific Indicators (originally containing 4-items each) of food reputation on separate scales. In the food reputation section, participants rated each item according to the following instruction (where, for each given questionnaire, X was substituted by the specific food item label to be assessed with FRM-ITA): "For each of the following statements, please indicate to what extent the reported characteristic describes X. It is enough to express your own opinion, on the basis of what you know about X, or according to whatever you have read, seen and heard about it." This instruction aims to trigger the reputation framework judgment of a target entity based on an individual's both direct and indirect experience of it.

The final section of the self-report questionnaire included six items that assessed gender, age, education, area of origin in Italy, height, and weight.

Results and Discussion

Following the FRM model, results of the first-order CFAs show the best measurement models (item-markers) for each Specific Indicator of food reputation: fit indices for each model measured by the FRM-ITA (H1), covariances among Specific Indicators for each Synthetic Indicator of food reputation (H2), and lambda coefficients for the retained items (H3) are reported in **Tables 1**, **4**–**9**, **22**, respectively.

Essence

For the scale measuring Essence, the model includes four correlated Specific Indicators of Food Reputation (each measured by three items): Composition, Genuineness, Life Time, and Recognition. The Composition and Life Time factors, as well as Life Time and Recognition factors, were not significantly correlated.

Cultural Effects

For the scale measuring Cultural Effects, the model includes four correlated Specific Indicators of Food Reputation: Territorial Identity (three items), Tradition (three items), Familiarity (three items), and Innovativeness (four items).

Economic Effects

For the scale measuring Economic Effects, the model includes three correlated Specific Indicators of food reputation: Context (three items), Price (three items), and Preparation (four items). The factors Context and Price were not significantly correlated.

Environmental Effects

For the scale measuring Environmental Effects, the model includes four correlated Specific Indicators of food reputation: Social and Environmental Responsibility (three items), Traceability (three items), Proximity (four items), and Safety (three items). The Social and Environmental Responsibility and the Proximity factors were not significantly correlated.

Physiological Effects

For the scale measuring Physiological Effects, the model includes three correlated Specific Indicators of food reputation: Ability to Satisfy (three items), Digestibility (four items), and Lightness (three items).

Psychological Effects

For the scale measuring Psychological Effects, the model includes five correlated Specific Indicators of food reputation: Organoleptic Perception (four items), Personal Memories (three items), Psycho-physical Well-being (four items), Conviviality (three items), and Group Belongingness (four items). The following correlations among factors were not statistically significant: Personal Memories-Conviviality, Psycho-physical Well-being-Conviviality, and Conviviality-Group Belongingness.

Conclusion

Study 1 results, based on an extensive correlational survey conducted across Italy, overall confirm the measurement model theorized by the original FRM (Bonaiuto et al., 2017): the tested models produced good fit indexes (H1); first order factors (i.e., the Specific Indicators of Food Reputation) were all correlated to each other (H2) within the following Synthetic Indicators of Food Reputation: Cultural Effects and Physiological Effects; and, a total of 76 items (from the initial total of 92 items) were retained (H3). In the finalized FRM-ITA, one item was removed from each of the following Specific Indicators of Food Reputation (the relevant overarching group's Synthetic Indicator of Food reputation is indicated in brackets): Composition, Genuineness, Life time, Recognition (Essence); Territorial identity, Tradition, Familiarity (Cultural Effects); Context, Price (Economic Effects); Social and Environmental responsibility, Traceability, Safety (Environmental Effects); Ability to satisfy, Lightness (Physiological Effects); Personal memories, Conviviality (Psychological Effects). The finalized FRM-ITA is given in **Appendix 1**. In conclusion, in Study 1 the FRM-ITA results successfully achieved. Hence, the English version of the instrument is targeted.

STUDY 2: FRM-ENG

Aims and Hypotheses

Study 2 applies the aims and hypotheses reported in section Aims and Hypotheses in the U.S. context, and therefore is concerned with the validation of the English version of the FRM, henceforth FRM-ENG. It originates from the FRM-ITA, which was translated and then back-translated by a team of English and Italian native speaker scholars (including some of the authors).

Method

Participants and Procedure

The online survey was administrated to a total amount of about 400 participants, during October 2016. Participants were recruited in the USA using Amazon's Mechanical Turk (MTurk), a crowd sourcing website that allows the public to complete a variety of tasks, such as research studies. Studies using MTurk are valid and reliable (Rand, 2012; Siegel et al., 2019) and allow to reach a more demographically diverse sample (Buhrmester et al., 2011). In this study, participants volunteered to participate in a 10–15-min survey about food for research purposes. Similar to Study 1, each participant was randomly allocated to one of the three possible conditions (vegetables, peeled tomatoes, citrus fruit). After a preliminary data screening (incomplete survey, response set, missing data), a finalized sample ($N = 303$) was used for data analysis. The finalized sample was evenly distributed across conditions (vegetables: 33.3%; peeled tomatoes: 33.0%; citrus fruit: 33.7%) and composed of: women 52.1%; Americans: 93.4%; average age: 36.9 years (*SD*: 11.9); high school = 34.7%, bachelor degree = 48.2%, master degree = 12.9%, post-graduate education = 4.3%; employed full time = 62.7%, part time = 12.2%, unemployed = 8.9%, student = 5.3%, retired = 2.6%, occasional job = 2.3%, other = 5.6%; married = 47.2%, single = 35.6%, cohabitee or in a relationship = 8.6%; separated or divorced = 7.9%, widow/a = 1%. Similar to USA national data (DNPAO, 2019), where about half the people are overweight and obese, participants' Body Mass Index was: underweight, 3.8%; healthy weight, 46.4%; overweight, 29.4%; obese, 20.5%.

Measures

The FRM-ENG survey consists of the same 102 items used in the FRM-ITA (see section Method for details). The latter has been translated in English and back-translated in Italian. All items were measured on seven-point Likert-type items (from "Completely disagree" to "Completely agree"). The final section of the questionnaire included eight items measuring gender, age, education, marital status, employment, nationality, height and weight.

Results and Discussion

Following the FRM model, results of the first-order CFAs show the best measurement models (item-markers) for each Specific Indicator of food reputation: fit indices for each model measured by the FRM-ENG (H1), covariances among Specific Indicators for each Synthetic Indicator of food reputation (H2), and lambda coefficients for the retained items (H3) are reported in **Tables 2**, **10**–**15**, **22**, respectively.

TABLE 2 | CFA on food reputation's synthetic indicators of FRM-ENG–Study 2.

Goodness of fit indexes	Chi^2	df	*p*	RMSEA	SRMR	CFI
Essence	227.35	88	<0.001	0.072	0.065	0.957
Cultural effects	106.02	46	<0.001	0.066	0.055	0.962
Economic effects	126.72	43	<0.001	0.080	0.070	0.960
Environmental effects	99.59	41	<0.001	0.069	0.063	0.955
Physiological effects	47.43	20	<0.001	0.067	0.054	0.986
Psychological effects	337.71	128	<0.001	0.074	0.079	0.951

CFA, confirmatory factor analysis; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; CFI, comparative fit index.

Essence

For the scale measuring Essence, the model includes four correlated Specific Indicators of food reputation (factors), each measured by four items: Composition, Genuineness, Life Time, and Recognition.

Cultural Effects

For the scale measuring Cultural Effects, the model includes four correlated Specific Indicators of food reputation, each measured by three items: Territorial Identity, Tradition, Familiarity, and Innovativeness.

Economic Effects

For the scale measuring Economic Effects, the model includes three correlated Specific Indicators of food reputation, each measured by four items: Context, Price, and Preparation.

Environmental Effects

For the scale measuring Environmental Effects, the model includes four correlated Specific Indicators of food reputation, each measured by three items: Social and Environmental Responsibility, Traceability, Proximity, and Safety. The factors Traceability and Proximity, and Proximity and Safety were not significantly correlated.

Physiological Effects

For the scale measuring Physiological Effects, the model includes three correlated Specific Indicators of food reputation, each measured by three items: Ability to Satisfy, Digestibility, and Lightness.

Psychological Effects

For the scale measuring Psychological Effects, the model includes five correlated Specific Indicators of food reputation: Organoleptic Perception (four items), Personal Memories (three items), Psycho-physical Well-being (three items), Conviviality (three items), and Group Belongingness (four items). The correlations among the following factors were not statistically significant: Organoleptic Perception-Personal Memories, Organoleptic Perception-Group Belongingness, Personal Memories-Conviviality, and Conviviality-Group Belongingness.

Conclusion

Similar to Study 1, results of Study 2, based on a survey administered to an *ad hoc* sample of North Americans confirm the measurement model theorized by the original FRM (Bonaiuto et al., 2017): the hypothesized models produced good fit indexes H1); first order factors were all correlated to each other (H2) in the following Synthetic Indicators of Food Reputation: Essence, Cultural Effects, Economic Effects, and Physiological Effects; and, a total of 78 items were retained (H3). In the finalized FRM-ENG, one item was removed from each of the following Specific Indicators of Food Reputation (the group's Synthetic

Indicator of Food reputation is indicated in brackets): Territorial identity, Tradition, Familiarity, Innovativeness (Cultural Effects); Social and environmental responsibility, Traceability, Proximity, Safety (Environmental Effects); Ability to satisfy, Digestibility, Lightness (Physiological Effects); Personal memories, Psycho-physical Well-being, Conviviality (Psychological Effects). The finalized FRM-ENG is presented in **Appendix 1**. In conclusion, Study 2 successfully defined the FRM-ENG. The Mandarin Chinese version of the instrument then was addressed.

TABLE 3 | CFA on food reputation's synthetic indicators of FRM-CHI–Study 3.

Goodness of fit indexes	Chi^2	df	*p*	RMSEA	SRMR	CFI
Essence	187.63	68	<0.001	0.076	0.080	0.929
Cultural effects	175.23	66	<0.001	0.073	0.069	0.912
Economic effects	74.41	31	<0.001	0.068	0.053	0.942
Environmental effects	82.44	44	<0.001	0.053	0.038	0.950
Physiological effects	117.39	41	<0.001	0.078	0.069	0.949
Psychological effects	173.08	84	<0.001	0.059	0.064	0.964

CFA, confirmatory factor analysis; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; CFI, comparative fit index.

TABLE 4 | Covariance matrix of the specific indicators of food reputation for the synthetic indicator ESSENCE of FRM-ITA–Study 1.

Essence	1.	2.	3.	4.
1. Composition	–			
2. Genuineness	0.49***	–		
3. Life time		0.21***	–	
4. Recognition	−0.65***	−0.69***		–

****p < 0.001; empty cells represent non-constrained covariances.*

TABLE 5 | Covariance matrix of the specific indicators of food reputation for the synthetic indicator CULTURAL EFFECTS of FRM-ITA–Study 1.

Cultural effects	5.	6.	7.	8.
5. Territorial Identity	–			
6. Tradition	0.56***	–		
7. Familiarity	0.53***	0.57***	–	
8. Innovativeness	0.38***	0.36***	0.50***	–

****p < 0.001; empty cells represent non-constrained covariances.*

TABLE 6 | Covariance matrix of the specific indicators of food reputation for the synthetic indicator ECONOMIC EFFECTS of FRM-ITA–Study 1.

Economic effects	9.	10.	11.
9. Context	–		
10. Price		–	
11. Preparation	0.46***	0.04†	–

*†p < 0.10; ***p < 0.001; empty cells represent non-constrained covariances.*

STUDY 3: FRM-CHI

Aims and Hypotheses

Study 2 applies the aims and hypotheses reported in section Aims and Hypotheses in the U.S. context, and therefore is concerned with the validation of the Chinese-Mandarin version of the FRM, henceforth FRM-CHI. It originates from the FRM-ENG, which was translated and then back-translated by a team of English and Chinese-Mandarin native speakers scholars (including some of the authors).

Method

Participants and Procedure

The online survey was administrated to about 350 participants, during May-August 2015. Participants were recruited at Zhejiang University (Hangzhou, China) via email using an available mailing list of students; to further populate the sample, participants were also recruited in the streets around the University and surveys were administered either via a mobile device or filled out in paper-and-pencil form. Respondents volunteered to participate in a 10–15-min survey about food for research purposes. Similar to Study 1 and 2, each participant

TABLE 7 | Covariance matrix of the specific indicators of food reputation for the synthetic indicator ENVIRONMENTAL EFFECTS of FRM-ITA–Study 1.

Environmental effects	12.	13.	14.	15.
12. Social and Environm. Resp.	–			
13. Traceability	−0.15***	–		
14. Proximity		0.44***	–	
15. Safety	−0.5***	0.29***	0.08**	–

***p < 0.01; ***p < 0.001; empty cells represent non-constrained covariances.*

TABLE 8 | Covariance matrix of the specific indicators of food reputation for the synthetic indicator PHYSIOLOGICAL EFFECTS of FRM-ITA–Study 1.

Physiological effects	16.	17.	18.
16. Ability to Satisfy	–		
17. Digestibility	0.72***	–	
18. Lightness	−0.61***	−0.65***	–

****p < 0.001; empty cells represent non-constrained covariances.*

TABLE 9 | Covariance matrix of the specific indicators of food reputation for the synthetic indicator PSYCHOLOGICAL EFFECTS of FRM-ITA–Study 1.

Psychological effects	19.	20.	21.	22.	23.
19. Organoleptic perception	–				
20. Personal memories	0.18***	–			
21. Psyco-physical well-being	0.17***	0.45***	–		
22. Conviviality	−0.64***			–	
23. Group belongingness		0.54***	0.50***		–

****p < 0.001; empty cells represent non-constrained covariances.*

was randomly allocated to one of the three possible conditions (vegetables, peeled tomatoes, citrus fruit). After a preliminary data screening (incomplete survey, response set, missing data), a finalized sample (N = 308) was used for data analysis. The finalized sample was evenly distributed across conditions (vegetables: 36.0%; peeled tomatoes: 31.5%; citrus fruit: 32.5%) and composed of: women 58.1%; Chinese: 100%; average age: 26.7 years (*SD*: 6.8); high school = 7.2%, bachelor degree = 79.4%, master degree = 10.8%, post-graduate education = 2.6%; married = 21.2%, single = 75.2%, cohabitee or in a relationship = 2.6%; separated or divorced = 0.3%, widow/er = 0.6%. Similar to Chinese national data (WHO, 2019), where only a small minority of inhabitants are obese, participants' Body Mass Index was: underweight, 21.2%; healthy weight, 69%; overweight, 6.1%; obese, 3.7%.

Measures

The FRM-CHI survey consists of the same 102 items used in the FRM-ENG (see section Method for details). The latter was translated in Chinese and then back-translated in English by a team of experienced researchers who were native in one language and fluent at the professional level in the other one (supervised by some of the co-authors). All items were measured on seven-point Likert-type items (from "Completely disagree" to "Completely agree").

Results and Discussion

As per Study 1–2, results of the first-order CFAs show the best measurement models (item-markers) for each Specific Indicator of food reputation: fit indices for each model measured by the FRM-CHI (H1), covariances among Specific Indicators for each Synthetic Indicator of food reputation (H2), and lambda coefficients for the retained items (H3) are reported in **Tables 3**, **16**–**21**, **22**, respectively.

Essence

For the scale measuring Essence, the model includes four correlated Specific Indicators of food reputation (factors): Composition (three items), Genuineness (four items), Life Time (four items), and Recognition (three items). The factors Life Time and Recognition were not significantly correlated.

Cultural Effects

For the scale measuring Cultural Effects, the model includes four correlated Specific Indicators of food reputation: Territorial

TABLE 10 | Covariance matrix of the specific indicators of food reputation for the synthetic indicator ESSENCE of FRM-ENG–Study 2.

Essence	1.	2.	3.	4.
1. Composition	–			
2. Genuineness	0.97***	–		
3. Life time	0.29***	0.34***	–	
4. Recognition	0.96***	0.96***	0.33***	–

****p < 0.001; empty cells represent non-constrained covariances.*

TABLE 11 | Covariance matrix of the specific indicators of food reputation for the synthetic indicator Cultural effects of FRM-ENG–Study 2.

Cultural Effects	5.	6.	7.	8.
5. Territorial identity	–			
6. Tradition	−0.75***	–		
7. Familiarity	−0.49***	0.71***	–	
8. Innovativeness	0.24***	−0.49***	−0.77***	–

****p < 0.001; empty cells represent non-constrained covariances.*

TABLE 12 | Covariance matrix of the specific indicators of food reputation for the synthetic indicator ECONOMIC EFFECTS of FRM-ENG–Study 2.

Economic effects	9.	10.	11.
9. Context	–		
10. Price	−0.41***	–	
11. Preparation	0.45***	−0.56***	–

****p < 0.001; empty cells represent non-constrained covariances.*

TABLE 13 | Covariance matrix of the specific indicators of food reputation for the synthetic indicator ENVIRONMENTAL EFFECTS of FRM-ENG–Study 2.

Environmental effects	12.	13.	14.	15.
12. Social and Environm. Resp.	–			
13. Traceability	−0.60***	–		
14. Proximity	−0.24***		–	
15. Safety	−0.64***	−0.61***		–

****p < 0.001; empty cells represent non-constrained covariances.*

TABLE 14 | Covariance matrix of the specific indicators of food reputation for the synthetic indicator PHYSIOLOGICAL EFFECTS of FRM-ENG–Study 2.

Physiological effects	16.	17.	18.
16. Ability to satisfy	–		
17. Digestibility	0.51***	–	
18. Lightness	−0.57***	−0.87***	–

****p < 0.001; empty cells represent non-constrained covariances.*

TABLE 15 | Covariance matrix of the specific indicators of food reputation for the synthetic indicator PSYCHOLOGICAL EFFECTS of FRM-ENG–Study 2.

Psychological effects	19.	20.	21.	22.	23.
19. Organoleptic perception	–				
20. Personal memories		–			
21. Psyco-physical well-being	0.39***	0.37***	–		
22. Conviviality	−0.76***		−0.37***	–	
23. Group belongingness		0.60***	0.39***		–

****p < 0.001; empty cells represent non-constrained covariances.*

TABLE 16 | Covariance matrix of the specific indicators of food reputation for the synthetic indicator ESSENCE of FRM-CHI–Study 3.

Essence	1.	2.	3.	4.
1. Composition	–			
2. Genuineness	0.68***	–		
3. Life time	0.30***	0.11***	–	
4. Recognition	0.72***	0.57***		–

****p < 0.001; empty cells represent non-constrained covariances.*

TABLE 17 | Covariance matrix of the specific indicators of food reputation for the synthetic indicator CULTURAL EFFECTS of FRM-CHI–Study 3.

Cultural effects	5.	6.	7.	8.
5. Territorial identity	–			
6. Tradition	0.22***	–		
7. Familiarity	0.53***		–	
8. Innovativeness	0.29***	0.20***	0.42***	–

****p < 0.001; empty cells represent non-constrained covariances.*

TABLE 18 | Covariance matrix of the specific indicators of food reputation for the synthetic indicator ECONOMIC EFFECTS of FRM-CHI–Study 3.

Economic effects	9.	10.	11.
9. Context	–		
10. Price	0.39***	–	
11. Preparation	0.36***	0.42***	–

****p < 0.001; empty cells represent non-constrained covariances.*

TABLE 19 | Covariance matrix of the specific indicators of food reputation for the synthetic indicator ENVIRONMENTAL EFFECTS of FRM-CHI–Study 3.

Environmental effects	12.	13.	14.	15.
12. Social and Environm. Resp.	–			
13. Traceability	−0.73***	–		
14. Proximity		0.30***	–	
15. Safety	−0.42***	0.44***	0.13†	–

*†p < 0.10; ***p < 0.001; empty cells represent non-constrained covariances.*

TABLE 20 | Covariance matrix of the specific indicators of food reputation for the synthetic indicator PHYSIOLOGICAL EFFECTS of FRM-CHI–Study 3.

Physiological effects	16.	17.	18.
16. Ability to satisfy	–		
17. Digestibility	0.46***	–	
18. Lightness	−0.25***	−0.96***	–

****p < 0.001; empty cells represent non-constrained covariances.*

Identity (three items), Tradition (three items), Familiarity (four items), and Innovativeness (four items).

TABLE 21 | Covariance matrix of the specific indicators of food reputation for the synthetic indicator PSYCHOLOGICAL EFFECTS of FRM-CHI–Study 3.

Psychological effects	19.	20.	21.	22.	23.
19. Organoleptic perception	–				
20. Personal memories		–			
21. Psyco-physical well-being	0.46***	0.38***	–		
22. Conviviality	−0.71***		0.46***	–	
23. Group belongingness		0.46***	0.28***		–

****p < 0.001; empty cells represent non-constrained covariances.*

Economic Effects

For the scale measuring Economic Effects, the model includes three correlated Specific Indicators of food reputation: Context (three items), Price (three items), and Preparation (four items).

Environmental Effects

For the scale measuring Environmental Effects, the model includes four correlated Specific Indicators of food reputation, each measured by three items: Social and Environmental Responsibility, Traceability, Proximity, and Safety. The factors Social and Environmental Responsibility and Proximity were not significantly correlated.

Physiological Effects

For the scale measuring Physiological Effects, the model includes three correlated Specific Indicators of food reputation, each measured by four items: Ability to Satisfy, Digestibility, and Lightness.

Psychological Effects

For the scale measuring Psychological Effects, the model includes five correlated Specific Indicators of food reputation, each measured by three items: Organoleptic Perception, Personal Memories, Psycho-physical Well-being, Conviviality, and Group Belongingness. The following correlations among factors were not significant: Organoleptic Perception-Personal Memories, Organoleptic Perception-Group Belongingness, Personal Memories-Conviviality, and Conviviality-Group Belongingness.

Conclusion

Similar to Studies 1 and 2, results of Study 3, based on a survey administered to an *ad hoc* sample of Chinese, generally confirms the measurement model theorized by the original FRM (Bonaiuto et al., 2017): the proposed models produced good fit indices (H1); first order factors (i.e., the Specific Indicators of Food Reputation) were all correlated in the following Synthetic Indicators of Food Reputation: Cultural Effects, Economic Effects, and Physiological Effects; and, a total of 77 items were retained (H3). In the finalized FRM-CHI, one item was removed from each of the following Specific Indicators of Food Reputation (the overarching group's Synthetic Indicator of Food reputation is indicated in brackets): Composition, Recognition (Essence); Territorial identity, Tradition (Cultural Effects); Context, Price (Economic Effects); Social and environmental

responsibility, Traceability, Proximity, Safety (Environmental Effects); Organoleptic Perception, Personal memories, Psycho-Physical Well-being, Conviviality, Group Belongingness (Psychological Effects). The finalized FRM-CHI is presented in **Appendix 1**. In conclusion, Study 3 successfully defined the FRM-CHI.

Auxiliary Analysis

To further corroborate the importance of defining the three versions of the FRM, we conducted a *post-hoc* auxiliary analysis where we compared the Specific Indicators of food reputation describing the three aggregated product categories in the three countries. A series of 23 ANOVAs has been conducted to test for significant differences in each Specific Indicator of food reputation (of the three food categories aggregated) across the three cultural contexts. Specifically, in **Figure 1**, we show the statistical differences (one-way ANOVA and 95% confidence interval of the mean) among the three countries for each specific indicator of food reputation. Results show that some reputational features of the examined food products are indeed perceived differently across cultures (all $p < 0.05$): for example, Italians perceive Composition, Life Time, Familiarity, Social and Environmental Responsibility, Lightness and Psycho-Physical Well-being to be significantly lower than Americans and Chinese; Americans perceive Genuineness, Recognition, Familiarity, Price, Social and Environmental Responsibility, Traceability, Safety, Digestibility and Lightness to be significantly higher than Italians and Chinese; Chinese perceive Preparation and Ability to Satisfy to be significantly lower, while Innovativeness significantly higher than Italians and Americans. Furthermore, as an example, we suggest the visual representation of the FRM in the form of a Kiviat graph (Morris, 1974)—or radar chart (**Figure 2**)—to have a visual representation of the magnitude of each given product category's reputational profile.

In conclusion, although the test of such statistical differences goes beyond the aim of the present research, we believe that such representation is a useful example to highlight one of the possible applications of the FRM. Results show that people's reputation of the food categories here examined changes significantly across different cultural contexts. These results, together with the fact that consumers increasingly demand local and traditional food (Pieniak et al., 2009), substantiate the idea that in order to understand people's actions in relation to food preferences and therefore food consumption, it is important to take into account the repertoire of cultural differences that underlies the contexts of analysis. In order to do so, the culture-specific measures of food-reputation here provided can therefore be very effective and useful tools to acquire such knowledge. In turn, the knowledge of culture-specific food perception could be indeed leveraged to promote a more sustainable consumption of food.

GENERAL DISCUSSION

The three reported studies succeeded in validating the original model proposed for the FRM (Bonaiuto et al., 2017). Drawing on the idea that food can play different roles in different cultures, and therefore the concept of food reputation might change across different cultural settings, it is important to provide available tools capable of measuring food related constructs cross-culturally. The three versions of the Food Reputation Map, namely the FRM-ITA, FRM-ENG, and FRM-CHI in Italian, American English, and Mandarin Chinese, respectively, were created and validated by administration of the same FRM item sets in Italy, USA and China (**Table 1**). Together, the three studies represent a first attempt at creating a series of tools that could be applied in future studies for improving the understanding of individuals' food perceptions, assessments, and consumption. Overall, the three studies confirm the measurement structure of the FRM through the verification of the three operational hypotheses of the present research: in fact, model fit indexes, correlations among Specific Indicators of food reputation, and lambda coefficient—only with few exceptions in each context—were satisfactory and confirmed the original theoretical model of food reputation already presented in past research (Bonaiuto et al., 2012b,c, 2017). The Food Reputation Map theoretical model, encompassing twenty-three Specific Indicators, which can be further grouped into six Synthetic Indicators of food reputation, was replicated in the three different cultural contexts, keeping constant three target food categories. The results held across three diverse samples of Italian, American, and Chinese respondents.

According to the assumptions that (a) food is a social agent (Bonaiuto et al., 2017), (b) it is fundamentally linked to specific cultural settings (Counihan and Van Esterik, 2013), and (c) is subject to continuous change (Devine, 2005), the three measures of food reputation presented here can be applied to study food reputation according to, and within, different cultural settings. The finalized sets of items measure each of the twenty-three Specific Indicators of food reputation either by a three-item or four-item marker pool: such items, in each cultural setting, apparently have a different weight in measuring the specific indicator of food reputation. Also, results show that correlations among Specific Indicators of food reputation—which, according to the FRM model cluster into a Synthetic Indicator of food reputation—can change across cultural settings. These results support the idea that food reputation can be measured by a standard set of items and can be synthesized by the same set of Indicators (Specific and Synthetic ones). This tenet does not exclude the possibility that specific target food categories can also be defined and rated differently according to different cultural settings in terms of their respective food reputation: further research should investigate which parameters of food reputation are, on the one hand, context specific and which are, on the other hand, generalizable across cultures.

Limitations and Future Directions

The new and promising tools developed in this research should be considered in light of some limitations, which can guide future research developments for understanding both generalizable and context-specific features of food reputation. First, it should be noted that the new FRM measures developed here emerged from

TABLE 22 | Standardized lambda coefficients for each item and its specific indicator of food reputation in each version of the FRM.

Reputational area	Synthetic indicator	#	Specific indicator	Item label	FRM-ITA	FRM-ENG	FRM-CHI
Area 0—Food intrinsic features	Essence	1.	Composition	comp1	0.68	0.85	0.81
				comp2		0.90	0.86
				comp3	−0.86	−0.53	
				comp4	0.69	0.71	0.73
		2.	Genuineness	genuin1	0.48	0.87	0.87
				genuin2	0.49	0.89	0.94
				genuin3		−0.54	0.32
				genuin4	−0.73	−0.68	−0.31
		3.	Life time	lifetime1	0.38	0.61	0.82
				lifetime2	−0.79	−0.78	−0.34
				lifetime3		0.63	0.24
				lifetime4	−0.74	−0.93	−0.21
		4.	Recognition	recog1		0.79	0.55
				recog2	0.63	−0.51	
				recog3	0.73	−0.56	−0.22
				recog4	0.81	−0.63	−0.42
Area 1—Food-context effects or relations	Cultural effects	5.	Territorial identity	terr_id1	0.40	0.29	0.17
				terr_id2	0.85	0.75	0.45
				terr_id3	0.73	0.93	0.84
				terr_id4			
		6.	Tradition	trad1		0.12	0.82
				trad2	0.77	−0.84	
				trad3	−0.21		0.76
				trad4	0.76	−0.74	−0.16
		7.	Familiarity	famil1		0.58	−0.40
				famil2	0.70		0.61
				famil3	−0.41	0.46	−0.48
				famil4	0.73	−0.73	0.77
		8.	Innovativeness	innov1	0.80	0.84	0.43
				innov2	0.76		0.76
				innov3	0.77	0.91	0.57
				innov4	0.81	0.86	0.80
	Economic effects	9.	Context	contex1	0.19	0.80	0.75
				contex2	−0.75	−0.39	−0.44
				contex3	−0.88	−0.47	
				contex4		0.82	0.54
		10.	Price	price1		0.63	
				price2	0.63	−0.44	0.76
				price3	0.72	−0.89	0.83
				price4	0.81	−0.92	0.70
		11.	Preparation	prep1	0.37	0.94	0.97
				prep2	−0.72	−0.45	−0.23
				prep3	0.43	0.78	0.61
				prep4	−0.81	−0.52	−0.25
	Environmental Effects	12.	Social and environmental responsibility	resp1	0.86	0.72	0.30
				resp2	0.83	0.99	
				resp3	−0.18	−0.29	−0.70

(Continued)

TABLE 22 | Continued

Reputational area	Synthetic indicator	#	Specific indicator	Item label	FRM-ITA	FRM-ENG	FRM-CHI
				resp4			−0.69
		13.	Traceability	traceab1		−0.93	
				traceab2	0.53	0.42	0.59
				traceab3	0.85	0.38	1.30
				traceab4	0.76		0.32
		14.	Proximity	prox1	0.93	0.47	0.68
				prox2	0.67	0.50	0.60
				prox3	−0.28		
				prox4	−0.29	0.29	0.28
		15.	Safety	saf1	0.27		0.90
				saf2		−0.40	0.83
				saf3	−0.85	0.93	−0.09
				saf4	−0.89	0.89	
Area 2—Food-individual effects or relations	Physiological effects	16.	Ability to satisfy	ab_satisfy1	0.27	0.63	0.88
				ab_satisfy2	−0.84	−0.95	−0.59
				ab_satisfy3	−0.28	0.78	−0.75
				ab_satisfy4			0.63
		17.	Digestibiliy	digest1	0.30	0.46	0.55
				digest2	0.22		0.40
				digest3	−0.82	−0.85	−0.42
				digest4	−0.81	−0.97	−0.53
		18.	Lightness	light1	0.78	0.87	0.33
				light2	0.80	0.88	0.51
				light3	−0.65	−0.56	−0.87
				light4			−0.80
	Psychological effects	19.	Organoleptic perception	perc1	0.52	0.71	0.58
				perc2	0.42	0.64	
				perc3	−0.78	−0.97	−0.81
				perc4	−0.79	−0.95	−0.92
		20.	Personal memories	memor1	0.80	0.75	0.66
				memor2			
				memor3	0.81	0.88	0.91
				memor4	0.88	0.87	0.86
		21.	Psycho-physical well-being	well-being1	0.69		0.82
				well-being2	0.82	0.86	0.92
				well-being3	0.84	0.88	0.80
				well-being4	0.80	0.80	
		22.	Conviviality	conviv1			
				conviv2	0.71	0.80	0.83
				conviv3	0.80	0.81	0.84
				conviv4	0.73	0.87	0.71
		23.	Group belongingness	group_bel1	0.69	0.88	0.80
				group_bel2	0.90	0.91	0.91
				group_bel3	0.86	0.86	
				group_bel4	0.86	0.87	0.68

a testing involving specific samples in Italy, USA, and China (N = 1,337, 303, and 307, respectively), where participants responded to the specific survey in their own native language. Although the Italian sample was gathered by quota sampling in the Italian population across genders, ages, and main geographical areas, the American and Chinese samples were convenient samples (MTurk and college students, respectively). Whereas, the Italian sample could be considered representative of the Italian population (ISTAT, 2019) the American and Chinese sample might not be representative of their respective populations.

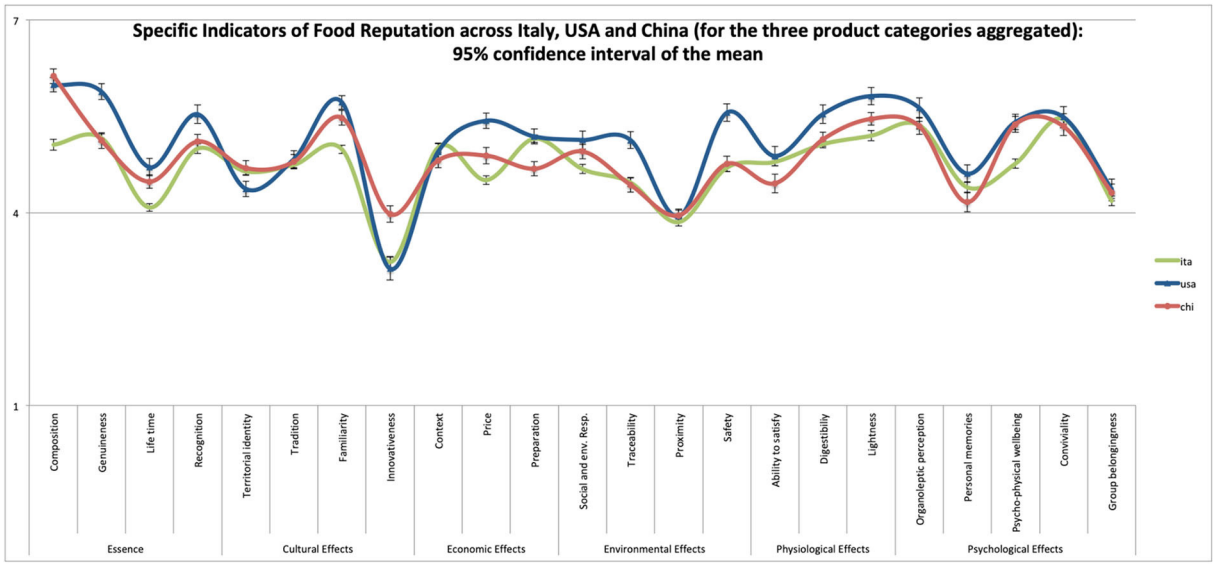

FIGURE 1 | Statistical comparison of the three product categories aggregated across the three countries of Study 1, 2, and 3.

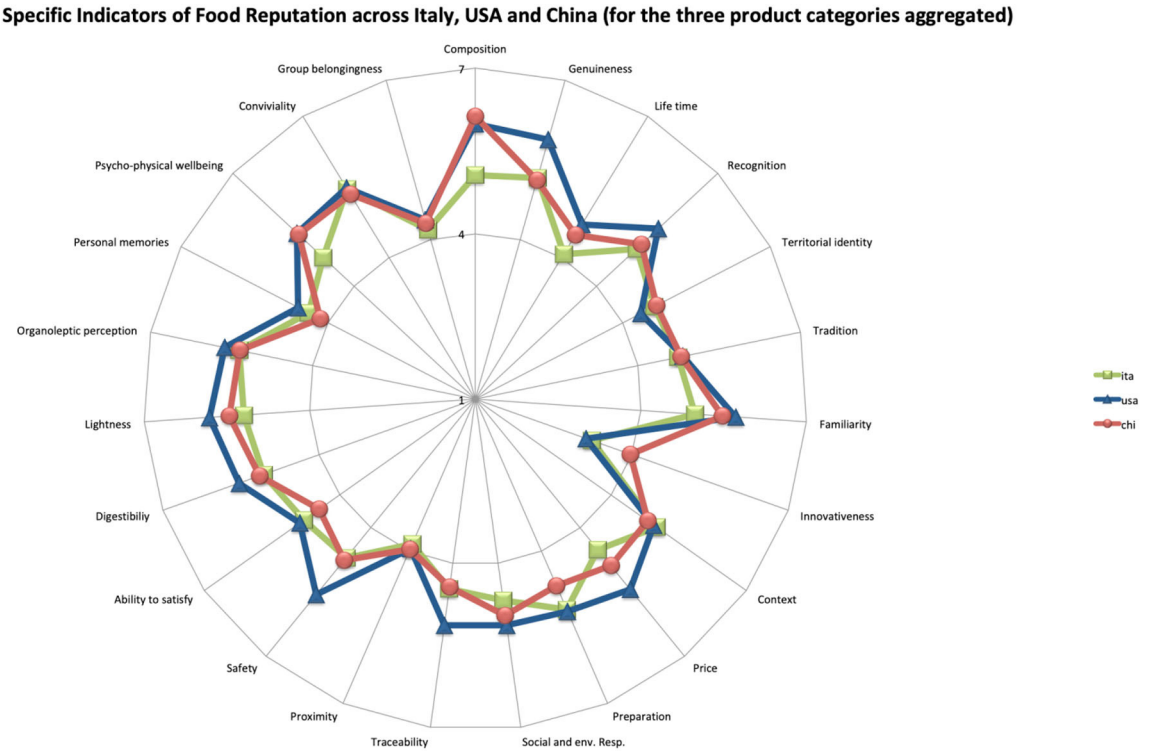

FIGURE 2 | Kiviat graph for the descriptive representation of FRM.

Thus, future research should aim at replicating the FRM model within larger, representative sample within each context, possibly including various other socio-demographic information, such as ethnicity and immigration status to allow for a deeper understanding of how reputational features of a given food could be perceived differently within specific groups.

Second, the FRM tools developed in this research have referred to three different goods, namely vegetables, citrus fruit

and peeled tomatoes, all very relevant goods for the Italian food market (Castiglione et al., 2007; Zaccarini Bonelli, 2012; Bonaiuto et al., 2017). However, these goods might not be central within other food markets in other cultural contexts, and therefore future research should consider how food reputation features are linked to products whose importance is more or less central within various specific cultural settings.

Also, as already pointed out in previous research (Bonaiuto et al., 2012b, 2017), the FRM model originated and has been developed from a set of initial researches (carried out with both qualitative and quantitative methodology) based in Italy (Bonaiuto et al., 2012a,b,c, 2017). Such a feature on the one hand is a strength considering the variety of approaches and methods used in its development; on the other hand, it could potentially represent a limiting factor in terms of cultural diversity. In fact, it is well-acknowledged that food is a fundamental aspect in the Italian culture (Parasecoli, 2004), and therefore it might be the case that some outcomes which emerged in the Italian sample could be culture-specific rather than cultural universals. Thus, a test of the FRM in other cultures is needed to generalize the validity of the FRM across different cultural and linguistic contexts, possibly considering classes of products, which are very relevant for those specific cultures, to assure the best benchmarking approach. Overall, the present research is a first attempt to set a standard measure, which can be used to assess this issue; however, future research should investigate whether other fundamental tenets of food reputation can arise in different contexts.

Furthermore, concerning factorial the structure of the FRM model, the second-order factors of food reputation (namely, the Synthetic Indicators) have not been discussed here—a goal that would have been out of the scope of the present manuscript. Rather, here we test which items of each Specific Indicator of food reputation (first-order factor) are indeed the most appropriate markers to measure the intended Specific Indicator within each culture. Future research should therefore confirm the second-order overall structure of the model in different cultural contexts. In addition, concerning the comparison between cultures, we assumed and demonstrated that the best item-markers for each Specific Indicator of food reputation can vary cross-culturally. However, one un-answered question is whether or not (and, if yes, which) facets of food reputation could be universally relevant: starting from the present results, future research should therefore test the multi-group invariance of the FRM model across different cultural groups.

Practical Implications

In spite of such limitations, the present tools set an effective and useful standard of measures, which can be implemented in various practical activities. A series of possible applications can be considered in light of these new tools, which are highlighted here in view of future developments.

At the consumer level, one possible application lies in the opportunity to gather new knowledge on different reputational features, or perceived features that can be linked to reputation (Péneau et al., 2006), which may affect consumer choices in different contexts (Bonaiuto et al., 2012b). This goal could be achieved, for example, by investigating a given product's reputation in two different cultural contexts to understand its culture-specific reputational features' strengths and weaknesses. Such a strategy could be used to address various issues. For example, it could help individuals' decision-making on how to self-regulate eating behaviors (Johnson et al., 2012); or it could shed light on how ethnic identity, socialization and other culture-specific behaviors affect food consumption (Xu et al., 2004); or, in more general terms, it could deepen our understanding of cultural specific influences of food reputation on the attitude-behavior consistency (Crano and Prislin, 2011) related to food choices.

From a marketing perspective, because in both physical and online markets peer-to-peer knowledge represents a fundamental asset for consumers and businesses to derive information related to reputation and trust (Ert et al., 2016), the knowledge and management of a given food product's reputational features can obviously be an important asset. Drawing upon the evidence that different food reputational features have different impacts on consumers' food choices (Bonaiuto et al., 2012b,c), food reputation management could be a very effective strategy for various stakeholders (e.g., businesses or consumers) to gain strategic advantage from their competitors. On the one hand, businesses could, for example, grow their own reputation (Riel and van Fombrun, 2007) by taking advantage of their products' best reputational features, or they could improve their own products' reputation by investing in specific weak reputational features to be addressed. On the other hand, specific clusters of consumers, such as athletes or clinical patients, could acquire knowledge about specific reputational features of a given product and then use this knowledge to their advantage (for example, for improving performance or for sticking to prescribed nutritional programs; e.g., Johnson et al., 2012).

At the broader perspective, policy makers, opinion-leaders and various institutional stakeholders can potentially use the present tools to promote well-being at the community level. In fact, the various reputational features of the food reputation model, confirmed here, could be studied to serve purposes related to, among others, community-based health interventions (Schulz et al., 2005; Ball et al., 2010; Brand et al., 2014), environmental sustainability (Tilman and Clark, 2014), and price control (UN World Food Programme, 2012). Indeed, one of the major strengths of our research lies in the fact that by considering all possible facets of food reputation (defined by the FRM), and by developing a culture-specific instrument measuring such facets (e.g., FRM-ENG), it would be possible to understand whether a specific reputational feature (e.g., Tradition) could be leveraged to promote for example health or sustainable consumption at the community level in a given culture. We could draw upon the example of the Specific Indicator "Tradition": although it has been often argued that there is no real *cuisine* tradition in the U.S. (e.g., Mintz, 2002), results of our Auxiliary analysis show no significant differences in Tradition across the three different cultures. This specific result could indicate that, despite that perhaps Italy and China have (at least historically)

greater food traditions than the U.S., this is not reflected in the perceptions of individuals. Findings like this can inform marketers, practitioners, and policymakers alike to engage in more informed actions and solutions toward healthier, more sustainable and better informed food-related decisions.

Within this approach, the study of food reputational features could indeed be leveraged to promote food sustainability in a variety of ways. For example, provided that information about sustainability are communicated to consumers, consumption behaviors might have a major role in bringing about more sustainable food production (Grunert, 2011). Past research has already shown that some perceived features of food, such as food safety, environmental concern, nutritive value, taste, freshness and appearance—that are, arguably, very much comparable to the reputational features by the FRM, might influence organic food consumer preferences (Shafie and Rennie, 2012). However, how individuals can be encouraged to cut unsustainable consumption behavior (e.g., excessive meat consumption) has been underexplored, and more in-depth studies on the factors that could increase people's willingness to engage in a more sustainable food consumption are much needed (Hartmann and Siegrist, 2017). We argue that, ideally, the FRM model could be used to develop international evidence-based knowledge, which in turn could inform and support international exchange of information and effective policy design on drivers of sustainable consumer behavior and evaluations across countries worldwide (McGeevor, 2009).

Conclusion

From a social-psychological perspective, understanding processes driving individuals' food preferences and food consumption (i.e., food consumer behavior), food markets, and political decision-making is an important asset to be developed. The fundamental importance of understanding the cultural specificity of food reputation (Parasecoli, 2004), is reflected in the assumption that human behavior can only exists in a given place, and therefore it is both the product of, and it produces, a whole series of transactions between individuals and the specific environments where their behavior occurs (Proshansky et al., 1970; Bronfenbrenner, 1977; Bonnes and Secchiaroli, 1995; Bonnes and Bonaiuto, 2002; Devine-Wright, 2013). The global issues and challenges related to food consumption must be faced by interdisciplinary efforts and tackled by multiple perspectives (FAO, 2009). On the one hand, a stunning 113 million people across 53 countries are suffering acute hunger (Global Report on Food Crises, 2019); on the other hand, trend forecasts suggest that by 2030, 51% of the population will be obese (Finkelstein et al., 2012). In this respect, the crucial importance of food reputation lies in both its theoretical and applied implications for understanding food consumption choices and behaviors. By drawing upon the present research program, and by further developing the measures provided, the detailed and specific knowledge capital that could be derived provides the initial building blocks for a number of new possible interventions and action plans designed to tackle the current global food–related challenges, and potentially be leveraged to foster food sustainability. From a behavioral science perspective, whether in the realm of the consumption, production, marketing, political, or clinical intervention over food and drink matters, a "think global, act local" approach (Devine-Wright, 2013) could materially facilitate the development of international sustainable solutions to some of the global challenges related to food.

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

SD and MB designed the research questions and the study. SD, MB, FF, WC, and JM supervised the data collection. SD performed the statistical analysis to discuss with MB and FF for interpretation and drafted the manuscript. WC, FF, and MB provided the feedback on the manuscript. SD, FB, UG, and IP contributed to the data collection. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

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Analysis of Scientific and Press Articles Related to Cultured Meat for a Better Understanding of Its Perception

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Cultured meat is presented by its advocates as a good alternative for consumers who want to be more ethically minded but who do not wish to change their diet. This novel food has become an emerging topic in both the scientific field and the press media. From a bibliometric analysis of scientific publications and on a sociometric analysis of the mainstream press, the aim of this study was to identify potential differences between the scientific view and the public perception. This research analyzed the publications indexed by SCI-EXPANDED in the Web of Science Core Collection database owned by Clarivate Analytics, for scientific literature analysis, and indexed by the Factiva database, for the press media. A total of 327 scientific publications were analyzed according to year of publication and country and institution of origin, also including coauthorships, co-citations, and scientific fields' and journals' networks. A knowledge mapping using VOSviewer was used to study the literature in the field. Based on Factiva, 12,900 press articles dealing with artificial meat, mainly in English, have been found through public databases. The main conclusion is that cultured meat is mainly developing in the USA and the UK, with other countries, such as China, observing the trend for potential future applications. Scientific articles seemed initially to focus mainly on technical aspects of artificial meat and more recently on health value, consumer's acceptance, and sustainability. However, the potential environment-friendly effects of this novel food are more and more studied or described in scientific or press articles.

Keywords: cultured meat, Web of Science, press, public, perception, bibliometrics

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INTRODUCTION

Besides animal farming, many efficient ways of protein production are being developed to satisfy the increasing demand for food by the growing human population, while taking into account today's challenges when it comes to livestock, may they be environmental or in terms of animal welfare (Scollan et al., 2011; Aiking, 2014; Gerber et al., 2015; Willett et al., 2019). Among the solutions, cultured meat or *in vitro* meat is particularly promoted by its advocates as a sustainable alternative for consumers who want to be more ethically minded but who do not wish to change the composition of their diet (Post, 2012; Kadim et al., 2015; Moritz et al., 2015; Shapiro, 2018; Chriki and Hocquette, 2020).

Pros and cons of the cultured meat process were recently described in a review Chriki and Hocquette (2020). In this review, the authors updated current knowledge on this subject by focusing on recent publications and issues, which had not been well-described previously.

In August 2013, the first "lab-grown hamburger" was prepared and tasted during a television program (Post, 2014). Since then, the rise of the global cultured meat market has been heralded. Consequently, this novel food has attracted a lot of media attention, but the treatment has been vastly different depending on the media. Particularly, some scientists (Goodwin and Shoulders, 2013; Hopkins, 2015) concluded that the Western media have given a distorted picture of the obstacles which are in the path of cultured meat acceptance, especially by overemphasizing and over representing the importance of the reception of cultured meat among vegetarians.

In this context, the aim of this study was to understand how the topic of cultured meat is treated in the scientific literature and in the news media to identify potential differences between the scientific view and the public perception. Thus, this study was based on a bibliometric analysis of scientific publications and on a sociometric analysis of the mainstream press about *in vitro* meat.

METHODOLOGY

Using academic databases to conduct research on specialized topics has become the normative mode of scholarly investigation (Fernandes et al., 2019). Electronic databases that gather scientific publications provide a mechanism for rapid access to broad information, eliminating the need to manually search through paper copies of various publication types (Driedger and Weimer, 2015).

Characterized as a functional way to measure the influence of publications in scientific communities, **bibliometric analysis** is defined as "a statistical analysis of books, scientific articles, or other media of communication" (Pritchard, 1969, p. 349). Indeed, the academic impact of any research (or of a specific article) can be assessed by the number of citations by other authors in the specific field (Iftikhar et al., 2019). However, other analyses can be conducted using the available research filters by year or country of publication or using keywords for example (Fernandes et al., 2019). For articles from the written press, similar analyses can be conducted as well (Goodwin and Shoulders, 2013; Hopkins, 2015).

Data Sources

This study on **cultured meat** was based on the science literature from the Science Citation Index Expanded (SCI-EXPANDED) database of the Web of Science (WoS) Core Collection database from Clarivate Analytics (formerly known as the Institute for Scientific Information). Using WoS as the search source provided researchers with quality literature and gave solid basis to the study (Jacso, 2005; Zhao et al., 2019; Zhu and Liu, 2020). Some comparative studies concluded that WoS and Scopus retrieved no duplicates, while Google Scholar retrieved multiple copies (Adriaanse and Rensleigh, 2013; Driedger and Weimer, 2015).

Indeed, WoS covers a wide range of studies and thus offers a more general and comparative view of publications in specific fields (here, cultured meat).

In order to compare citation impact for published papers, data were sent to InCites, which provides normalized citation data and global metrics from the WoS dataset.

The following analysis was performed: coauthorship (the relatedness of items is based on the number of coauthored documents) and co-citation (the relatedness of items is based on the number of times they cite each other) (van Eck and Waltman, 2010).

For the written press, this study was carried out with the Factiva database, produced by the Dow Jones (Johal, 2009; Driedger and Weimer, 2015). This business information and research tool provides worldwide, full-text coverage of international newspapers and newswires which helps researchers to carry out an information watch and analyze media coverage on a specific subject (Chen et al., 2020). The units selected for content analysis using an interface of R (R Core Team, 2018), named IRaMuTeQ, were articles published in daily newspapers from 2010 to 2019 with a title and a full text in English or with at least a title translated into English. Based on R software and python language, IRaMuTeQ extracted qualitative information from texts (such as keywords) using descriptive statistics (Chaves et al., 2017).

Other specific platforms such as the *China National Knowledge Infrastructure* (CNKI) (cnki.net) and the *Baidu Scholar* platform, which are the most widely used platforms in China, were also used to specifically target Chinese publications. Different names designing artificial meat used in English publications were translated into Chinese and used as keywords to extract corresponding articles through titles, keywords, and full texts. The number of press articles was collected according to the publication year and article type. A general understanding of the main perspective of articles dealing with artificial meat was therefore obtained and analyzed as for the English ones.

Keyword Selection

The 24 keywords used to collect publications (**Table 1**) were based on scientific articles and reviews dealing with cultured meat, particularly those based on the influence of the name on the acceptance of this novel food (Siegrist and Sütterlin, 2017; Asioli et al., 2018; Siegrist et al., 2018; Bryant and Barnett, 2019; Bryant C. J. et al., 2019; Ong et al., 2020). The question whether these keywords cover most of the articles from the written press will be discussed later based on the results.

Both in WoS (in *Topic*, as of December 31, 2019) and Factiva (as of December 31, 2019) databases, we searched for articles containing the following words:

> "*artificial meat*" OR "*meat in vitro*" OR "*in vitro meat*" OR "*cultured meat*" OR "*synthetic meat*" OR "*lab-grown meat*" OR "*lab meat*" OR "*cell-based meat*" OR "*clean meat*" OR "*fake meat*" OR "*slaughter-free meat*" OR "*cell-cultured meat*" OR "*craft meat*" OR "*cultivated meat*" OR "*victimless meat*" OR "*animal-free meat*" OR "*cruelty-free meat*" OR "*shmeat*" OR "*Frankenmeat*" OR "*test*

TABLE 1 | Different names of cultured meat used in scientific publications.

Names/keywords	References[b]
Cultured meat (97)[a]	Edelman et al., 2005; Bhat and Fayaz, 2011; Forgacs et al., 2012; Post, 2012; Hopkins, 2015; Bryant and Barnett, 2018; Hamdan et al., 2018; Bodiou et al., 2020; Chriki and Hocquette, 2020; Weinrich et al., 2020; Zhang et al., 2020
in vitro meat (85)	Datar and Betti, 2010; Laestadius, 2015; Sharma et al., 2015; Hocquette, 2016; Wilks and Phillips, 2017; Lee, 2018; Bhat et al., 2019; Bryant and Barnett, 2019; Woll, 2019; Li et al., 2020
Clean meat (25)	Lagally and Specht, 2017; Windhorst, 2018, 2019; Bryant C. et al., 2019; Bryant C. J. et al., 2019
Artificial meat (21)	Bonny et al., 2015, 2017; Hocquette, 2015; Hocquette et al., 2015; Orzechowski, 2015; Sodhi, 2017
Synthetic meat (19)	Kadim et al., 2015; Marcu et al., 2015; Jones, 2017; Siegrist and Sütterlin, 2017; Lynch and Pierrehumbert, 2019; Warner, 2019
Cell-based meat (10)/cell-cultured meat (1)/cellular meat (1)	Bomgardner, 2018b; Johnson, 2019; Mohorcich and Reese, 2019; Simsa et al., 2019; Swartz, 2019; Warner, 2019
Lab-grown meat (7)/lab meat (2)	Galusky, 2014; Mayhall, 2019; Mouat et al., 2019; Warner, 2019
Fake meat (11)	Fellet, 2015; Grimstead, 2018; Bomgardner, 2019
Vegetarian (8)/vegan meat (3)	Hopkins, 2015; Weber, 2018; Alvaro, 2019
Animal-free meat (5)	Bhat et al., 2017; Bomgardner, 2018a; Mouat et al., 2019
Test tube meat (4)	Fox, 2009
Cultivated meat (3)	Borning and Tiberius, 2017
Other names: craft meat, victimless meat, cruelty-free meat, slaughter-free meat, Frankenmeat, unnatural meat, shmeat	Metcalf, 2013; Welin, 2013; Marcu et al., 2015; Wilks and Phillips, 2017; Siegrist et al., 2018; Alvaro, 2019; Bhat et al., 2019; Bryant and Barnett, 2019; Burton, 2019; Mouat et al., 2019; Ong et al., 2020

[a] *Names/keywords' number of citations in titles, keywords, and abstracts of articles.*
[b] *This reference list is not exhaustive: the articles indicated as examples are those mainly discussed in the Results section.*

tube meat" OR "unnatural meat" OR "vegetarian meat" OR "vegan meat" OR "cellular meat."

Data Analysis

Among others, we considered different sets of elements that characterize the scientific or the press publications, such as year, scientific fields, journal, and authors, etc., to analyze data collected from WoS and/or Factiva.

The obtained results were analyzed by means of univariate statistics (absolute and relative frequency) and compared with what was postulated by the Laws of Bibliometrics, namely, Lotka's Law, Bradford's Law, and Zipf's Law based on authors' production on the studied topic, journal coverage of the topic, or occurrence of keywords related to the subject, respectively (Fernandes et al., 2019; Zhao et al., 2019). This allowed to identify patterns and to trace possible biases for this subject in the academic field or in mainstream media.

VOS Mapping

Then, for scientific articles (from WoS) only, the production of maps structured through the VOS mapping technique was used, according to Korom (2019). The construction of a VOS map basically follows three steps, developed by the VOSviewer software: normalization, mapping, and clustering.

VOSviewer is a very useful tool for graphical representation of bibliometric maps. This software, available for free, offers a convenient process for constructing and visualizing bibliometric maps of any kind of co-occurrence data (van Eck and Waltman, 2010).

RESULTS

Scientific Articles Dealing With Cultured Meat From the Web of Science Database

Time Distribution and Scientific Fields' Networks

A total of 327 publications from the WoS (see **Supplmentary Material**) were collected and further analyzed. After some papers mentioning words related with synthetic meat, a first significant increase in the number of scientific papers dealing with cultured meat was observed in 2012–2014, then in 2015. From 2017, the number of papers dealing with cultured meat has regularly increased (**Figure 1**).

Within the 24 keywords studied in this bibliometric analysis, two of them were the most widely used, namely, "cultured meat," and to a lesser extent, "*in vitro* meat" (**Figure 2**).

Quite logically, the main scientific field in which scientific articles about cultured meat were published is *Food Science Technology* (**Table 2**). Indeed, these articles mainly concern the process of cultured meat. However, a significant proportion of articles also concerns nutritional or environmental issues, agricultural science or social science, such as history, philosophy of sciences, or ethics (**Table 2**).

This view was confirmed by a more precise analysis of relationships between keywords in titles, author keywords, and abstracts. With the 97 keywords found in the scientific articles, four peripheral networks or clusters surrounding the most common wordings were observed. **Cluster 1** with the word "*in vitro* meat" is related to the process of artificial meat production, while **Cluster 2** with the word "clean meat" is more related to the challenges and advantages of *in vitro* meat production. **Cluster 3** around the word "cultured

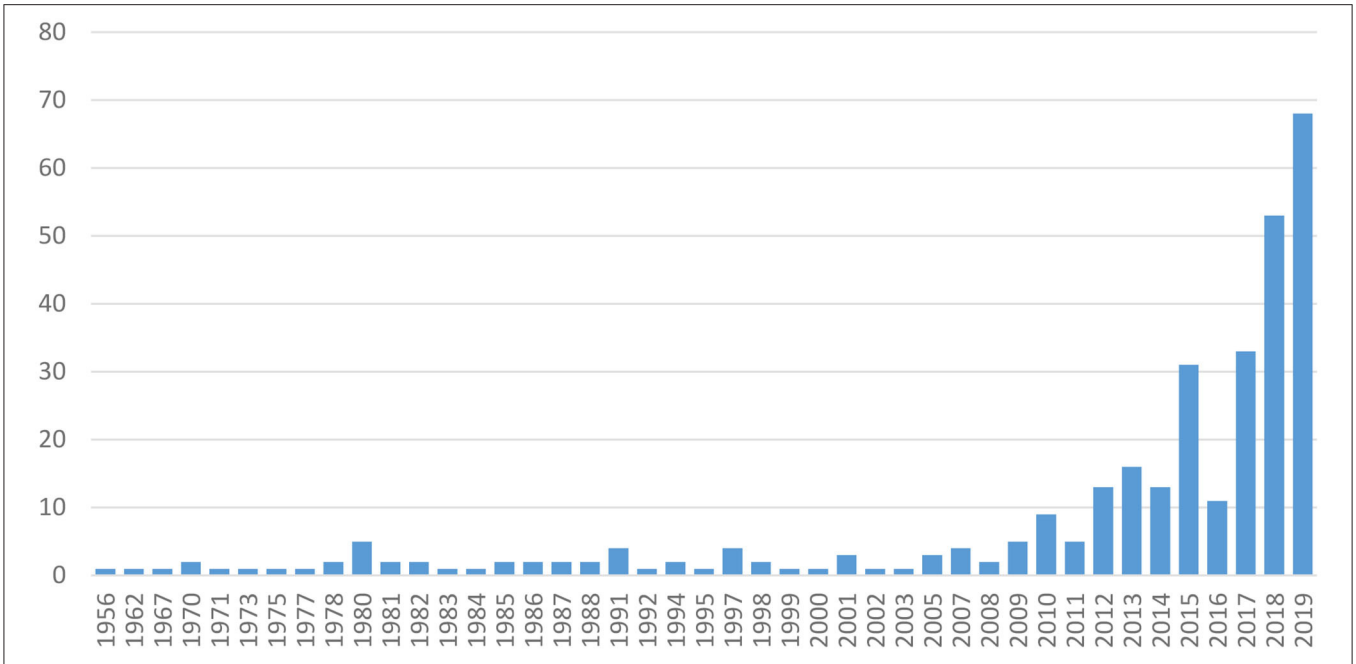

FIGURE 1 | Number of articles dealing with cultured meat recorded per year (as of December 31, 2019) in the Web of Science (WoS) bibliometric database.

meat" describes consumers' acceptance. **Cluster 4** is more related to sustainability and environmental issues for meat in general (**Figure 3**).

Clusters were obtained using the VOSviewer software, which constructs bibliometric maps of co-occurrence keywords (van Eck and Waltman, 2010), with a minimum of one article with two terms in this case. Keyword co-occurrence analysis is universal in scientometric analysis (Radhakrishnan et al., 2017). It mainly studies the link strengths among co-occurrence keywords in a large variety of literature (Zhao et al., 2019).

Its function is to analyze the internal relationship within an academic field and to reveal the subtopics of research within it.

Countries and Institutions Analysis

The research papers related to cultured meat were published mainly by the USA (22.6%), the United Kingdom (14.1%), the Netherlands and Germany (7.6% each), Australia (5.5%), France, and New Zealand (4.0% each), plus other countries (**Table 3**). The major institutions or local campuses are: INRAE-VetAgro Sup-Clermont University in France and Wageningen University Research in the Netherlands (10 and 9 articles, respectively), whereas publications dealing with cultured meat were published from more diverse groups of institutions in the case of other countries (**Table 3**).

The scientific impact of the published articles is presented in **Table 4** by institution according to the number of citations, the citation impact (normalized by scientific category), and the proportion of documents in Q1 (the top 25% journals in one scientific category). The articles with the highest impact are from the University of Oxford and Brunel University, which published articles related to the environmental impact of cultured meat and social issues (consumer attitudes, market issues). Articles from the Universities of Bath and of Ghent also have high impacts and also concern consumer behaviors. Wageningen University and French institutions published articles which were also related to social issues (food sustainability, meat alternatives, consumer behaviors). It is noteworthy that Maastricht University, which is Prof. Mark Post's (the leading scientist for cultured meat), has published a relatively low number of scientific articles (6) compared to other institutions (**Table 3**) and has published scientific papers mainly related to technical issues but with a relatively lower impact compared to other institutions (**Table 4**).

Journals Network

The major scientific journals, in which articles dealing with cultured meat were published, are journals specialized in meat science [such as *Fleischwirtschaft* (for meat industry), which is the German meat science journal (13 papers); and *Meat Science* (12 papers), which is the internationally renowned scientific journal for meat qualities researchers]. In addition, other journals focusing on social science have published a significant number of papers related to ethics or consumer perception, such as *Journal of Agricultural Environmental Ethics and Appetite* (10 papers each). The *Journal of Integrative Agriculture* (from China) also published a special issue on cultured meat in 2015 with 10 articles.

Seven scientific papers were classified as highly cited papers, but none of them is directly related to *in vitro* meat. They are dealing with food, protein, and meat consumption in general in relation to environmental issues or sustainability, and artificial meat is mentioned as one solution among others.

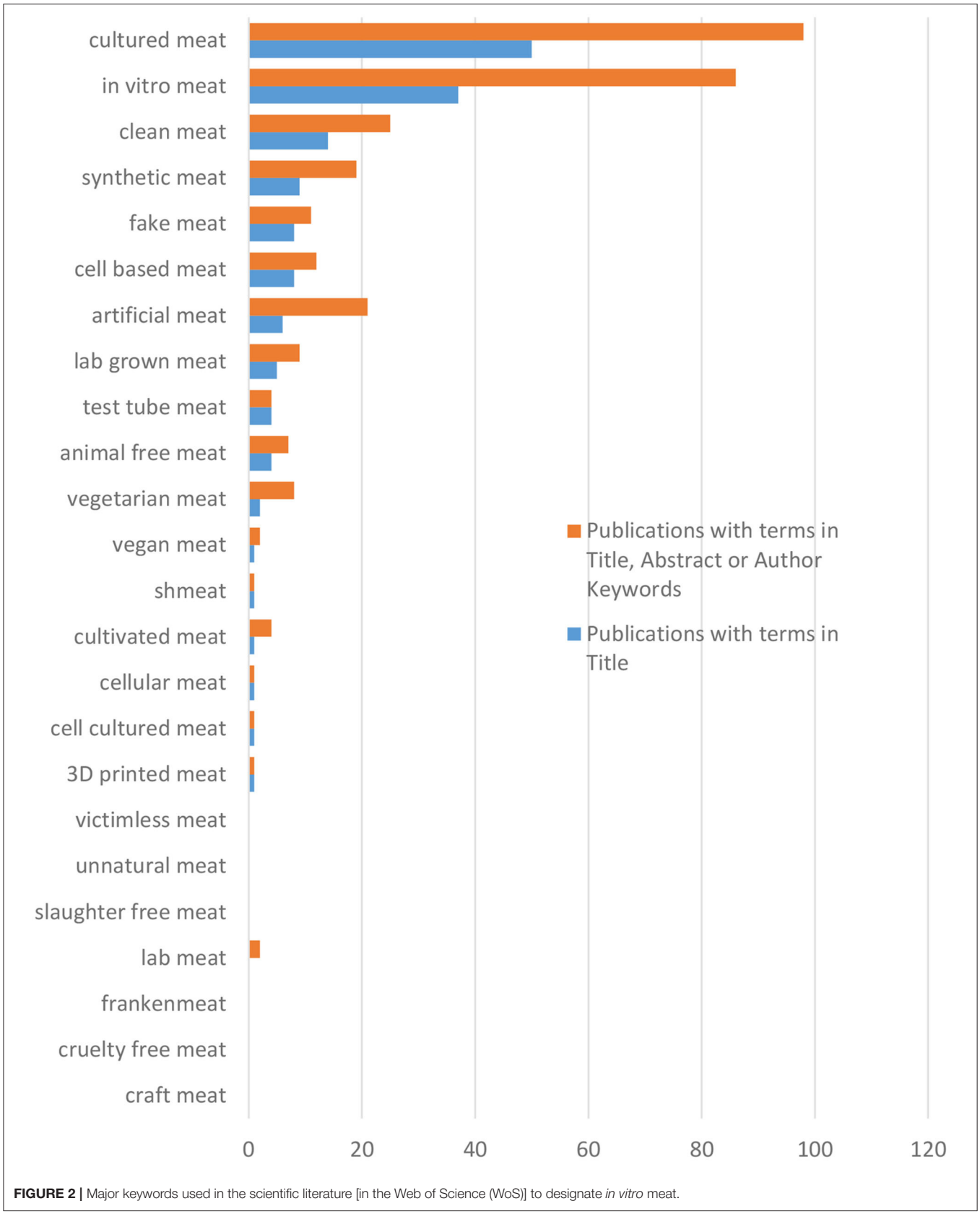

FIGURE 2 | Major keywords used in the scientific literature [in the Web of Science (WoS)] to designate *in vitro* meat.

Articles Dealing With Cultured Meat in Mainstream Media

Time Distribution and Keywords Distribution

In the international media, 12,900 press articles dealing with artificial meat have been found through public databases.

TABLE 2 | Major scientific fields in which articles related to cultured meat were published.

Major web of science categories	Number of publications
Food Science and Technology	86
Nutrition and Dietetics	32
Environmental Sciences	30
Agriculture Multidisciplinary	27
History and Philosophy of Science	26
Applied Microbiology and Biotechnology	25
Agriculture, Dairy and Animal Science	21
Multidisciplinary Sciences	21
Ethics	17
Cell Biology	13
Behavioral Sciences	11
Chemistry Multidisciplinary	11

The evolution of the number of occurrences increased almost exponentially between 1995 and 2019, with a peak of occurrence in 2013 (with 915 articles), particularly after the presentation of the first *in vitro* hamburger by Mark Post in 2013. The "publicity" made at that time by Mark Post was widely reported in the media. The year 2019 alone accounts for more than 36% of publications on the subject with 4,688 articles (and 22% for the year 2018 with 2,801 publications) (**Figure 4**).

Predominant keywords are "meat" and to a lesser extent "food," which might be interpreted by the fact that "cultured meat" is presented as a new type of meat or a novel food (**Figure 5A**). It is interesting to note that different keywords are sometimes associated in the same publication. However, the predominant wording for this novel food is "meat substitute" (6,213 occurrences) and to a lesser extent "alternative protein" (4,059 occurrences), "fake meat" (3,296 occurrences), "clean meat" (2,396 occurrences), lab-grown meat (2,387 occurrences), and "cultured meat" (2,380 occurrences) (**Figure 5B**).

Analysis by Countries and Institutions

Most articles come from the American press (3,746 articles: 18.3%), United Kingdom (2,199 articles; 17.0%), Australia (880 articles; 6.8%), Canada (748 articles, 5.8%), or New Zealand (579

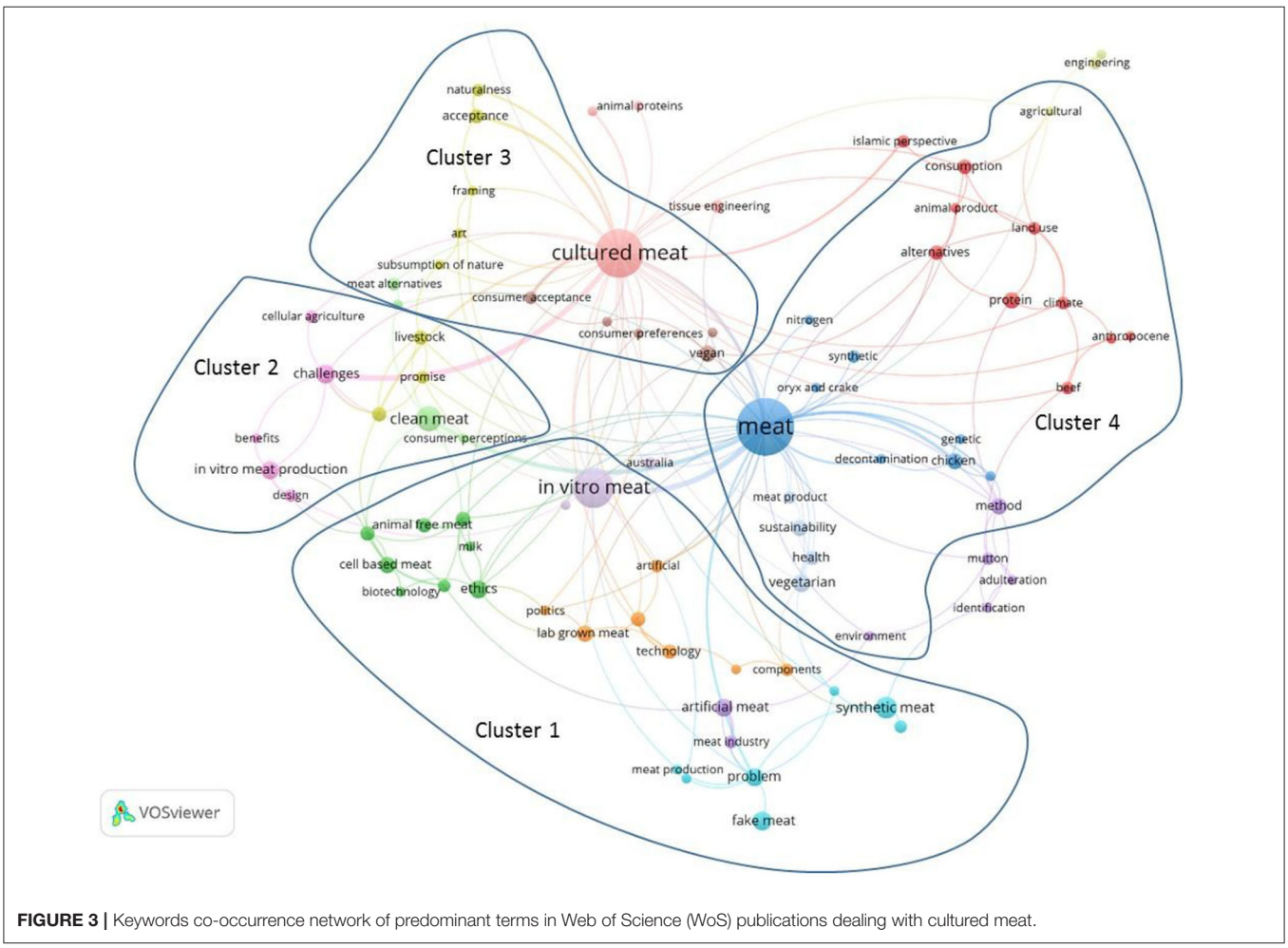

FIGURE 3 | Keywords co-occurrence network of predominant terms in Web of Science (WoS) publications dealing with cultured meat.

TABLE 3 | Major countries from which articles related to cultured meat were published.

Countries	Number of publications	Major institutions/locations	Number of publications
USA	74	University of California system	7
		Arizona State University	6
		Good Food Institute	6
United Kingdom	46	University of Bath	8
		University of Oxford	8
		Brunel University	5
Germany	25	Helmholtz Association	5
		Karlsruhe Institute of Technology	5
The Netherlands	25	Wageningen University Research	9
		Maastricht University	6
Australia	18	Several institutions or locations	<5 each
France	13	INRAE, University of Auvergne, VetAgroSup	10
New Zealand	13	Massey University	7
Canada	12	Several institutions or locations	<5 each
China	12	Several institutions or locations	<5 each
Italy	11	Several institutions or locations	<5 each
Sweden	11	Several institutions or locations	<5 each
India	10	Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir	5
Belgium	9	Ghent University	6

TABLE 4 | Impacts of scientific articles dealing with cultured meat by institution, which published them.

Organization	No. publications	Times cited	Category normalized citation impact	% Documents in Q1 journals
INRAE	10	239	2.06	29
Wageningen University and Research	9	154	2.70	57
Universite Clermont Auvergne and Associes	8	188	2.17	40
University of Bath	8	119	3.30	100
University of Oxford	8	406	4.53	57
Massey University	7	112	1.92	33
University of California System	7	241	2.08	57
Arizona State University	6	66	1.15	25
Ghent University	6	162	3.37	50
VetAgro Sup	6	92	1.74	25
Maastricht University	5	121	0.91	50
ETH Zurich	5	131	3.96	67
Karlsruhe Institute of Technology	5	40	1.71	75
University of Wisconsin System	5	58	1.34	40
University of London	5	209	1.87	67
Brunel University	5	57	4.52	80
Helmholtz Association	5	40	1.71	75

Source InCites Clarivate Analytics (InCites dataset updated March 26, 2020. Includes Web of Science (WoS) content indexed through February 29, 2020).

articles; 4.5%). Around 5.8% of press articles come from China (742 articles), and it is interesting to note that the Netherlands, Mark Post's country and his company Mosa Meat, counts 235 press articles, or 1.8% only of the total (**Table 5**).

For the overwhelming majority of articles coming from English-speaking countries, it is not astonishing that 93.9% of those were written in English (12,115 articles) and to a much lower extent in German (428 articles, 4.5%), Chinese (92 articles, 1.0%), French (57 articles, 0.6%), Spanish (40 articles, 0.4%), Italian (39 articles, 0.4%), or Portuguese (30 articles, 0.3%) (**Table 5**).

About 1,122 articles (9%) were published in international financial newspapers such as Dow Jones Newswires (subsidiary of News Corporation publishing financial information), *The Wall Street Journal* and Barron's magazine, *William Reed Business Media* or *Financial Times*. The articles were also found in well-known newspaper titles such as *The Telegraph*, *The Guardian*, *The Times*.

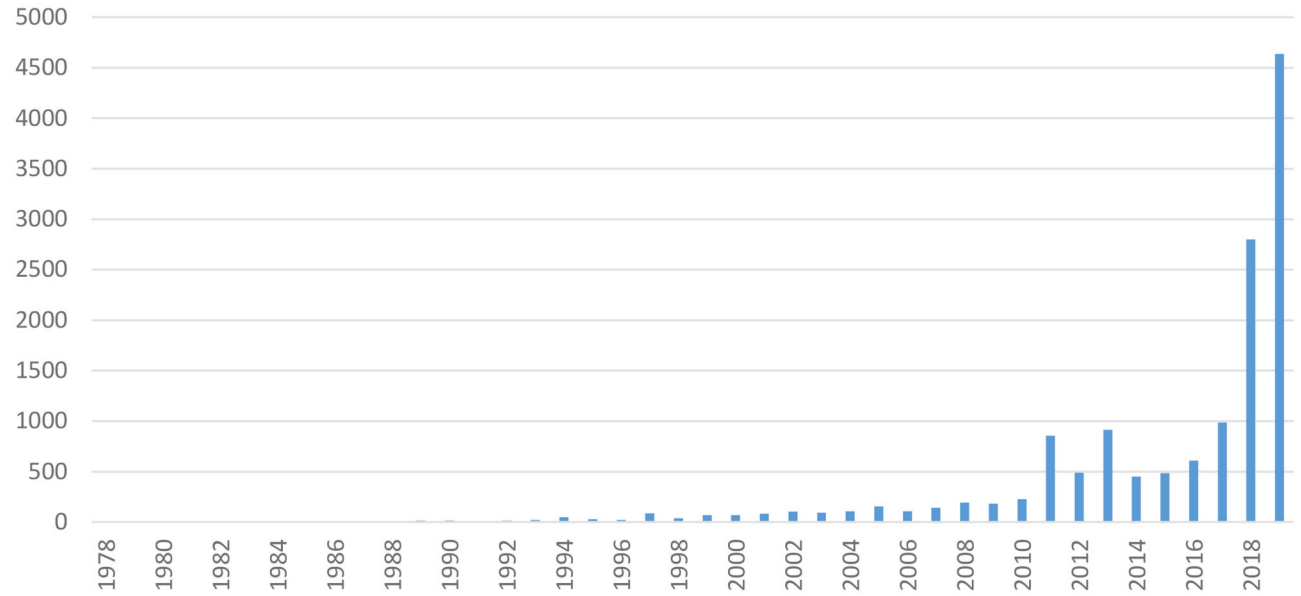

FIGURE 4 | Number of articles dealing with cultured meat and recorded per year in the Factiva bibliometric database.

Nevertheless, most of the articles (73%) were published in mainstream media (*PR Newswire*, *The Times*, *The Telegraph*, *The Guardian*, *The New York Times*, *Daily Mail*, etc.). It is also interesting to note that 5% of these articles were published in medical (*NewsRx* Medical Newsletter, etc.) or cooking journals (*Food Weekly News*, etc.) (**Table 6**).

Among the 9,543 articles, respectively, 982 and 443 deal with the theme of "vegetable meats" developed, respectively, by the start-ups Beyond Meat and Impossible Food (**Table 7**). These plant-based meat producers are the focus of 11% of the articles.

Google, Apple, Facebook, Amazon (GAFA) executives who have invested in these companies are also widely cited in the articles. This is notably the case of Bill Gates (Microsoft, 301 articles) who became an Impossible Food and Beyond Meat investor. Convinced by vegetable meats, Bill Gates declared in 2013: "*I couldn't tell the difference between Beyond Meat chicken and real chicken*." This is also the case of Sergey Brin (Google, 295 articles) or Jeffrey Bezos (Amazon, 42 articles), who have, respectively, invested in Mosa Meat (cellular meat) and NotCo (novel plant-based meat and dairy alternatives) (**Table 8**).

However, it is also possible to retrieve and classify data from the Factiva database by the names of start-ups (or of their managers) that develop cultured meat. As indicated in **Table 9**, the major start-ups identified in this way were, in the decreasing number of articles they have published, Mosa Meat (Mark Post), Memphis Meat (Uma Valeti, Nicholas Genovese, or Will Clem), Aleph-Farms (Didier Toubia), Vital Meat (Etienne Duthoit), Gourmey (Nicolas Morin-Forest), Modern Meadow (Andras Forgacs), Hampton Creek/Just (Joshua Tetrick), Higher Steaks (Benjmaina Bollgag), IntegriCulture (Yuki Hanyu), or Vow (George Peppou/Tim Nookesmith). In particular, we can see the development of articles mentioning these companies in recent years.

Comparison Between Scientific and Written Press Publications

Comparison of Scientific and Written Press Publications Across Countries

One way of comparing scientific and press media publications is to study the frequency of keywords used by authors for the designation of cultured meat among those common in both types of articles.

As previously observed, the preferred wordings in the scientific literature are "cultured meat" and "*in vitro* meat," whereas "fake meat," "cultured meat," "clean meat," and "lab meat" (combined with lab-grown meat) are the most frequent wordings used in the written press (**Figure 6**).

The characteristics for the other articles are roughly the same for both scientific and mainstream articles: they are mainly published in the USA first and in the UK in second place, with a sharp increase from 2017 to 2019. However, the third and fourth countries publishing scientific articles are Germany and the Netherlands for the scientific articles but Australia, Canada, and China for the press articles.

Comparison of Scientific and Press Media Publications in China

A specific focus was made on publications in China or in the Chinese language. The reasons are the following: China is the largest country in the world in terms of population, Chinese is the most widely spoken language in the world, the number of press articles about cultured meat has increased by a factor of five between 2018 and 2019, so that China is today the fourth country in the world, i.e., the first non-English-speaking country interested in this new product (after the USA, the UK, and Australia). Furthermore, the concept of "cultured meat" comes

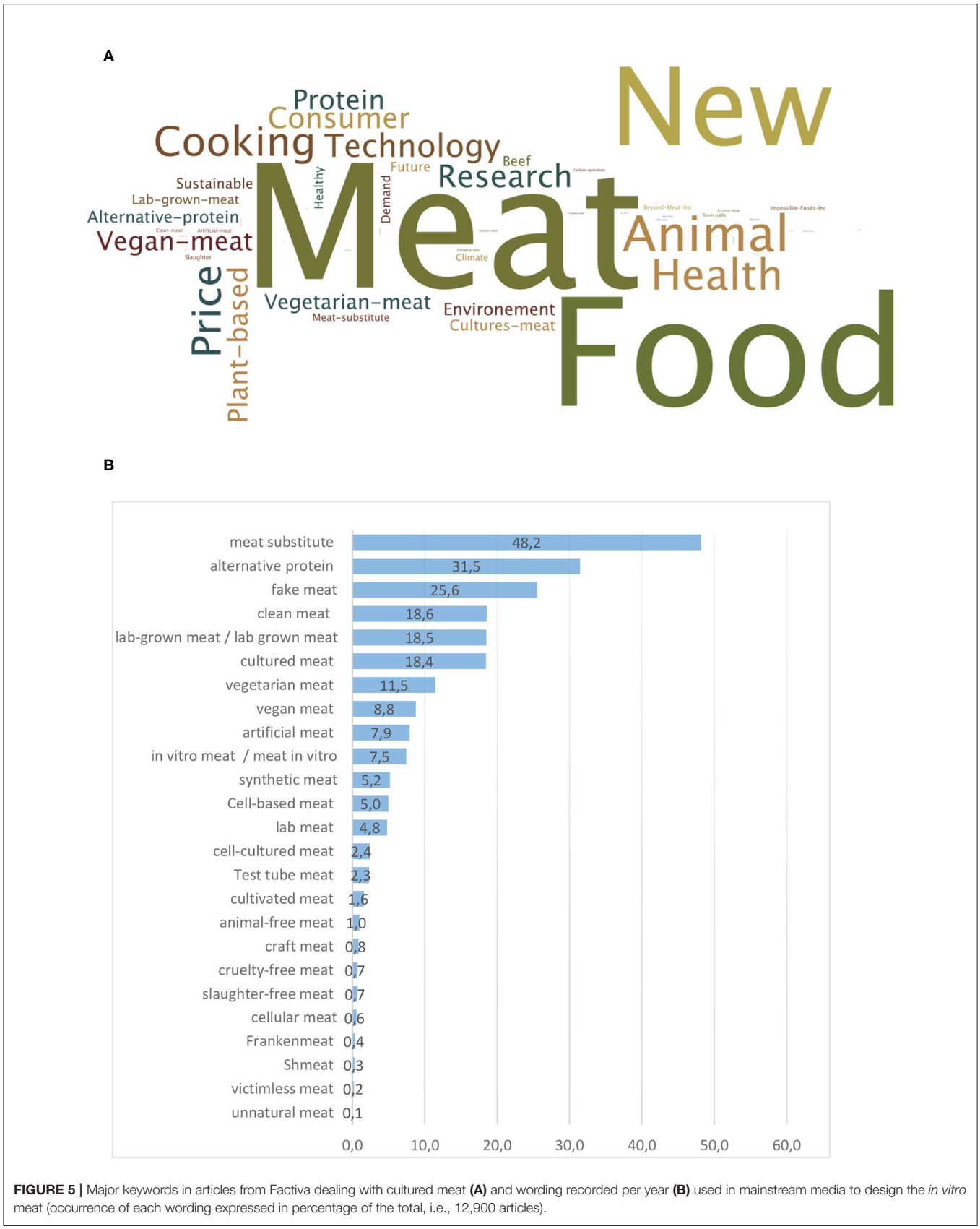

FIGURE 5 | Major keywords in articles from Factiva dealing with cultured meat **(A)** and wording recorded per year **(B)** used in mainstream media to design the *in vitro* meat (occurrence of each wording expressed in percentage of the total, i.e., 12,900 articles).

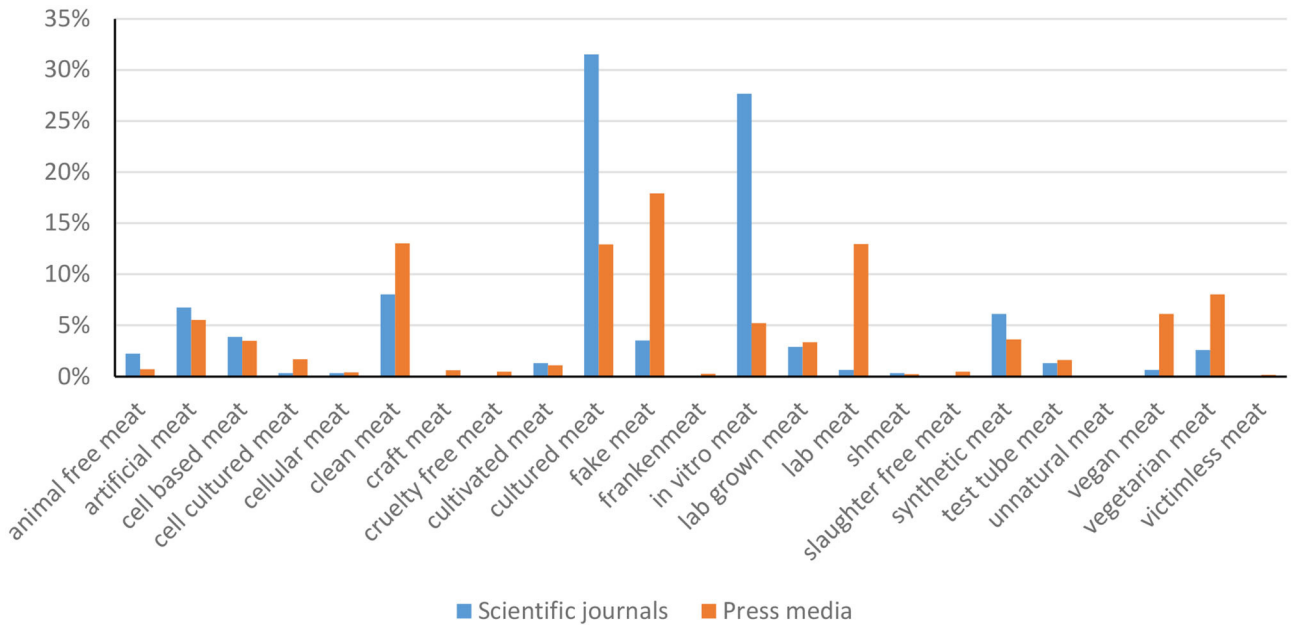

FIGURE 6 | Proportions of keywords in scientific articles and in the written media to designate cultured meat.

TABLE 5 | Number and proportions of articles published in mainstream media according to the country and the language used.

Countries	Number of publications	Languages
USA	3,746 (18.3%)	
UK	2,199 (17.0%)	12,115 out of 12,900 publications (93.9%) are written in English
Australia	880 (6.8%)	
Canada	748 (5.8%)	
New Zealand	579 (4.5%)	
The Netherlands	235 (1.8%)	46 out of 903 publications from China are written in Chinese
China	742 (5.8%)	
Other countries	3,771 (43.0%)	

TABLE 6 | Number of articles published in mainstream media about cultured meat by press title.

Journals	Number of publications
Dow Jones Newswires (USA)	540
The Telegraph (UK)	213
The Guardian (UK)	210
The Times (UK)	208
PR Newswire (USA)	199
The Wall Street Journal (USA)	197
Financial Times (UK)	195
William Reed Business Media (UK)	190
The New York Times (USA)	190
UWire (University Wire) (USA)	177
Daily Mail (UK)	170
The Independent (UK)	149
Postmedia Breaking News (Canada)	145
NewsRx Medical Newsletter (USA)	137

from the Western World, and it might be interesting to analyze how it is perceived by such a different culture.

From the WOS database, we found only one scientific publication in Chinese about cultured meat from a total of 12 scientific articles from China. In the Chinese media, 903 press articles dealing with artificial meat have been found through the public database Factiva including 46 in Chinese. A huge increase (by a factor of 5) was observed between 2018 and 2019 (from 83 in 2018 to 400 in 2019). The most frequently used words are "artificial meat," "cultured meat," and "*in vitro* meat." However, Chinese people often use different platforms.

In the CNKI (cnki.net), an academic thesis publication platform, 212 Chinese publications dealing with artificial meat have been found by using all the words related to cultured meat. In addition, before 2019, there were <10 papers published on this subject every year. In 2019, the number of artificial meat-related publications increased to 55. This may be explained by the global trend of increasing worldwide research on artificial meat.

Baidu Scholar is a broader publication search platform than CNKI, which can gather publications from multiple websites. From this platform, we found a total of 496 scientific and press articles dealing with cultured meat written in Chinese by Chinese authors. Most of these publications are pieces of review literature aimed to introduce the concept of cultured meat to the general public. In addition, there are also some rigorous pieces of review literature aimed at elaborating the most cutting-edge

technologies of artificial meat in the current world. Their aims are, for example, to demonstrate the application of cell culture techniques to cultured meat or to analyze the progress of patent applications related to artificial meat technology all over the world. These elements are expected to provide a reference for the implementation of large-scale production of artificial meat in China.

It is therefore obvious that Chinese academics have a strong interest in research on artificial meat, and there will be more attention on artificial meat with the vegetarian beef and pork products served by Starbucks® in China since April 2020. Although no Chinese original research publications on *in vitro* meat have been found by using Chinese academic websites, original research publications in English on artificial meat from China can be found by using overseas academic websites, such as Google Scholar. This may be due to that the majority of Chinese scientists prefer international peer-reviewed papers and publish work in international platforms. For example, a Chinese team from Jiangnan University designed a large-scale airlift reactor for cultured meat manufacturing, allowing to produce, with a single 300 m^2 reactor, cultured meat for 75,000 people. On the other hand, Nanjing Agricultural University announced in 2019 that the first cultured meat developed from pig muscle stem cells in China had been produced by a Chinese scientist and his team.

Due to thousands of years of vegetarian diet history, vegetarian meat has a large market in China with a high acceptance by Chinese consumers. In China, artificial meat and vegetarian meat are clearly two different concepts. Chinese publications about vegetarian meat mainly refer to the use of soybean protein as the main ingredient. Vegetarian meat has a large market in China due to the long history of vegetarian diet culture of Chinese people. After searching for vegetarian meat on *Baidu scholar*, 396 publications can be found about patented works on vegetarian food recipes, which has no relationship with cell-tissue engineering. Besides, some pieces of review literature can also be found, such as discussions about the current problems and future development of vegetarian protein meat.

The development of the artificial meat in Western countries has always attracted the attention of Chinese researchers. On *Baidu Scholar*, a number of Chinese publications discussed the development of artificial meat in Western countries, mainly in the United States (79 publications) and in Europe (especially the United Kingdom and the Netherlands with, respectively, 13 and 34 publications). There were also some articles/reports discussing the potential acceptance of artificial meat from America by Chinese consumers.

TABLE 7 | Number and proportions of articles published in public media about cultured meat by firm or organization.

Firms or organizations	Number of publications
Beyond Meat Incorporated	982
Impossible Foods Inc.	443
Tyson Foods Inc.	187
Agence sanitaire de sécurité alimentaire	107
United States Department of Agriculture	87
McDonald's Corporation	75
People for the Ethical Treatment of Animals	74
Cargill, Inc.	70
National Cattlemen's Beef Association	69
Burger King Worldwide Inc.	47
Centre for Cellular and Molecular Biology	47
Amazon	42
Food and Agricultural Organization of the United Nations	41
Scotland's Rural College	39
European Union	39

TABLE 8 | Number of articles published in mainstream media about cultured meat mentioning a celebrity.

Number of publications	Leader	Details
301	William (Bill) Gates (USA)	Cofounder with Paul Allen of the company Microsoft
295	Sergey *(Mikhaylovich)* Brin (Russia)	Cofounder with Larry Page of the company Google
195	Ethan Walden Brown (USA)	Founder of Beyond Meat
111	Patrick Brown (USA)	Founder of Impossible Foods Inc.
78	Scott Gottlieb (USA)	American physician and investor who was the 23rd Commissioner of the Food and Drug Administration from 2017 to April 2019
67	Elon Reeve Musk (Canada)	Cofounder of PayPal
65	Bruce Friedrich (USA)	Cofounder of Good Food Institute
61	Ingrid Newkik (UK)	British animal rights activist, President of People for the Ethical Treatment of Animals, commonly known as PETA
53	Justin Whitmore (USA)	Executive Vice President at Tyson Foods
46	Josh Tetrick (USA)	CEO of JUST, Inc., formerly known as Hampton Creek
43	George Ervin Perdue (USA)	Secretary of Agriculture in President D. Trump's office
42	Jeffrey P. Bezos (USA)	President and Chief Executive Officer of Amazon
38	David Lee (USA)	Chief Financial Officer of Impossible Foods
38	Evan Williams (USA)	Cofounder of Twitter, Blogger and Medium

TABLE 9 | Number of articles in the press media about the specific start-ups (or the leaders of these start-ups) that develop cultured meat.

Start-up ***Leader***	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Year company was founded**
Mosa meat						11	69	71	425	425	174	2015
Mark Post	61	144	860	1,168	178	197	171	156	451	894	101	
Memphis meat							15	76	90	118	55	2016
Uma Valeti, Nicholas Genovese, Will Clem	2	40	24	8	0	1	80	158	100	55	59	
Aleph Farms								0	99	595	160	2017
Didier Toubia									59	146	28	
Vital Meat									11	17	7	2018
Etienne Duthoit										12	8	
Gourmey									4	6	7	2019
Nicolas Morin-Forest									1	9	6	
Modern Meadow		1	88	96	258	132	149	108	120	188	28	2011
Andras Forgacs		0	84	80	78	80	26	14	8	15	0	
Hampton Creek/JUST		0	0	0	0	0	0	208	178	100	16	2011
Joshua Tetrick								10	8	8	0	
Higher Steaks								0	4	81	6	2017
Benjamina Bollag								0	0	9	0	
integriCulture								0	28	48	18	2017
Yuki Hanyu								1	7	8	1	
VOW										0	0	2019
George Peppou, Tim Noakesmith										9	0	
Shojinmeat Project							1	5	10	2	5	2014
Yuki Hanyu								1	7	3	5	
SuperMeat						16	88	83	354	198	39	2015
Yaakov Nahmias						25	43	6	21	58	4	
Finless Foods								0	0	0	0	2017
Mike Seleden and Brian Wyrwas								2	7	3	0	
IndieBio					4	42	51	60	78	141	26	2014

DISCUSSION

Cultured Meat Is an Emerging Topic, Especially in the USA and the UK

Gathering all publications dealing with the same subject, either from scientific journals or from the written press, is never accurate because it depends on the keywords taken into account and on the databases. In our specific case, the same keywords were used for searching both the scientific and the public databases.

Taking into account the small size of the bibliographic corpus, it is likely that we gathered most of the scientific papers dealing with cultured meat by using more than 20 keywords since the number of articles is roughly the same from the two well-known and widely used databases: ISI Web of Science and Scopus (327 and 309, respectively). For the written press, being exhaustive is always a greater challenge due to the diversity of article types, languages, countries of origin, etc. Nevertheless, in both cases, we observed the same trends: the publications are mainly from the USA and the UK, and the number of articles has increased from

2013 and especially from 2017 onward, confirming previously observed trends (Fernandes et al., 2019).

It might be surprising that the media coverage is more or less parallel to the publications of scientific articles. Indeed, public awareness of scientific achievements often appears after a delay depending on the global interest of the media for the subject. In this specific case, there is no delay and even a high ratio of articles in the written press by scientific articles (roughly 30) compared to other subjects such as "meat" with a ratio of 16 only or "cultured cells" with a ratio of roughly one (data not shown). We can thus hypothesize that this is neither the technique *per se* nor the meat subject which is attractive but the combination of both, i.e., the idea to provide new types of meat for the future in a context of anxiety for food security in the future (Gilland, 2002). In addition to that, advocates of artificial meat are very active in the written press since the highly publicized tasting of a cultured beef hamburger on August 5, 2013, in London. The most active countries in terms of publishing scientific articles are mainly the USA and the UK, but also Germany (with many scientific articles in German), the Netherlands, Australia, France, New Zealand, and Canada. However, the Western media, particularly in the USA, the UK (which are also very active in the press media), and Canada, have been perceived to give a biased picture of cultured meat (Goodwin and Shoulders, 2013; Hopkins, 2015).

On the other hand, a huge country like China does not publish so many scientific articles, but in proportion, much more articles in the press media. Most of them are pieces of review literature, which mainly aim to describe the current trend of artificial meat in China and in the whole world. These elements are expected to provide information to rationalize large-scale production of artificial meat in China, a country which is traditionally more oriented toward vegetarian meat.

The Wording Is Important

It is widely acknowledged that the name given to any object or process can affect subsequent evaluations and feelings about it. In this way, different names were proposed for cultured meat, with different consequences on consumer attitude. They include "*in vitro* meat," "clean meat," "cultured meat," "lab-grown meat," "synthetic meat," and other names (Bryant and Barnett, 2019; Bryant C. J. et al., 2019; Ong et al., 2020).

The wordings "fake meat" or "lab meat" are more frequently used in the written press. On the other hand, scientific authors prefer "cultured meat" and "*in vitro* meat." The latter may reflect the necessity to notify the general public that cultured meat is produced within research labs, which is obvious for scientists. One other interpretation is the fact that popular media use less technical words for a better understanding by readers. Moreover, scientists tend to describe facts without any emotion or judgment, particularly with a novel technology. Maybe this is not the case with a part of the mainstream media, which use terms like "fake" more often. Another explanation is that the term "fake meat" is not exclusively used for *in vitro* meat. Indeed, "fake meat" may also refer to a plant-based product that generally looks and tastes like meat, and this may increase the use of this word particularly in the written press artificially. In scientific literature, the term "fake meat" is mainly used in editorial material (70% of its use), which is not representative of scientific peer-reviewed papers.

Furthermore, the wording "fake meat" could discourage consumers, with possible negative connotations. In fact, the lack of consumer acceptance could be a major barrier to the introduction of cultured meat in the market (Siegrist et al., 2018; Ong et al., 2020) and how the product is framed is of paramount importance for its acceptance by consumers. "Lab-grown meat" is apparently not favorable for high acceptance, whereas "clean meat" is more favorable (Bryant and Barnett, 2019). Otherwise, some authors (Asioli et al., 2018) have demonstrated that consumers tend to strongly reject the name "*in vitro* meat." Moreover, the term "cultured" is less disliked than the terms "artificial" and "lab-grown" (Asioli et al., 2018). This is confirmed by the study by Siegrist et al. (2018), which concluded that consumers have a low level of acceptance of cultured meat because it is perceived as unnatural. Bryant C. et al. (2019) and Siegrist and Sütterlin (2017) argued that higher acceptance may be favored by less technical descriptions of cultured meat. This may be explained by the fact that the process for "ultra-processed foods" is associated with something scientific and unnatural and, therefore, negatively affects the product's image. In reality, consumers seem to dislike unnatural food. A recent study confirmed that German consumers, despite recognizing the potential ethical advantages of cultured meat, consider themselves to be only moderately prepared to accept cultured meat due to its unnatural status (Weinrich et al., 2020).

The Issues Around Cultured Meat Are Important

Technical issues about cultured meat still represent challenges, including for advocates of cultured meat. For non-convinced scientists, cultured meat is already obsolete since progress in competing meat substitutes (such as plant-based meat alternatives) is huge, some of these products being already commercialized unlike cultured meat (Warner, 2019). However, the scientific publications with the highest impact are generally not those about technical issues (as those from M. Post) but those from a limited number of researchers from the universities of Bath, Oxford, or Ghent, which are more related to social sciences (such as acceptance by consumers) [e.g., van der Weele et al. (2019)] and/or environmental issues [such as Tuomisto and de Mattos (2011)]. Indeed, in some countries, such as the Netherlands, France, and New-Zealand, scientific articles are published by one or two groups only, discussing the advantages and limitations of cultured meat. In the Netherlands, the two active groups are Wageningen University Research and Maastricht University (the former is very active in social science) [e.g., van der Weele et al. (2019)], while the latter is the institution where M. Post is very active in tissue engineering [e.g., Post (2012)].

These issues about cultured meat have been evidenced by cluster 4 of the cluster analysis of published scientific articles. This cluster is not restricted to cultured meat but considers all issues related to meat production such as food supply by

sustainable productions including meat substitutes and any type of alternatives to meat (Bonny et al., 2017). One important issue, which is a cluster *per se*, is the potential benefits of artificial meat in terms of health and climate protection encapsulated in the concept of "clean meat." Cultured meat is thus an option for consumers and citizens who do not want to stop eating meat but who are willing to decrease the potential disadvantages of meat production and consumption.

New Consumption Behavior

Flexitarianism has been developing in recent years and was designated as the "food trend of the year 2017" (Dagevos and Reinders, 2018). The same year, a similar trend called "the reducetarian" appeared (Kateman, 2017). This trend toward lower meat consumption is thus observed in many countries. It is sustained with various issues related to meat consumption (such as ethics, the environment, health, etc.), independent of economic reasons.

Although it is unknown how many flexitarians already existed in the second half of the previous century, scholarly attention to meat reduction practices in the last few years provides evidence that flexitarianism constitutes a genuine food consumer segment (Dagevos and Reinders, 2018).

This evolution can be seen in the terms commonly found in the topics covered by press articles. The frequency of wordings related to "alternative method" of meat production (such as "meat substitute," "alternative protein," "vegetarian meat," and "vegan meat") is also not surprising. It can thus be hypothesized that a sizable share of press articles targeted readers whose consumption behavior has evolved toward a lower consumption of meat and a higher consumption of plant-based meat substitutes in the last few years.

Many authors agree that diets for which most calories come from plant sources while limiting or avoiding animal sources are more sustainable, healthier, and alleviate animal suffering (Sabaté, 2003; De Boer and Aiking, 2011; Graça et al., 2015). In spite of these benefits, consumers in Western societies do not seem willing to reduce their meat consumption (Latvala et al., 2012; Schösler et al., 2012). In this context, cultured meat is possibly a viable alternative (which is presented as such in the press) all the more as the most promising pathways to encourage large-scale shifts toward less meat-based diets are likely the ones that do not challenge existing meal formats and hierarchies, in which meat has a central role (Schösler et al., 2012).

Drivers of Consumer Acceptance of Cultured Meat

During the introduction of this technology to the public, it became clear that public acceptance was not immediate and perhaps not obvious. The theoretical framework on rejection of novel and unfamiliar foods was laid down by Rozin and Fallon (1980).

Verbeke et al. (2015) indicate that only 10% of consumers would be really opposed to *in vitro* meat, the vast majority having a rather hesitant attitude. Other works have highlighted the importance of the perception of "ultra-processed foods" such as *in vitro* meat, which results in less consent to buy or to eat this product, contrary to claims related to its societal benefits or to its similarity to conventional meat (Bryant and Dillard, 2019; Ong et al., 2020). A recent review has highlighted that the main motivations for acceptance of meat substitutes are criteria related to good health and meeting the nutritional needs of consumers rather than collective values (such as environmental protection or animal welfare) (Chriki and Hocquette, 2020).

However, consumer acceptance is likely to increase when consumers become more familiar with the concept of cultured meat, as they are bound to become increasingly reassured if the product becomes authorized, accessible, and available (Bryant and Barnett, 2019), and as its name becomes more attractive (Ong et al., 2020).

Thus, using quite "positive" wordings (such as "meat substitute," "alternative protein," "vegetarian meat," "vegan meat," but also "cruelty-free meat," "animal-free meat," "victimless meat") is particularly interesting to consider; indeed, a recent research article (Rolland et al., 2020) has concluded that having positive information improves acceptance and willingness to taste "cultured" meat. According to Grunert et al. (2004), the potential for success of new products can be better exploited by developing products that are solicited and/or requested by consumers. Creating a new expectation around artificial meat is thus a favorable opportunity to enable its development and appropriation by consumers.

CONCLUSION

Cultured meat has become an emerging topic in both the scientific and media literature, especially in the last 3 years. It is mainly developing in the USA and the UK, with other countries, such as China observing the trend for potential future applications. The wordings of the scientific literature (mainly "cultured meat," "*in vitro* meat") indicate that scientific articles seem to focus, at least initially, mainly on the methods and technical aspects of artificial meat. However, more and more published studies are now focused on advancements, challenges, and potential advantages of cultured meat because most of the technical issues are thought to be solvable at some point in time. Thus, at the present time, the technique seems to be increasingly well-mastered and it no longer seems to be the "rate-limiting point" for the development of artificial meat on a large scale, even if this view is not shared by all scientists. Thus, articles reporting on technical aspects tended in recent months to give way to more general considerations about the health value of artificial meat and its acceptance by consumers, which seem to be a greater concern for them. Through the occurrence of the term "clean meat," reference to the environment-friendly effects of this technology is also more and more represented in the press and scientific articles. These trends are mainly observed in the written press with has a greater interest for this topic.

DATA AVAILABILITY STATEMENT

All datasets presented in this study are included in the article/**Supplementary Material**.

AUTHOR CONTRIBUTIONS

SC, M-PE-O, and J-FH contributed equally in the redaction of this paper. WoS analysis was done by DF. JL has done analyses of the Chinese publications.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2020.01845/full#supplementary-material

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Two Birds, One Stone: The Effectiveness of Health and Environmental Messages to Reduce Meat Consumption and Encourage Pro-environmental Behavioral Spillover

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There is a growing consensus that reducing excess meat consumption will be necessary to meet climate change targets, whilst also benefitting people's health. Strategies aimed at encouraging reduced meat consumption also have the potential to promote additional pro-environmental behaviors through behavioral spillover, which can be catalyzed through an increased pro-environmental identity. Based on this, the current study tested the effectiveness of a randomized two-week messaging intervention on reducing red and processed meat consumption and encouraging pro-environmental behavioral spillover. Participants were undergraduate students in the United Kingdom (n = 320 at baseline) randomly allocated to four conditions in which they received information about the health, environmental, or combined (health and environmental) impacts of meat consumption, and a no-message control. The results showed that receiving information on the health and/or environmental impacts of meat was effective in reducing red and processed meat consumption compared to the control group during the intervention period, with some effects remaining one-month later. However, the intervention did not have any effect on pro-environmental identity and there was little evidence of behavioral spillover. Implications for future research and interventions aimed at reducing meat consumption are discussed.

Keywords: meat, health, environment, spillover, message, intervention, identity

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INTRODUCTION

Most people in high-income countries eat high amounts of meat that exceed nutritional needs (Sans and Combris, 2015), while meat consumption in lower income countries is also on an upward trajectory (Tilman and Clark, 2014). Though differences are found according to country and commodity, recent data shows that the consumption of meat remains high in many countries (see OECD, 2020). This is problematic given that the overconsumption of meat is associated with serious negative health and environmental impacts. For example, the overconsumption of red and

processed meat is associated with an increased risk of non-communicable diseases; cardiovascular disease, stroke and certain forms of cancer (Walker et al., 2005; Micha et al., 2012; Yang et al., 2016). Furthermore, meat is a major driver of climate change, responsible for approximately 15% of global anthropogenic greenhouse gas emissions (Gerber et al., 2013; Bailey et al., 2014). This has led to a growing consensus that reducing excess meat consumption will be necessary to meet climate change targets, whilst also benefitting people's health (e.g., Bajželj et al., 2014; Hedenus et al., 2014; Tilman and Clark, 2014; Ritchie et al., 2018). However, attempts to reduce meat consumption remain absent from most climate change mitigation strategies, given that such strategies have low political appeal and may be unpopular among the public (e.g., Laestadius et al., 2014). This has subsequently led to a lack of media attention and low public awareness of the link between meat consumption and climate change in many countries (Wellesley et al., 2015). Indeed, people tend to greatly underestimate the extent to which meat production contributes to climate change (Bailey et al., 2014; Macdiarmid et al., 2016). This is concerning, given that people's willingness to reduce their meat consumption has been associated with the extent to which they believe reducing their meat consumption will be effective in mitigating climate change (Truelove and Parks, 2012; de Boer et al., 2016). The lack of awareness of the environmental impacts of meat eating therefore may be contributing to people's inaction (Bailey et al., 2014; Wellesley et al., 2015). There is therefore a clear need to communicate the negative impacts of meat, including its contribution to climate change, to raise awareness and motivate individuals to reduce their consumption.

Intervention studies aimed at reducing meat consumption have begun to emerge in the literature in recent years. These studies have demonstrated that information provision can be effective in encouraging individuals to reduce their meat consumption (e.g., see Bianchi et al., 2018). Although, it should be noted that much of the literature has focused on the effectiveness of interventions on changing attitudes or intentions to eat meat, while fewer studies have demonstrated the effect of informational strategies on eliciting behavior change, i.e., reducing meat consumption (see Harguess et al., 2019). This is problematic as attitudes and intentions do not always predict behavior (Kormos and Gifford, 2014; Hassan et al., 2016), including reducing ones' meat consumption (Allen and Baines, 2002; Stubbs et al., 2018). Much of the literature has focused on the effectiveness of health messages (e.g., Berndsen and Van Der Pligt, 2005; Cordts et al., 2014; Bertolotti et al., 2019), while fewer studies have demonstrated the effectiveness of environmental messages (e.g., Hunter and Röös, 2016; Graham and Abrahamse, 2017; Stea and Pickering, 2019), in encouraging meat reduction. This possibly stems from evidence that individuals tend to underestimate the impact of meat on contributing to climate change and tend to be unwilling to reduce their meat consumption for environmental reasons (De Boer et al., 2013; Macdiarmid et al., 2016). This has led some authors to conclude that focusing on the health impacts might be a more effective strategy for encouraging a reduced meat consumption (e.g., Wellesley et al., 2015). However, studies comparing the effects of health and environmental messages are limited, and while there is some evidence that health messages can be more effective in increasing intentions to reduce one's meat consumption (e.g., Cordts et al., 2014), other studies have found no significant differences in the effectiveness of health and environmental messages on reducing meat consumption (e.g., Carfora et al., 2019b).

On the other hand, it is possible that multiple arguments can be combined to encourage a reduced meat consumption. This is based on evidence that pro-environmental behavior, including decisions to reduce one's meat consumption, can be motivated by many different factors (Jagers et al., 2017). Thus, it has been suggested that combining different motives might be a more effective strategy for reducing meat consumption than communicating each of these issues in isolation (De Boer et al., 2013). As such, recent literature has begun to investigate whether providing information on different impacts of meat simultaneously, can be an effective strategy for reducing consumption. For example, Amiot et al. (2018) tested the effect of a multi-component intervention, part of which included providing information highlighting the impacts of meat on health, the environment and on animal welfare, on reducing meat consumption among Canadian male participants. They found no differences two weeks after receiving the information, however, four weeks later, participants in the experimental condition ate significantly less red meat than those in the control group. On the other hand, Carfora et al. (2019b) recently tested the effects of providing information on the health and environmental impacts of meat both separately and in combination, as part of a randomized messaging intervention in Italy. They found that providing information either about the health or the environmental impacts of meat was effective in reducing participants' red and processed meat consumption shortly after the intervention and one-month later, while combining this information had no significant effects. Thus, it is not clear whether combining different types of information would be an effective strategy for encouraging a reduced meat consumption compared to communicating this information in isolation.

Interventions aimed at encouraging reduced meat consumption could also have the potential to encourage other untargeted pro-environmental behaviors, through pro-environmental behavioral spillover. Positive behavioral spillover occurs when adopting an initial pro-environmental behavior leads to a greater engagement in other subsequent pro-environmental behaviors (Poortinga et al., 2013). Spillover is most likely to occur between similar behaviors (Whitmarsh and O'Neill, 2010) and can occur between both private-sphere (i.e., consumer or domestic) and public-sphere (i.e., political or social) behaviors (Nash et al., 2017). For example, Lanzini and Thøgersen (2014) found that an intervention aimed at encouraging green purchasing behavior also led to an increase in recycling, public transport use, as well as water and energy saving behaviors. Furthermore, Thomas et al. (2019) found that a charge on plastic bags lead to an increased use of re-usable shopping bags and increased support for other waste-related policies. Thus, an intervention aimed at one behavior has the potential to catalyze other lifestyle changes, maximizing the positive outcomes of an intervention on the environment. However, negative

spillover can also occur, whereby successfully encouraging an individual to adopt a pro-environmental behavior is associated with a decreased willingness to perform other pro-environmental behaviors, or an increase in environmentally unsustainable behaviors due to contribution ethic or moral licensing effects (Thøgersen and Crompton, 2009). For example, Tiefenbeck et al. (2013) found that households who reduced their water consumption following an intervention aimed at water conservation subsequently increased their energy consumption, compared to a control group. Thus, negative spillover has the potential to undermine efforts to promote environmentally friendly action. Little is currently known about whether an intervention aimed at meat reduction would lead to behavioral spillover, or whether any potential spillover effects would be positive or negative. Considering that few studies have investigated the effects of interventions on reducing people's meat consumption, even fewer have investigated whether a reduced consumption of meat might be associated with uptake of other pro-environmental behaviors.

Despite this, two recent studies show some evidence of positive behavioral spillover following an intervention aimed at meat reduction. Verfuerth et al. (2019) investigated spillover following a workplace intervention which used information provision on the environmental impacts of meat to encourage a reduced meat consumption. They found that individuals who reduced their meat consumption during the intervention were also more likely to engage in other pro-environmental behaviors outside the workplace, including buying local rather than imported food produce, recycling, eating smaller food portions, reducing packaging, and buying products with sustainable palm oil one-month later. Another study found that participants who reduced their red meat consumption as part of a message-framing intervention showed an increased environmental concern, which in turn lead to an increased likelihood of donating to an environmental organization (Carrico et al., 2018). This effect was found for participants who had received information on the health impacts of meat, as well as those who had received information on the environmental impacts. Thus, while the literature investigating meat reduction and behavioral spillover is in its infancy, there is some evidence that an intervention aimed at meat reduction could potentially lead to an uptake of other private- and public-sphere pro-environmental behaviors. Furthermore, the literature suggests that this effect can occur even if meat reduction is motivated by health rather than environmental motives (e.g., Carrico et al., 2018).

However, there is evidence that different types of information can either promote or dampen pro-environmental behavior and subsequent spillover effects. For example, Schwartz et al. (2015) found that participants were more willing to enroll in an energy-saving program when the environmental benefits were emphasized compared to financial benefits, and also compared to when both the financial and environmental benefits were emphasized together. Furthermore, participants were less likely to cite environmental reasons for enrolling in an energy saving program when it was framed in terms of the financial benefits, even when these benefits were emphasized together with the environmental benefits. Similarly, Evans et al. (2012) found that participants were more likely to recycle a sheet of paper following a task highlighting the environmental aspects of a behavior (car-sharing) compared to a control condition. However, there was no effect when financial aspects of the behavior were highlighted, even if the financial aspects were highlighted together with the environmental aspects in a combined condition. The authors concluded that highlighting the environmental impacts of a behavior would make self-transcendent values (e.g., helping others and the environment) more salient leading to further related actions, while highlighting the financial impacts of the behavior would have made self-interest values (e.g., power and wealth) salient, increasing the likelihood of other self-interest rather than self-transcendent behaviors. This is in line with goal-framing theory which indicates that spillover results from the activation of a common motivation or overarching goal, e.g., to mitigate rising greenhouse gas emissions, which can cause an indirect link between different behaviors (Lindenberg and Steg, 2007). On the other hand, the evidence suggests that highlighting other goals, particularly relating to self-interest, might reduce the likelihood of spillover occurring. While there is evidence that health-framed messages may have more universal appeal than environmentally framed ones (Myers et al., 2012), very little research has explored the effects of combining health and environmental messages (Carfora et al., 2019b). Thus, it is not clear whether combining health with environmental messages might have a positive or negative effect on spillover.

There is widespread evidence to suggest that pro-environmental self-identity plays an important role in pro-environmental behavior. For example, pro-environmental identity has been found to predict pro-environmental behavior over and above other psychosocial factors (Whitmarsh and O'Neill, 2010). People can make inferences about their identity based on past behavior, which may subsequently lead people to act in accordance with that self-perception (Bem, 1972). For example, reminding individuals of their past pro-environmental behavior can lead to an increased pro-environmental identity and as a result a greater engagement in subsequent pro-environmental behaviors (see Cornelissen et al., 2008; Van der Werff et al., 2013). Self-identity is therefore considered a key factor in behavioral spillover (Whitmarsh and O'Neill, 2010; Truelove et al., 2014). In line with this, Verfuerth et al. (2019) found that participants who reduced their meat consumption during a workplace intervention showed an increased pro-environmental identity, which was associated with positive spillover to pro-environmental behavior outside of the workplace. Thus, it is important to consider pro-environmental identity when investigating behavioral spillover, as it can act as an important catalyst for pro-environmental behavior.

Finally, studies have shown that combining information with other techniques can be effective for increasing the efficacy of interventions aimed at reducing meat consumption. For example, framing information in terms of social values (e.g., self-transcendence or self-enhancement) can increase positive attitudes toward eating less meat when matched to the existing values of participants (Graham and Abrahamse, 2017). Pairing information with implementation intentions, for example a clear time-oriented goal as to how and when one will change their

behavior, can improve the efficacy of interventions aimed at reducing meat consumption (e.g., Amiot et al., 2018; Rees et al., 2018). Additionally, encouraging participants to self-monitor their meat intake can also be used increase the likelihood that a goal to reduce ones' consumption is achieved (e.g., Carfora et al., 2017, 2019b). Food diaries are also often used to encourage a greater adherence with dietary programs and to increase awareness of ones' food choices (Zepeda and Deal, 2008). As such, food diaries can be used to encourage a reduced meat consumption when combined with other techniques, such as self-monitoring (e.g., Carfora et al., 2017, 2019b; Amiot et al., 2018). Thus, the literature suggests that providing information on the different impacts of meat can be effective in encouraging meat reduction, especially when combined with other intervention components.

The current study builds on existing literature, to further investigate the effects of information provision on reducing red and processed meat consumption and encouraging pro-environmental behavioral spillover. Whereas past literature has tended to focus on the effects of interventions on attitudes and intentions, we test the effects of information (coupled with goal intentions) on red and processed meat consumption reported across three time points. We build on past literature by investigating the effects of environmental, health and combined messages to reduce red and processed meat consumption. Furthermore, we add to the emerging literature on behavioral spillover, by investigating whether eating less red and processed meat would spillover to other untargeted pro-environmental behaviors, whether any spillover effects could be attributed to an increased pro-environmental identity, and whether spillover and pro-environmental identity might differ across the different messaging conditions. The potential for spillover is also examined across various public- and private-sphere pro-environmental behaviors, to shed light on the types of pro-environmental behaviors that might occur following a reduced red and processed meat consumption. Overall, this study aims to improve understanding of the potential effectiveness of informational strategies on encouraging dietary change and eliciting other pro-environmental lifestyle choices.

Based on the literature reviewed above, we hypothesized that participants receiving information on the health or environmental impacts of meat would significantly reduce their red and processed meat consumption during the intervention and one-month later, as compared to baseline and control participants (H1). It was not known whether participants who received combined information on both the health and environmental impacts would reduce their red and processed meat consumption at either time point, given that previous studies have yielded mixed results on the effects of combined messages (Research Question 1 – RQ1). Second, it was hypothesized that reduced consumption of red and processed meat would lead to an increased willingness to perform other pro-environmental behaviors immediately after the intervention and one-month later (H2). Third, it was hypothesized that this hypothesized relationship would be mediated by pro-environmental identity, whereby reduced consumption of red and processed meat would lead to an increased pro-environmental identity (H3), in turn increasing willingness to perform other pro-environmental behaviors when controlling for change in red and processed meat consumption (H4). We also explored whether the different messaging conditions would have an effect on pro-environmental identity and behavioral spillover. Specifically, we explored whether participants in the environment, health and combined conditions would be more willing to perform untargeted pro-environmental behaviors compared to participants in the control condition (Research Question 2 – RQ2) and whether these participants would also show a greater change in their pro-environmental identity compared to participants in the control condition (Research Question 3 – RQ3).

MATERIALS AND METHODS

Ethics

This study was reviewed and approved by the Cardiff University School of Psychology Research Ethics Committee.

Participants

Participants were recruited from a university in the United Kingdom. The study was advertised on posters placed in university buildings, as well as through online social media pages and an online participant pool for Psychology undergraduate students. In all cases, the study was advertised as being "a Psychology project about attitudes and food choice." In the information sheet, the study was described as being about "attitudes and red meat" specifically. Participants were not informed that the study aimed to investigate an intervention for reducing red and processed meat consumption. Eligibility criteria were included so that only students who consumed at least three portions of red or processed meat each week and were not already following any specific dietary plan qualified for participation. Where the study was advertised, it was stated that only students who consumed at least three portions of red or processed meat would be eligible to take part. Participants were also required to confirm that they met each of the inclusion criteria via screening questions at the start of the survey. Those that did not meet all criteria were automatically directed to the end of the survey and were disqualified from participation. A power analysis using G*power (for mac version 3.1.9.4) was conducted to determine the required sample size to detect changes in meat consumption between the different conditions over time. The analysis was based on a small-medium effect size ($\eta^2 = 0.30$), determined by similar past literature investigating the effectiveness of interventions aimed at reducing meat consumption (Carfora et al., 2017; Amiot et al., 2018). With a power of 0.95 and $\alpha = 0.05$, the results showed that a sample size of 250 participants was needed. We used this as a guideline and oversampled in anticipation of participant drop-outs. In total, 320 participants took part at baseline in exchange for payment (£15) or course credits; 59 participants were male and 260 female, and one participant for which gender information was missing. At baseline, the sample involved 293 undergraduate and 27 postgraduate students, with a mean age of 20 years.

At time 2 (end of the intervention), 251 (78%) participants answered the survey, of which 205 were female and 45 were male, the gender information was missing for one participant. At this time, 229 participants were undergraduate and 22 were postgraduate students, the mean age of participants was 20. At time 3 (one month after the intervention), 238 (74%) participants answered the survey, of which 191 were female and 46 were male, the gender information missing for one participant. At this time, 217 participants were undergraduates and 21 participants were postgraduate students, the mean age of participants was 20.

Design

The study used a mixed design. A between-subjects design randomly allocated participants to one of four conditions: (1) Health (T1: $n = 78$; T2: $n = 58$, T3: $n = 56$), in which participants received information on the impacts of red and processed meat on health. (2) Environment (T1: $n = 83$; T2: $n = 67$; T3: $n = 67$), in which participants received information on the impacts of red and processed meat on the environment. (3) Combined (T1: $n = 86$; T2: $n = 69$; T3: $n = 63$), in which participants received information on the impacts of red and processed meat on both health and on the environment. (4) Control (T1: $n = 73$; T2: $n = 57$; T3: $n = 52$), in which participants did not receive any information on the impacts of meat. Participants in the health, environment and combined conditions were also provided with a time-oriented goal, to try to eat no more than two portions of red/processed meat each week for the two-weeks of the intervention period. Participants in the control condition were asked not to change their diet in anyway. The information displayed to participants can be viewed in the **Supplementary Appendix S1**. Red and processed meat consumption was compared over time using a within-subjects design, as well as between conditions using a between-subjects design.

A within-subjects design was used to investigate the relationship between participants' willingness to perform additional pro-environmental behaviors as a result of red and processed meat reduction and an increased pro-environmental identity. A between-subjects design was used to compare participants' willingness to preform additional pro-environmental behaviors and change in pro-environmental identity between conditions.

Materials

Online Survey(s)

The study was conducted online through a series of surveys implemented on Qualtrics and an automated chatbot using Facebook messenger. The pre-test survey was given to participants at baseline (T1) before the messaging intervention. This survey included a consent form and information sheet, demographic questions, and a measure of red and processed meat consumption. The survey also included a link to the automated Facebook chatbot, from which the randomized messaging intervention was implemented. The post-test survey was sent to participants at the end of the two-week messaging intervention (T2) and included a measure of red and processed meat consumption, a measure of behavioral spillover and a measure of pro-environmental identity. The same survey was sent to participants again at the one-month follow-up (T3).

Food Diaries

Participants were asked to record all their food intake using a food diary every day during the two-week intervention period, to increase engagement with the intervention programme. The food diaries were implemented via a survey on Qualtrics which was sent through a link in the Facebook chatbot each day of the two-week intervention period. Participants were asked to indicate which foods they had eaten throughout the day for breakfast, lunch, dinner, as well as any snacks. Participants could select which foods they had eaten from a list of response items (e.g., cereals, beans, red meat etc.) and had the option to enter free text for any foods not included within the provided response items. For each food, participants were required to indicate the number of portions consumed, as well as the portion size from "small," "medium," and "large." The food diaries were used during the two-week intervention period but were not used at baseline or after the intervention. The data from the food diaries are not used in the current paper, as comparisons cannot be made from before to after the randomized messaging intervention.

Randomized Messaging Intervention

The intervention was run through an automated private chat on Facebook Messenger, which was built using "ManyChat" chatbot software (Manychat.com). Every day for two weeks, participants in the health, environment and combined conditions received messages on the positive impacts of eating less red and processed meat on health, the environment, or on both health and the environment. This was followed by a reminder to try not to eat more than two portions of red and processed meat each week, in addition to a reminder to complete the food diary. For example, in the environment condition, one message read: "*If you eat only a small amount of red and processed meat, you will protect the environment by reducing excessive land use. Remember to try and eat no more than two portions of red and processed meat this week. Please record all of the food you have eaten today using today's food diary*." The messages highlighted a different health and/or environmental issue each day of the intervention. Thus, participants in the health, environment and combined conditions received 14 different messages in total. The messages were sent to participants once in the morning (at 8 am) and once in the evening (at 5 pm), every day during the two-week intervention period. Control participants were not sent any information on the impacts of meat but were sent a reminder to complete the food diary every day of the intervention e.g., "*Please record all of the food you have eaten today using today's food diary*," once in the morning (8 am) and again in the evening (5 pm) every day during the intervention period. The messages sent to participants each day of the intervention can be viewed in the **Supplementary Appendix S2.**

Measures

Red and Processed Meat Consumption

Self-reported red and processed meat consumption was recorded using a measure adapted from existing literature

(Carfora et al., 2019a,b). Red and processed meat consumption was measured separately. For each type of meat, participants were provided with a definition (e.g., "*Processed meat includes meat that has been modified to improve its taste or shelf life through smoking, curing or adding salt or preservatives. . .*") and were given an example of a medium portion size in grams (e.g., "*A medium portion refers to about 60 grams, for example two small sausages or five slices of salami. . .*"). Red and processed meat consumption was recorded at three time points: at baseline, immediately after the two-week intervention period, and one-month later. At each time point, participants were asked to record the number of servings of red and processed meat they had consumed during the *previous week* (e.g., "*How many servings of processed meat have you eaten in the previous week? If you cannot remember please give your best estimate*"), using a 15-point response scale from 0 to 14 servings or more. Thus, the measures reflect the number of servings consumed by participants during one week before the intervention (T1), during the second week of the intervention period (T2) and four weeks after the intervention (T3). Responses for red and processed meat consumption were combined to create a single outcome variable.

Behavioral Spillover

Participants' willingness to perform ten different pro-environmental behaviors was measured at T2 and T3, as an indicator of behavioral spillover. Participants were asked how often they planned to perform the following behaviors in the following 6 months: *"have shorter showers or infrequent baths," "Purchase an eco-friendly product," "buy a product with less packaging," "buy organic food produce," "Buy local rather than imported food produce," "eat seasonal fruit and vegetables," "reduce my consumption of meat and dairy products," "use public transport instead of driving my car," "volunteer for an environmental group,"* and *"donate to an environmental group."* For each item, participants were asked to select one of the following options: "not at all," "once," "2 to 3 times," "4 to 5 times," "6 to 7 times," "8 to 9 times" or "more than 10 times." Responses were coded from 1 ("not at all") to 7 ("more than 10 times"). This measure was adapted from previous literature on behavioral spillover (e.g., Whitmarsh and O'Neill, 2010; Lauren et al., 2017).

Pro-environmental Identity

Pro-environmental identity was measured at T1, T2, and T3 using a three-item scale adapted from Whitmarsh and O'Neill (2010): "*I am an environmentally-friendly person*," "*I am someone who is concerned with environmental issues*" and "*I would be embarrassed to be seen as having an environmentally-friendly lifestyle*" (reverse coded). The third item was removed after reliability analysis indicated doing so would significantly improve the reliability of this measure (from a = 0.63 to a = 0.84 at T1, from a = 0.67 to a = 0.80 at T2 and from a = 0.63 to a = 0.80 at T3). Items were presented as 7-point Likert scales ranging from 1 = strongly disagree to 7 = strongly agree. Pro-environmental identity was also measured through a visual scale adapted from the Inclusion of Nature in Self scale (Schultz, 2001). Participants were given a brief description of "*an environmentally conscious person*" and were asked to select one of seven images, each depicting a pair of circles representing (1) the self and (2) an "environmentally conscious person," with varying degrees of overlap. Responses were coded from 1 (no overlap between the circles) to 7 (complete overlap of the circles). Both scale and visual measures were combined to capture different aspects of identity and considering that using multiple heterogenous items within a scale can increase its validity (e.g., Eisinga et al., 2013). The overall measure of pro-environmental identity showed good reliability at T1 (a = 0.82), T2 (a = 0.80) and at T3 (a = 0.80).

Procedure

The study was conducted entirely online using Qualtrics and Facebook Messenger. Participants were sent a link to complete the baseline survey and were directed to answer screening questions, followed by demographic questions and a measure of red and processed meat consumption for the preceding week. Following this, participants were randomly allocated to one of the four messaging conditions using a randomized display logic in Qualtrics. Participants were given a link to the automated chatbot on Facebook Messenger and were told that for the next study phase they would be required to complete a food diary every day for two-weeks. Control participants were asked not to change their diet during this time. Participants in the experimental conditions were given some brief information highlighting the negative impacts of red and processed meat on either health and/or the environment (depending on the condition) and were asked to try to eat no more than two portions of red and processed meat each week of the two-week intervention period. All participants were asked to answer the surveys and food diaries honestly and were told that there were no "right or wrong" answers. The baseline survey ended after participants confirmed they had read and understood this information. The intervention began within one week of completing this survey. Participants were sent automated messages every day during the intervention. On the final day of the two-week intervention period, participants were sent the post-test survey via the Facebook chat and through email. The one-month follow-up survey was sent to participants via the chatbot and email one-month later. Participants were debriefed and then either awarded their credits or paid in cash.

Statistical Analysis

All data were analyzed using IBM SPSS for mac (version 20). Change in red and processed meat consumption over time was analyzed using a Linear Mixed Model (LMM), which has many advantages over traditional statistical techniques, such as repeated measures ANOVA, including being able to handle missing data without loss of statistical power (Gueorguieva and Krystal, 2004). A hierarchical structure was used with measurement occasion at level one being nested within individuals at level two. Time of the measurement occasion (i.e., whether it is T1, T2, and T3) and condition were included as fixed variables with a time × condition

interaction term. Both variables were dummy coded so that the intervention (T2) and at the one-month follow-up (T3) were compared to baseline (T1) as the reference group, and the environment, health and combined conditions were compared to the control condition as the reference group. The effects for time and condition were estimated by constructing fixed slopes and random intercept models with red and processed meat as the dependent variable. This means that the data was modeled assuming that the amount of red and processed meat consumption can vary across the level two units (i.e., individuals), but that the impacts of time and condition are fixed across individuals. Here, we only report the fixed effects for condition and time.

Behavioral spillover was investigated at the end of the intervention period (T2) and one-month later (T3). Participants' willingness to engage in each of the 10 pro-environmental behaviors was analyzed separately, to shed light on the types of pro-environmental behaviors that might result following reduced red and processed meat consumption. Holm-Bonferroni correction of the P value was applied considering the increased risk of type 1 error due to multiple testing of the 10 pro-environmental behaviors at T2 and T3 (Holm, 1979).

RESULTS

Pre-analysis

Demographic variables as well as red and processed meat consumption and pro-environmental identity across the different conditions are summarized in **Table 1**. Analysis was conducted to investigate whether the final participant sample was representative of the initial sample, given the attrition rate ($n = -82$). Chi-square analysis using a Fisher-Freeman-Halton test indicated no significant association between condition and whether participants dropped out of the study ($x^2 = 1.45$, $p = 0.698$), indicating that the final participant sample was not skewed across conditions. A one-way ANOVA showed that there was no significant difference in participants' pro-environmental identity [$F(1,318) = 0.57$, $p = 0.451$] or between the amount of red and processed meat consumed by participants [$F(1,318) = 0.23$, $p = 0.630$], in the initial and final samples. Therefore, the results suggest that the final sample of participants was equivalent to the initial sample for the variables of interest.

The Effect of the Intervention on Red and Processed Meat Consumption

Participants' average reported consumption of red and processed meat is summarized in **Figure 1**. The results from the linear-mixed model showed that there was no significant main effect of condition when controlling for time (see **Table 2**). There was, however, a significant interaction between time and condition, whereby participants in the environment, health and combined conditions significantly reduced their red and processed meat consumption at T2 compared to T1, while participants in the control condition showed no change in consumption. There was a significant main effect of time when controlling for condition, whereby participants in all conditions significantly reduced their consumption of red and processed meat at T3 compared to T1. The results also showed a significant interaction between time and condition, whereby participants in the combined condition reduced their red and processed meat consumption significantly more than control participants at T3 compared to T1. There were no other interaction effects. Thus, the results showed that providing information on the health and/or environmental impacts of meat had a significant effect on reducing red and processed meat consumption during the intervention and one-month later, supporting Hypothesis 1.

The mean differences in red and processed meat consumption reported by participants at T2 compared to T1, and at T3 compared to T1, were calculated and compared across the different experimental conditions to assess whether there were any significant differences between the health, environment and combined conditions on reducing participants' red and processed meat consumption. Interpretation of the confidence intervals showed that there were no significant differences between the environment and health condition (M difference = −0.14, CI = −1.16,0.88), the health and combined condition (M difference = 0.04, CI = −1.11,1.19) or the environment and combined condition (M difference = 0.18, CI = −0.82,1.17) in reducing red and processed meat consumption at T2. There were also no significant differences between the environment and health condition (M difference = −0.06, CI = −1.03,0.91),

TABLE 1 | Participant demographics and variables of interest by condition at T1.

	Control	Health	Environment	Combined
Age	M = 20, SD = 2.09	M = 20, SD = 3.30	M = 20, SD = 1.92	M = 20, SD = 1.77
Gender				
Male	*N* = 18	*N* = 16	*N* = 15	*N* = 10
Female	*N* = 55	*N* = 62	*N* = 68	*N* = 75
Level of study				
Undergraduate	*N* = 64	*N* = 73	*N* = 76	*N* = 80
Postgraduate	*N* = 9	*N* = 5	*N* = 7	*N* = 6
Red and processed meat consumption	M = 7.03, SD = 3.23	M = 7.59, SD = 3.57	M = 7.01, SD = 3.25	M = 7.35, SD = 3.66
Pro-environmental identity	M = 4.71, SD = 1.05	M = 4.52, SD = 1.17	M = 4.43, SD = 0.867	M = 4.51, SD = 1.05

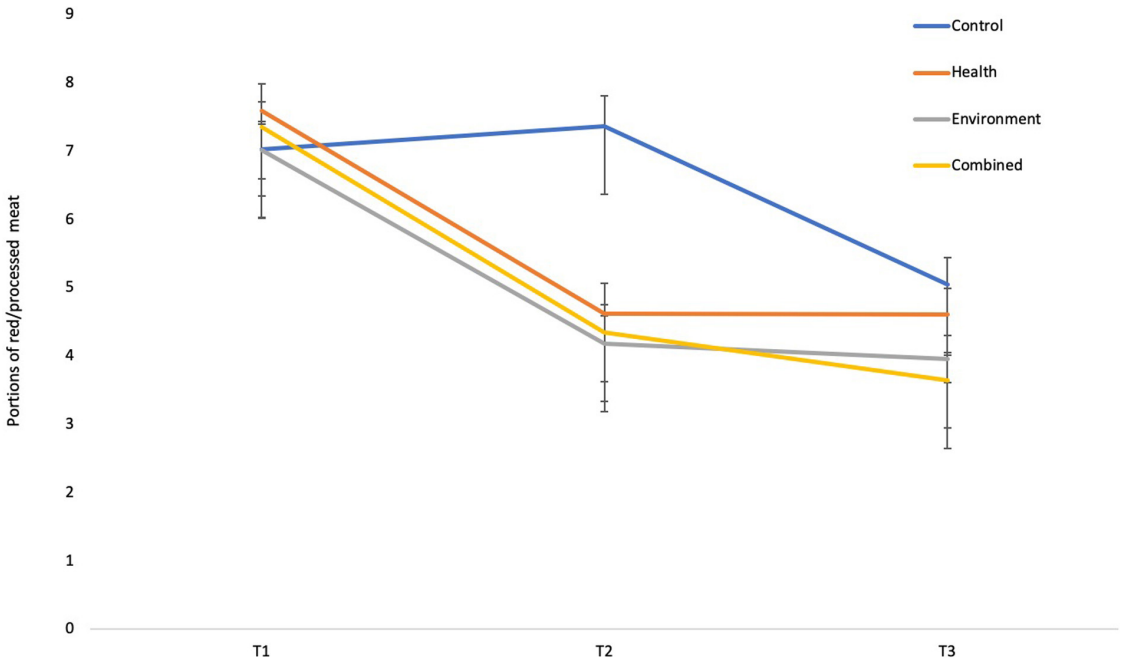

FIGURE 1 | Average red and processed meat consumption across time. Error bars represent standard error ± mean.

TABLE 2 | Multi-level model regression coefficients for red and processed meat.

Predictors	Estimate	Standard Error	df	*t*	*p*	95% CI
Intercept	7.03	0.40	334.36	17.43	0.000 ∗∗	[6.23,7.82]
Time						
Time 2	0.34	0.53	388.11	0.64	0.522	[−0.70,1.38]
Time 3	−1.98	0.49	363.65	−4.09	0.000 ∗∗	[−2.94,−1.03]
Condition						
Health	0.56	0.56	334.36	1.00	0.317	[−0.54,1.67]
Environment	-0.02	0.55	334.36	−0.03	0.978	[−1.10,1.07]
Combined	0.32	0.55	334.36	0.59	0.558	[−0.76,1.40]
Interactions						
Time 2 × Health	−3.31	0.74	388.11	−4.47	0.000 ∗∗	[−4.76,−1.85]
Time 2 × Environment	−3.17	0.72	387.38	−4.41	0.000 ∗∗	[−4.59,−1.76]
Time 2 × Combined	−3.35	0.71	387.52	−4.69	0.000 ∗∗	[−4.75,−1.95]
Time 3 × Health	−1.00	0.68	363.80	−1.48	0.140	[−2.32,0.33]
Time 3 × Environment	−1.08	0.65	360.59	−1.65	0.100	[−2.37,0.21]
Time 3 × Combined	−1.72	0.66	362.58	−2.62	0.009∗	[−3.01,−0.43]

*$p < 0.01$, **$p < 0.001$.

the health and combined condition (M difference = 0.38, CI = −0.62,1.36), or the environment and combined condition (M difference = 0.43, CI = −0.48,1.35), in reducing red and processed meat consumption at T3. Thus, there were no significant differences in the amount red and processed meat reduced by participants in the environment, health and combined conditions at either time point.

Investigating Behavioral Spillover

Tables showing regression parameters for all of the spillover analyses can be viewed in the **Supplementary Material.**

Positive Spillover Following Red and Processed Meat Reduction

Participants' willingness to perform each of the pro-environmental behaviors measured at times T2 and T3 is summarized in **Figures 2**, **3**, respectively. Multiple linear regressions were conducted to investigate whether reduced consumption of red and processed meat increased participants' willingness to perform other pro-environmental behaviors at T2 and T3, respectively. Differences between the experimental and control conditions were also investigated using dummy coded

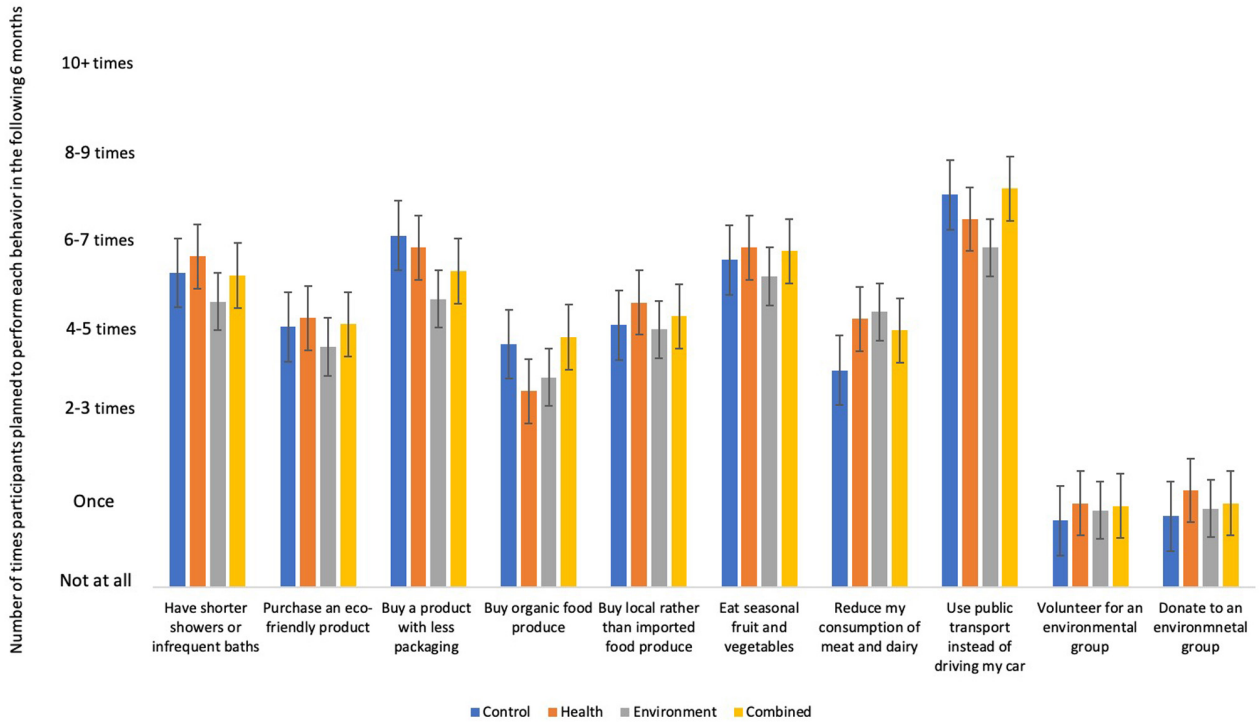

FIGURE 2 | Participants average willingness to perform pro-environmental behaviors at time 2.

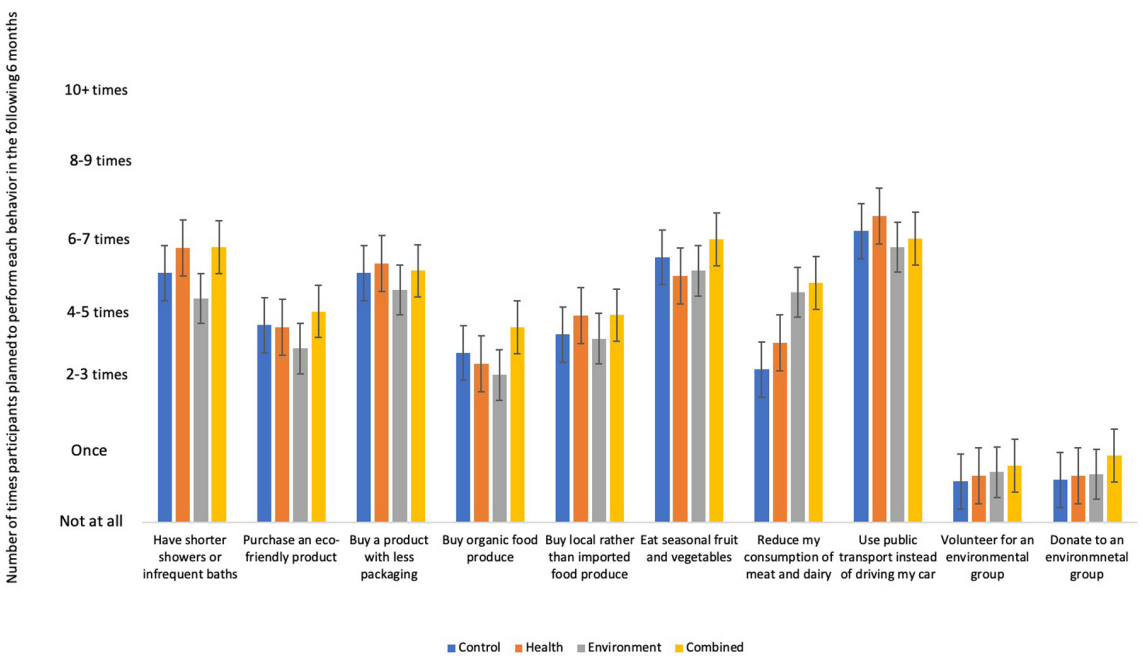

FIGURE 3 | Participants average willingness to perform pro-environmental behaviors at time 3.

variables. Analysis was first conducted to investigate behavioral spillover at T2. Multiple linear regressions were conducted with change in red and processed meat consumption (T2–T1) and dummy coded environment, health and combined conditions, with the control condition as the reference group, as independent variables. Willingness to perform each of the pro-environmental

behaviors measured at T2 were the dependent variables. The model did not significantly predict participants' willingness to perform any of the pro-environmental behaviors measured at T2 after correcting for multiple comparisons.

Multiple linear regressions were then conducted with change in red and processed meat consumption (T3–T1) and dummy coded environment, health and combined conditions, with the control condition as the reference group, as independent variables. Willingness to engage in each of the pro-environmental behaviors measured at T3 were the dependent variables. The model significantly predicted participants' willingness to eat less meat and dairy products [$F(4,228) = 5.35$, $p < 0.001$). A reduced consumption of red and processed meat was associated with an increased willingness to eat less meat and dairy ($B = -0.78$, $p = 0.018$, adjusted $R^2 = 0.07$). The results also showed a significant difference where participants in the environment and combined condition were significantly more willing to reduce their meat and dairy compared to participants in the control condition ($B = 1.00$, $p = 0.006$; $B = 1.07$, $p = 0.004$, respectively). There was no significant difference between the health and control condition ($p = 0.491$). When the reference group was switched, the results showed that participants in the combined and environmental conditions were also significantly more willing to eat less meat and dairy compared to participants in the health condition ($B = 0.81$, $p = 0.022$; $B = 0.74$, $p = 0.032$, respectively). There was no significant difference between the combined and environment condition ($B = 0.07$, $p = 0.841$). The model did not significantly predict any other pro-environmental behaviors at T3 after correcting for multiple comparisons. Thus, there was some evidence to support that a reduced consumption of red and processed meat one-month after the intervention led to an increased willingness to reduce ones' meat and dairy consumption. However, a reduced consumption of red and processed meat did not predict any other, untargeted, pro-environmental behaviors at either time point. Thus, Hypothesis 2 was only partially supported.

Pro-environmental Identity as a Driver of Spillover

Participants' pro-environmental identity was just above the midpoint at T1 (M = 4.54, SD = 1.04), T2 (M = 4.64, SD = 1.00) and T3 (M = 4.69, SD = 1.00), with little variation across these three timepoints. Following this, paired-samples *t*-tests showed that pro-environmental identity did not significantly increase at T2 [$t(248) = -1.49$, $p = 0.139$] or T3 [$t(233) = -1.58$, $p = 0.116$] compared to T1. Thus, the intervention did not appear to affect participants' pro-environmental identity.

Hierarchical multiple regressions were conducted to investigate whether reduced consumption of red and processed meat would predict increased pro-environmental identity at time T2. Pro-environmental identity at T1 was included as a covariate, given that the extent to which a participant is able to increase their identity after the intervention is dependent on their initial pro-environmental identity at baseline. Pro-environmental identity at T1 was entered in block 1, change in red and processed meat consumption (T2–T1) and dummy coded variables for the environment, health and combined conditions were entered in block 2, with the control condition as the reference group. Change in pro-environmental identity (T2–T1) was the dependent variable. The results showed that the overall model was significant [$F(5,242) = 9.91$, $p = < 0.001$, adjusted $R^2 = 0.15$]. Baseline pro-environmental identity explained 17% of variance in block 1 ($R^2 = 0.17$). However, adding change in red and processed meat consumption with the dummy coded conditions in block 2 did not explain any additional variance and did not significantly improve the model [R^2 change = 0.00, F change (4,242) = 0.36, $p = 0.837$]. In the overall model, change in red and processed meat consumption was not a significant predicter of change in pro-environmental identity when controlling for baseline identity. Participants in the environment, health and combined conditions did not show a greater change in their pro-environmental identity compared to participants in the control condition.

The above analysis was repeated to investigate whether reduced consumption of red and processed meat would predict increased pro-environmental identity at time T3. As with the above analysis, pro-environmental identity at T1 was entered in block 1, change in red and processed meat consumption (T3−T1) and dummy coded variables for the environment, health and combined condition were entered in block 2, with the control condition as the reference group. Change in pro-environmental identity (T3–T1) was the dependent variable. The results showed that the overall model was significant [$F(5,231) = 13.66$, $p = < 0.001$, adjusted $R^2 = 2.11$]. Baseline pro-environmental identity explained 22% of variance in block 1 ($R^2 = 0.22$). However, adding change in red and processed meat consumption with the dummy coded conditions in block 2 explained only any additional 1% of variance and did not significantly improve the model [R^2 change = 0.01, F change (4,231) = 1.02, $p = 0.399$]. In the overall model, change in red and processed meat consumption was not a significant predicter of change in pro-environmental identity when controlling for baseline identity. Participants in the environment, health and combined conditions did not show a greater change in their pro-environmental identity compared to participants in the control condition. Thus, the results did not show any evidence that participants' reduced consumption of red and processed meat was associated with increased pro-environmental identity shortly after the intervention or one-month later, meaning Hypothesis 3 was not supported.

Multiple regressions were subsequently conducted to investigate whether increased pro-environmental identity would predict increased willingness to perform pro-environmental behaviors at times T2 and T3, respectively. Change in pro-environmental identity at T2 (compared to T1) with dummy coded variables for the environment, health and combined conditions, with the control condition as the reference group, were entered as predictors of participants' willingness to perform each of the 10 pro-environmental behaviors measured at T2. The model was not significant for any of the pro-environmental behaviors measured at T2 (all p's > 0.05).

The above analysis was repeated with change in pro-environmental identity at T3 (compared to T1) and with dummy

coded variables for the environment, health and combined conditions, with the control condition as the reference group, entered as predictors of participants' willingness to perform each of the 10 pro-environmental behaviors measured at T3. The results showed that the model did not significantly predict any of the pro-environmental behaviors at T3 after correcting for multiple comparisons. Thus, there was no evidence to suggest that increased pro-environmental identity lead to an increased willingness to engage in additional pro-environmental behaviors, shortly after the intervention or one-month later, meaning Hypothesis 4 was not supported.

DISCUSSION

This study investigated whether providing information about the environmental and/or health impacts of eating meat would reduce participants' red and processed meat consumption and encourage additional untargeted pro-environmental behaviors. First, the results showed that providing information on the environmental and/or health impacts of meat was effective in significantly reducing participants' red and processed meat consumption during the intervention and one-month later, supporting Hypothesis 1. This adds to a growing body of literature investigating the effectiveness of informational strategies on encouraging meat reduction (e.g., see Bianchi et al., 2018; Harguess et al., 2019). Specifically, this study shows that providing information on the different impacts of meat can be an effective strategy for reducing red and processed meat consumption when this is also paired with a clear time-oriented goal. This study builds on past literature which has tended to focus on the effect of interventions on changing attitudes or intentions (ibid), by demonstrating the effectiveness of information provision on eliciting behavior change over a prolonged period of time. While past literature has demonstrated that providing health (e.g., Berndsen and Van Der Pligt, 2005; Cordts et al., 2014; Bertolotti et al., 2019), and to a lesser extent environmental (e.g., Hunter and Röös, 2016; Graham and Abrahamse, 2017; Stea and Pickering, 2019) messages can be effective in reducing meat consumption, the evidence on combined health and environmental messages has been mixed (e.g., Amiot et al., 2018; Carfora et al., 2019b). We add to this literature by demonstrating the effectiveness of combined messages in reducing red and processed meat consumption in the current study. Furthermore, only participants who received information on the combined impacts of red and processed meat reduced their red and processed meat significantly more than control participants at T3. Thus, in some cases the combined messages had an even stronger effect on reducing red and processed meat consumption compared to providing information on the health and environmental impacts only. This supports the notion that drawing on multiple motives can be an effective strategy to encourage a reduced consumption of meat, compared to focusing on different motives in isolation (De Boer et al., 2013).

The fact that participants in the control condition also reduced their red and processed meat consumption suggests that some aspect of the intervention other than information provision may have led participants to reduce their meat consumption. One possible explanation is that completing the daily food diaries led control participants to monitor their meat intake, causing a reduced consumption of red and processed meat. Previous literature has supported the role of self-monitoring in contributing to meat reduction (e.g., Carfora et al., 2017). Furthermore, past research has also demonstrated a similar delayed effect of an intervention containing a self-monitoring aspect on reducing red meat consumption (Amiot et al., 2018). Thus, it is possible that completing the daily food diaries lead to a delayed effect of self-monitoring on reducing red and processed meat consumption for participants in the control condition. This would indicate that providing information on the health and/or environmental impacts of meat and encouraging self-monitoring, could be an effective strategy for reducing excess meat consumption over a prolonged period of time. However, this explanation is speculative and would need to be validated by further research. An alternative explanation is that participants from different conditions shared information about the study aims in the delay between the intervention and the one-month follow-up, which could have led control participants to reduce their consumption as a result of social desirability. This possibility cannot be ruled out, as many participants were studying on the same course and therefore may have been acquainted with each other.

Second, the results suggested some limited evidence of behavioral spillover, partially supporting hypothesis 2. After correcting for multiple comparisons, there was only a significant effect where a reduced consumption of red and processed meat was associated with an increased willingness to eat less meat and dairy. We view this as partial evidence of spillover, considering the similarity between reducing ones' red and processed meat consumption and reducing ones' meat and dairy consumption. Nevertheless, this is a promising finding which suggests that reducing ones' red and processed meat consumption has the potential to encourage further dietary change. It is interesting to note that participants in the environmental and combined conditions were significantly more willing to perform this behavior than those in the control and health conditions. This suggests that providing information on the environmental and the combined environmental and health impacts of meat was particularly effective in encouraging further dietary change, compared to providing information only on the health impacts of meat. These findings contribute to literature investigating the effectiveness of combined messaging to encourage pro-environmental behavior, which has shown that highlighting financial motivations can reduce the effectiveness of pro-environmental messages to encourage pro-environmental behavior (e.g., Schwartz et al., 2015). On the other hand, the current study demonstrates that combining health with environmental motives can promote pro-environmental behavior and have longer lasting effects on behavior than when this information is communicated separately.

Third, the results showed that the intervention did not have any significant effects on pro-environmental identity and that pro-environmental identity did not have any significant

effect on participants' willingness to engage in different pro-environmental behaviors, meaning Hypotheses 3 and 4 were not supported. One possible explanation for these findings is that reducing one's meat consumption is not necessarily an environmentally salient behavior, given that many people are not aware of the negative environmental impacts associated with meat (e.g., Bailey et al., 2014; Macdiarmid et al., 2016). This could also explain the lack of evidence for behavioral spillover for untargeted pro-environmental behaviors in the current study, given that an increased pro-environmental identity can act as a catalyst for positive spillover (e.g., Cornelissen et al., 2008; Van der Werff et al., 2013). Future research could therefore focus on increasing the saliency of meat reduction as a pro-environmental behavior, to promote pro-environmental identity and subsequent spillover effects. This is supported by recent evidence in which participants were found to show a stronger pro-environmental identity and an increased uptake of different pro-environmental behaviors following a workplace intervention, which focused specifically and exclusively on the environmental impacts of meat (Verfuerth et al., 2019). Although this study showed limited evidence of positive spillover, it is worth noting that the results also did not show any evidence of negative behavioral spillover. This is an encouraging finding, demonstrating that our intervention successfully reduced participants' red and processed meat consumption, without inadvertently increasing negative environmental impacts through moral licensing or contribution ethic, as observed in other pro-environmental behavior change interventions (e.g., Tiefenbeck et al., 2013).

Limitations and Future Directions

It is worth noting that there are some limitations of the current study. First, the measure of red and processed meat consumption required participants to indicate the number of servings of red and processed meat they had eaten in the previous week. Although participants were provided with example portion sizes for red and processed meat, this might not have been sufficient to ensure a precise measure participants' meat consumption. Participants also may not have been able to accurately recall the amount of red and processed meat they had consumed retrospectively, during the previous week. On the other hand, using food diaries throughout the study duration might have provided a more accurate representation of participants' red and processed meat consumption, as food diaries would allow for food choices to be reported on a day-to-day basis and with different response options for different serving sizes. That the food diaries were completed only during the two-week intervention period is a limitation of this study, as the diary data could not be compared from before to after the intervention. Future studies would benefit from implementing food diaries across all study timepoints, to enhance the accuracy of self-report measures of meat consumption. Alternatively, future research might benefit from using more objective measures of meat consumption, for example by collecting shopping receipts (e.g., Kaiser et al., 2020), to overcome potential issues associated with self-report data, such as false reporting and desirability effects. Second this study investigated the effectiveness of different messages in reducing red and processed meat consumption, without measuring whether participants subsequently increased their consumption of other plant-based foods. It is therefore not possible to determine whether participants simply reduced their consumption of meat and thus overall food consumption, which could be considered a form of dieting. Although there is recent literature investigating the consumption of alternatives to meat, such as plant-based alternatives, insects and vegetarian meals (e.g., Schösler et al., 2012; Verbeke, 2015; Hartmann and Siegrist, 2017; Gómez-Luciano et al., 2019) studies have not tended to investigate whether these foods might be chosen as replacements for meat during, or after, an intervention aimed at reducing meat consumption. That this is not addressed in the current study is a limitation that should be considered in future research, to establish whether individuals are able to adopt a diet that is healthy and can realistically be maintained following a reduced consumption of red and processed meat. Third, only two of the ten measured pro-environmental behaviors were public-sphere behaviors, limiting the likelihood of detecting potential public-sphere spillover effects. Future research should investigate the potential for positive spillover from meat-reduction to public-sphere pro-environmental behaviors more extensively, given that public-sphere behaviors such as active political engagement, environmental lobbying and support for environmental policies could have a greater positive environmental impact compared to private-sphere behaviors, such as recycling or buying eco-friendly products (e.g., Thøgersen and Crompton, 2009; Lauren et al., 2017). Fourth, participants indicated their intentions to perform different pro-environmental behaviors in the upcoming months. However, there is often a gap between people's intentions and actions (e.g., Hassan et al., 2016). Future research might therefore benefit from investigating spillover using observable measures of behavior to improve the accuracy of this measure. Finally, the reliance on a student sample means that the findings may not be generalisable to the wider public. Thus, future research might benefit from using different participant samples, for example members of the general public, to improve generalisability.

CONCLUSION

This study contributes to the emerging literature on strategies aimed at encouraging a reduced meat consumption by demonstrating the effectiveness of information provision on reducing red and processed meat consumption and potentially spilling over to other dietary changes. These findings contribute to a greater understanding of the potential effectiveness of different strategies aimed at reducing meat consumption and highlight the usefulness of health and/or environmental messages in promoting healthier more sustainable diets, with no apparent negative impact on other pro-environmental lifestyle choices.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

This study was reviewed and approved by the Cardiff University School of Psychology Research Ethics Committee. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

EW conducted the research, analyzed the data, and drafted the manuscript. WP and LW advised on design, analysis and interpretation, and provided comments and edits to the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2020.577111/full#supplementary-material

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Buying Organic Food Products: The Role of Trust in the Theory of Planned Behavior

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When someone decides to buy organic food products trust plays a role. Consumers, in fact, are neither supposed to have the appropriate knowledge to evaluate the characteristics of these products, nor can they control that the food was actually manufactured following the procedures prescribed by organic production. Therefore, trust may contribute to the explanation of both purchasing intention and behavior since it represents a heuristic or shortcut that people adopt in order to reduce the large amount of information that consumers need to take into account. The present research aimed to analyze the role of trust in organic products on buying behavior adopting the Theory of Planned Behavior (TPB) as theoretical framework. A relational model was tested in which this variable was supposed to act as a background factor associated with all the classical constructs foreseen by the theory and the buying behavior. Also, indirect effects of trust on both intention and behavior were assessed. Two studies were conducted targeting the purchase of organic food products in general (Study 1) and of fresh organic fruit and vegetables (Study 2). In both studies, the data collection was organized in two waves, with a time lag of 1 month. At Time 1, the questionnaires included measures of intention, its antecedents and trust, while at Time 2 self-reported buying behavior was collected. Data were supplied by two convenience samples of Italian adults (237 and 227 participants) and analyzed via structural equation modeling. Results turned out to be overlapping in both studies, since trust was positively associated with attitude and subjective norm, and it was indirectly associated with intention and behavior, thanks to the mediation of the TPB constructs. The outcomes highlighted the importance of people's trust in organic products as a meaningful antecedent that boosts the TPB-based psychosocial processes that are supposed to stand behind both purchasing intentions and behaviors.

Keywords: Theory of Planned Behavior, organic food products, organic fruit and vegetables, trust, two-wave study, structural equation modeling

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INTRODUCTION

Sustainable consumption in the food sector is one of the main strategies for achieving environmental sustainability. The most effective ways to reduce the environmental impact of food consumption from the consumer perspective are the refusal of air-transported food, the preference for organic food, and the reduction in meat consumption (Jungbluth et al., 2000).

Organic production is defined as a complex and intertwined system of both farm management and the food production chain that aims to merge best environmental practice, a high level of biodiversity, the conservation of natural resources, high animal welfare standards, and a production method employing natural constituents and processes, as an example free from synthetic chemical substances and genetically modified organisms (European Commission, 2014). A major challenge in this sector is to both expand and respond to demand without compromising consumers' confidence in the above-mentioned principles and processes, as well as to build trust in the organic products imported, particularly as regards control measures (European Commission, 2014). Trust, credibility, transparency, and safety are key aspects of this sector, as ways of ensuring overall benefits in the long-term perspective (European Commission, 2016).

Organic agriculture has developed rapidly in Europe and North America in response to the feedback coming from both markets and in terms of consumers' demands. In Europe, as an example, the organic market has continued to grow (Willer et al., 2020a), and data from FiBL-AMI Survey (Willer et al., 2020c) showed that between 2000 and 2018 the retail sales of organic food has reached more than 40 billion euros. The largest European market for organic food in 2018 was Germany, with retail sales of 10.9 billion euros, followed by France (9.1 billion euros), and Italy (3.5 billion euros) (Willer et al., 2020b). According to the Bioreport 2017–2018 (Viganò, 2019), in 2017 the value of sales for the domestic use of organic food and drink in Italy grew by 18.6%, compared to in 2016. In 2018 the purchase of organic food products represented 3.7% of all food purchases, while in 2000 it was 0.7% (Nomisma, 2018). Furthermore, between June 2018 and June 2019 there was an increase in sales of organic products for domestic use in large retailers of 6% (Nomisma, 2019). Between March 2019 and March 2020, sales of organic fruit and vegetables recorded a growth of 24.8% (Assobio, 2020).

In the last two decades, research on sustainable food consumption has increased (Scalco et al., 2017), with contributions coming from scholars belonging to different fields. This trend reflects both the interdisciplinary nature of this research field and the interest shown—among others—by economists, nutritionists, and social psychologists. Although most of the research has been carried out in the United States and in Europe (Italy included), a growing interest has also emerged in recent years among scholars from other geographical areas, such as the Far East, Iran, China, and India (e.g., Teng and Wang, 2015; Yazdanpanah and Forouzani, 2015; Yadav and Pathak, 2016a,b, 2017; Nuttavuthisit and Thøgersen, 2017; Qi and Ploeger, 2019).

Many studies within the food consumption literature have assumed the Theory of Planned Behavior (TPB) (Ajzen, 1991) as their theoretical reference for investigating the psychosocial factors that explain consumers' intentions and behaviors. In brief, the TPB postulates that a given behavior is determined by the intention to execute it. Intention captures both motivations and cognitive planning, and it is an immediate antecedent of the behavior itself. Intention is a function of three factors, which are also related to each other: attitude toward the behavior, subjective norm, and perceived behavioral control (PBC). PBC can predict the behavior both directly and indirectly, thanks to the mediation of intention. The TPB has been applied successfully in a wide range of fields, such as those concerning health behaviors (McEachan et al., 2016), healthy eating (Riebl et al., 2015), pro-environmental behaviors (Klöckner, 2013), and organic food consumption (Scalco et al., 2017), and its predictive power has been demonstrated in a number of meta-analyses like those just mentioned.

In the present study, we investigated the role of consumer trust considered as a background factor within an extended TPB model. **Figure 1** shows the conceptual model. The paper presents two studies based on a prospective design and with data collected in two waves (Time 1 and Time 2, 1 month later). The first study considered the purchase of organic food in general as target behavior; the second was focused on the purchase of organic fruit and vegetables. On the one hand, we expect the first study to contribute to the understanding of the psychological processes behind the purchase of organic foods in general: indeed, "organic food" is intended to be a label or brand, which can nowadays be applied to a wide range of products. On the other hand, in the second study, fruit and vegetables were chosen because they represent, since 2000, the largest portion of the Italian organic food market, and the demand for them is growing rapidly (Saba and Messina, 2003; Ricci et al., 2018). In fact, the percentage of Italian families that had bought organic fruit and vegetables at least once in the last year increased from 53% in 2012 to 81% in 2018 (Nomisma, 2018). In particular, sales of organic fruit in 2017 were 12.3% higher compared to in 2016 (Viganò, 2019).

Aims and Hypotheses

Following the TPB, the first aim of the studies was to offer a contribution to the prediction and explanation of the intention to purchase organic food (in general or fruit and vegetables) at Time 1, and of self-reported behavior at Time 2. A second aim was to investigate how consumer trust is related to both intention and behavior. Finally, thanks to the analysis of the results from Studies 1 and 2, a third aim was to explore the possible similarity of the processes leading to purchasing intentions and to actual purchasing behaviors in the case of a general versus a specific target.

Many TPB-based studies use a prospective design and measure behavioral responses weeks or months after having measured attitudes, subjective norms, PBC, and intentions (Fishbein and Ajzen, 2010). Instead, in the case of green purchasing behavior, research tends to focus only on intention, while the effect on actual behavior is only assumed. For example, the recent meta-analysis by Scalco et al. (2017), based on twenty-three studies, revealed that the majority of them did not report the relationships between intentions and behaviors while only six reported the relationships between intentions and past or current behaviors. In any case, Scalco et al. (2017) found that the correlations between intentions and actual behaviors ranged between moderate and large. More recently, as far as we know, only one study on the purchase of organic milk (Carfora et al., 2019) considered future behavior and attested the predictive role of intention.

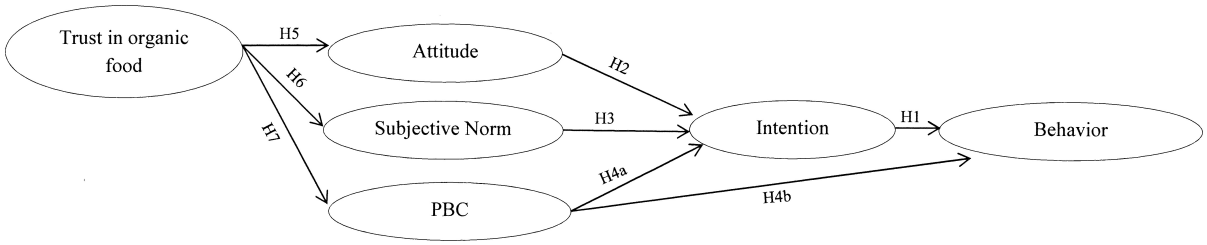

FIGURE 1 | Hypothesized model. PBC, Perceived Behavioral Control.

Consequently, as assumed by the TPB and as shown by previous evidence referred to the TPB framework, we proposed the subsequent hypothesis:

> H1. Intentions will predict self-reported future purchasing behavior of organic food in general, or organic fruit and vegetables in particular.

Attitudes toward a behavior express individuals' global positive/negative evaluations of it; they predict intentions and, consequently, behaviors. Aertsens et al. (2009) stated in their review that numerous studies on organic food consumption reported a positive and significant relationship between the attitude toward buying this kind of food and the intention to buy it—something that is consistent with the TPB. Therefore, also in the context of organic food consumption, attitude appears to play a crucial role in shaping behavior by its direct association with intention (Scalco et al., 2017). So, based on the TPB and previous results, we posed the following hypothesis:

> H2. There will be a positive relationship between consumers' attitudes toward the purchase of organic food in general, or organic fruit and vegetables in particular, and their intentions to purchase them.

Subjective norm, the second antecedent of intention, is an expression of normative influence. It reflects people's perception of what the most important referent individuals or groups, especially family and friends, consider to be an acceptable or unacceptable behavior. The effectiveness of subjective norm in explaining intention and behavior is debated in the literature, and results are mixed. Armitage and Conner (2001) argued that the normative component of the TPB might represent the comparatively weaker construct of the TPB. Nonetheless, the meta-analysis by Scalco et al. (2017) demonstrated the significant role played by subjective norm in shaping the intention to buy organic food products. Consequently, we hypothesize as follows:

> H3. Subjective norms will be positively associated with intentions to purchase organic food in general, or organic fruit and vegetables in particular.

PBC refers to people's perceptions of the easiness or difficulty of performing the behavior of interest (Ajzen, 1991), and it is considered to be a suitable proxy for actual control (Fishbein and Ajzen, 2010). PBC contributes to the prediction of both intention and behavior. In the case of complete control over behavior, PBC is an antecedent of intention, and intention alone predicts behavior; when the behavior is not completely under the person's volitional control, it may predict behavior directly. The strength of the association between PBC and intention varies across studies. In some cases, PBC had a significant impact on the intention to buy organic food (e.g., Zagata, 2012; Maichum et al., 2016; Yadav and Pathak, 2016a,b; Carfora et al., 2019; Wang et al., 2019; Fleşeriu et al., 2020); in others, the effect was not significant (e.g., Al-Swidi et al., 2014; Yazdanpanah and Forouzani, 2015). In the meta-analysis by Scalco et al. (2017), PBC seemed to play a minor role compared to attitude and subjective norm with respect to intention prediction. These different findings can be attributed to both the degree of availability of organic food in different contexts and to several dissimilarities regarding the items used to measure this construct. However, our hypotheses were as follows:

> H4a. PBC will be positively associated with intentions to purchase organic food in general, or organic fruit and vegetables in particular.

> H4b. PBC will be positively associated with future purchase of organic food in general, or organic fruit and vegetables in particular.

The TPB allows many background factors (e.g., age, sex, ethnicity, socioeconomic status, education, personality, past experiences) to act as sources of potential influence on the beliefs people hold (de Leeuw et al., 2015; Hagger and Hamilton, 2020). In the TPB integrated model developed for this study (**Figure 1**), we considered trust in organic food as a background variable. In fact, trust is a behavioral determinant whose nature may be relevant for all the TPB constructs: attitude, subjective norm and PBC (Mazzocchi et al., 2008).

In the organic food market, consumer trust is a crucial issue. Most consumers do not have the expertise, knowledge, and other resources to properly understand the characteristics distinguishing organic food, and so organic is a sort of credence quality (Nuttavuthisit and Thøgersen, 2017). Furthermore, not even after consumption the consumer can verify whether a product is organic and therefore trust in the product's integrity is an essential driver for the consumer to buy it. The lack of consumer trust in green products can act as a barrier to green consumption (Joshi and Rahman, 2015); vice versa, uncritical trust in the "organic food" category or label may leave consumers

at the mercy of marketers. Consequently, it is necessary to investigate more thoroughly the role of consumer confidence as regards organic food and to analyze the strength of its influence on intention and purchase behavior.

In the literature, it is possible to find several definitions of trust. One that is useful for our aims is that of Hobbs and Goddard (2015), which defines trust as "a heuristic that might be used in situations where lack of knowledge, experience or familiarity with firms, products or process used to create products hampers decision making" (p. 72). Trust has also been viewed as "a state of perceived vulnerability or risk that is derived from individual uncertainty regarding motives, intentions, and potential actions of others on whom they depend" (Kramer, 1999, p. 571). This last definition captures two important dimensions of the concept of trust: (a) the expectation that the counterpart will act in a reliable and not harmful manner and (b) the intention to rely on the counterpart, at the same time as accepting some degree of vulnerability (e.g., uncertainty, risk of being frustrated) (Singh and Sirdeshmukh, 2000).

Some studies considered trust as an additional predictor of the intention to buy eco-friendly food (e.g., Menozzi et al., 2015; Giampietri et al., 2018; Carfora et al., 2019) and found that trust was a significant antecedent of intention, explaining additional quotas of intention variance with respect to the classical TPB constructs. Very few studies tested the extent to which relationships between trust and intention and between trust and behavior were mediated by TPB constructs.

The proposed mediation of relations between trust, intention and behavior by TPB constructs can be summarized in the model presented in **Figure 1** where trust is proposed as predictor of attitude, subjective norm and PBC.

Previous studies confirmed that trust is an important predictor of customer attitudes and when the TPB was assumed as the theoretical framework, trust was identified as an antecedent of attitudes toward purchasing behavior (Teng and Wang, 2015; Ricci et al., 2018). To the best of our knowledge, no study in the field of organic food choice has analyzed the relationships between trust, subjective norm, and PBC, but some studies in the transport literature (e.g., Hsiao and Yang, 2010; Madha et al., 2016; Borhan et al., 2017; Ibrahim et al., 2020) and on on-line transactions (e.g., Wu and Chen, 2005) highlighted that trust via attitude, subjective norm and PBC had positive and indirect relationships with behavioral intention. Capitalizing on these results, our hypothesis concerning the link between trust and attitude was the following:

> H5. Trust in organic food will be positively associated with the attitude toward the purchase of organic food in general or organic fruit and vegetables in particular.

According to the TPB, subjective norms refer to people's perceptions of important referents' beliefs about the behavior. The positive association between individual trust and subjective norm means that those who have a higher degree of trust in purchasing organic food should rely more on their referent beliefs. This confidence in significant others and their beliefs can be expected to play a role in determining the subjective norms; in fact individuals will be more willing to comply with the important referents (Wu and Chen, 2005). So our hypothesis here was as follows:

> H6. Consumers' trust in the purchase behavior of organic food in general, or organic fruit and vegetables in particular, will be positively associated with subjective norm

In regards to PBC, trust can act as a resource that aids consumers to gain control over purchase through self-efficacy. Self-efficacy is built through self-confidence and mutual trust in interpersonal relationships; hence, trust between consumers and sellers or producers of organic food that behave in accordance with consumers' expectation should increase consumers self-efficacy and, in turn, increase PBC (Wu and Chen, 2005). So we developed the following hypothesis:

> H7. Consumers' trust in organic food will be positively associated with perceived behavioral control.

Finally, the three antecedents of intention (attitude, subjective norm, and PBC) are supposed to mediate the relationship between trust and intention, and the three antecedents of intention along with intention itself will mediate the relationship between trust and purchase behavior. Therefore, we hypothesized the following:

> H8. Trust will be positively and indirectly associated with purchase intentions of organic food in general, or organic fruit and vegetables in particular, via attitudes, subjective norms, and PBC.

> H9. Trust in organic food will be positively and indirectly associated with the future purchase behavior of organic food in general, or organic fruit and vegetables in particular, via attitudes, subjective norms, PBC, and intentions.

In conclusion, our study aimed to apply the TPB model, extended with measures of trust in organic food, and to offer an original contribution to the issue of predicting both the intention to buy and the purchasing behavior of organic food in general (Study 1) and organic fruit and vegetables in particular (Study 2).

Compared to the extant literature, we believe that our study can be considered to be innovative for three reasons. First, in both studies, self-reported actual purchases were assessed, while most research has limited the analysis to the intention to purchase. Second, data were collected in two waves, thus offering the possibility to separate the background measures (such as trust) and the measures of all the classical TPB constructs from the target measures, offering the chance to assess the predictive power of the hypothesized model. Third, the role of trust was questioned, given its possible heuristic role within social-cognitive processes existing behind both intention formation and behavioral execution in the case of organic food in general or organic fruit and vegetables in particular. Finally, the qualitative comparison between the results of Studies 1 and 2 can be seen as promising in order to sketch some general conclusions concerning the possible similarities of the TPB-based processes in the two different conditions (general *vs.* specific types of products). This will offer suggestions for both scholars and

practitioners interested in the interplay between cognitive and behavioral processes related to the field of organic food choice and consumption.

MATERIALS AND METHODS

Procedure and Participants

For both studies, the data collection was organized in two waves, Time 1 and Time 2. At Time 1, participants completed a structured anonymous questionnaire including the measures of the extended TPB model and socio-demographic variables. At Time 2, 1 month later, participants' self-reported behavior measures were collected. Since the two studies followed exactly the same design, the following description applies to both.

For each study, about one hundred university students from two different courses offered by the School of Psychology at Padua University were engaged in data collection. Students were asked to administer the questionnaire among three or four of their friends, relatives, or acquaintances who did not belong to the same family. Participants were provided with an envelope containing the questionnaire, an instruction letter, and an informed consent form that participants had to sign and return before completing the questionnaire at Time 1. In the instruction letter, participants were informed about the aim of the study, the purchasing behavior the study was focused on (i.e., the purchase of organic food or the purchase of organic fruit and vegetables), the estimated duration of the task, and the possibility of withholding their consent to participate at any time, and they were also assured that all answers would remain confidential. Each participant filled in the questionnaire autonomously and gave it back immediately. Informed consent forms and completed questionnaires were collected using separate envelopes and returned to the researchers by the students. One month later (Time 2), through scheduled appointments, the participants filled in the second questionnaire and were quickly debriefed.

In Study 1, there were 400 potential participants, but usable data was obtained from 371 individuals (response rate: 92.7%). Among them, 288 completed the second questionnaire (final response rate: 72%). Finally, participants who declared that they were not at least partially responsible for purchasing decisions regarding food products were excluded, so the final sample comprised 237 participants.

In Study 2, 300 potential participants were contacted, and usable data was obtained from 260 individuals (response rate: 86.7%). Among them, 233 also completed the second questionnaire (final response rate: 77.7%). The same exclusion criterion as in Study 1 was applied, so the final sample comprised 227 participants. **Table 1** provides the socio-demographic composition of the two samples.

A drop out analysis indicated in the case of Study 1 only one difference between the 237 participants included in the final sample and the 73 "drop outs" (participants who did not filled in the second questionnaire). In the final sample vs. "drop outs" there were more respondents that declared to be single than married or cohabiting ($\chi^2_1 = 5.21$, $p < 0.03$). No difference was found regarding TPB constructs and trust. As regards Study 2, the same analysis showed very few differences between the 227 participants included in the final sample and the 23 "drop outs." The former group scored significantly lower on both PBC ($M_{finalsample} = 4.55$ vs. $M_{dropouts} = 5.65$, $t_{248} = -3.29$, $p < 0.002$) and intention ($M_{finalsample} = 4.37$ vs. $M_{dropouts} = 5.20$, $t_{248} = -2.22$, $p < 0.03$) than the latter.

Overall, even if the people in Study 1 were slightly unbalanced in terms of where they lived in Italy compared to those of Study 2, we concluded that the typical participant was predominantly a middle-aged woman, currently in the workforce, and with at least a high-school education. The majority declared that they

TABLE 1 | Survey sample characteristics.

	Study 1 (n = 237)		Study 2 (n = 227)	
Demographics				
Age	19–70 years	M = 36.49, SD = 14.36	18–75 years	M = 39.58, SD = 15.45
	N	**%**	**N**	**%**
Gender				
Women	154	65	148	65.2
Men	82	34.6	79	34.8
Missing data	1	0.4	0	0
Italian geographic area				
Northeast	193	81.4	93	41
Northwest	22	9.3	10	4.4
Central	8	3.4	10	4.4
Southern	13	5.5	112	49.3
Missing data	1	0.4	2	0.9
Occupation				
Employed	125	52.7	117	51.5
Out of work (housewife, students, retired, unemployed)	110	46.4	106	46.7
Missing data	2	0.8	4	1.8
Education				
Compulsory school	31	13.1	26	11.4
High school	119	50.2	142	62.6
University degree	86	36.3	56	24.7
Missing data	1	0.4	3	1.3
Marital status				
Married or cohabiting	94	39.7	91	40.1
Single	143	60.3	136	59.8
Parental status				
Dependent children	81	34.2	93	41
No dependent children	156	65.8	134	59
Family net monthly income (in euros)				
Below 1,500	43	18.1	64	28.2
1,501–2,500	88	37.1	60	26.4
2,501 and above	98	41.4	91	40.1
Missing data	8	3.4	12	5.3
Where do you buy organic products?				
Large retailers	173	73	185	81.5
Small retailers	121	51.1	124	54.6
Direct manufacturer	86	36.3	120	52.9
Street markets	69	32.7	91	40.3
E-commerce	7	3.3	24	10.6

were single, did not have children, and were earning a salary, which was, according to national statistics, above the average level (ISTAT, 2019). As regards their supply sources of organic products, most respondents used large and small retailers, as well as direct manufacturers. This evidence supports the expanded availability of organic products, which is connected with the increase in consumer demand that has been experienced in the last decades.

Measures

The questionnaires presented measures of TPB constructs adapted from those already used in previous studies in the Italian context (Canova and Manganelli, 2016; Canova et al., 2020). The measures complied with the TPB questionnaire construction guidelines (Fishbein and Ajzen, 2010). In Study 1, the target behavior was the purchase of organic food products in the following month. For all participants, the following description of target behavior was provided: "The purchase of organic products, i.e., products coming from organic farming (e.g., cereals, fresh fruit and vegetables, honey and jams, milk and derivatives, oil, bread, tomato sauce and seasonings, wine, dried fruit, pickles, meat and fish), from any point of sale (e.g., supermarkets, specialized stores, small shops, hard discount shops, fair-trade shops, local markets) in the next month." In Study 2, the target behavior was the purchase of fresh organic fruit and vegetables in the next month. For all participants, the following description of target behavior was provided: "The purchase of fresh organic fruit and vegetables from any point of sale (e.g., supermarkets, specialized stores, small shops, hard discount shops, fair-trade shops, local markets) in the next month."

During the first wave of the studies, participants were asked to report their attitude, subjective norm, PBC, trust in organic food, and demographic information.

Trust in Organic Food

Three items derived from the literature were adopted (Giampietri et al., 2018): "I perceive organic food to be reliable," "I trust in organic food products," and "I trust in purchasing organic food products." The response scale ranged from 1 (strongly disagree) to 7 (strongly agree).

Attitude Toward the Behavior

Attitude was measured by presenting the participants with the statement: "To buy organic food products/organic fruit and vegetables in the next month would be..." and asking them to respond on four 7-point semantic differential adjective scales (unpleasant–pleasant, useless–useful, negative–positive, and crazy–wise). The response scales were anchored from 1 (negative pole) to 7 (positive pole).

Subjective Norm

The participants were asked to respond on a 7-point Likert-type scale to two items: "Most of the people who are important to me (family, friends, acquaintances, partners) think I should/should not buy organic food products/organic fruit and vegetables in the next month" and "Most people who are important to me would like me to buy organic food products/organic fruit and vegetables in the next month." The anchors varied for each question from 1 (I should not/false) to 7 (I should/true).

Perceived Behavioral Control

This was measured with two items: "To what extent do you think buying organic food products/organic fruit and vegetables in the next month is a behavior under your control?" and "How much control do you think you have over buying organic food products/organic fruit and vegetables in the next month?" The anchors varied for each question from 1 (Not at all/no control) to 7 (Very much/complete control).

Intention

Three items were used: "I intend to buy organic food products/organic fruit and vegetables in the next month," "How likely is it that you will form the intention to buy organic food products/organic fruit and vegetables in the next month?" and "How likely is it that you will actually buy organic food products/organic fruit and vegetables in the next month?" Lower points on the response scale (i.e., 1) indicated both low agreement and likelihood, whereas higher points (i.e., 7) indicated high agreement and likelihood.

Demographics

Gender, age, marital and parental status, the geographic area of residence, employment status, education, and net (i.e., after taxation) monthly income were assessed, along with where they predominantly purchased organic products (e.g., large retailers, small retailers, direct manufacturers and solidarity purchase groups, street markets). Moreover, the participants were asked: "Are you responsible for making decisions regarding the buying of food products?" (1 = Yes, I am the main person responsible for making decisions about buying food products; 2 = I am one of the people responsible for making decisions about buying food products; and 3 = No, I am not involved in the decision-making process about buying food products).

Self-Reported Behaviors

At Time 2, the participants had to report their buying behavior with reference to the month immediately before the second wave of the research. For this purpose, we used two items. In both studies, the first item was: "In the last month, have you personally bought organic food/organic fruit and vegetables?" with a response scale ranging from 0 (No, never) to 4 (Yes, regularly, every time I went shopping). The second item was different in each of the two studies; in Study 1, it was as follows: "In the last month, how many organic food products did you buy?" with a response scale from 0 (None) to 4 (More than four), while in Study 2 it was the following: "How much organic fresh fruit and vegetables have you bought during the last month?" ranging from 0 = I have not bought any organic fruit and vegetables to 4 = I have bought more than 10 kg of organic fruit and vegetables.

Data Analysis

In order to check the adequacy of the measurement model, we conducted a confirmatory factor analysis (CFA) using the

maximum likelihood method applied to covariance matrices with LISREL 8.80. Two parcels were created when the number of indicators was greater than two (i.e., in the case of attitude, intention, and trust) in order to reduce the numbers of the parameters to be estimated and to obtain conceivably smaller standard errors in the subsequent statistical analysis (Bagozzi, 1994). The measurement models of the two studies included six latent factors and twelve indicators. Goodness-of-fit was evaluated by means of the conventional indices that can be summarized as follows: χ^2, χ^2/df, CFI, RMSEA, and SRMR. Usually, a satisfactory model is denoted by χ^2 not being significant, $\chi^2/df \leq 3$, CFI ≥ 0.95, RMSEA ≤ 0.06, and SRMR ≤ 0.08 (Hu and Bentler, 1999). In order to estimate the reliability, the Cronbach's alpha coefficients and composite reliabilities were determined; then, descriptive statistics were computed for all the variables (**Tables 2** and **3**). Finally, a structural model was used in order to test the hypothesized model of relations (**Figure 1**). In the next section, results from both studies will be presented in parallel.

RESULTS

Descriptive Statistics

Tables 2, **3** show means and standard deviations for both the single items and the averages of composite scores of the constructs, and, in addition, reliability coefficients. Results of both studies showed that all constructs exhibited good levels of internal consistency: composite reliabilities (CRs) ranged from 0.88 to 0.96, and Cronbach's coefficients were satisfactory. As concerns the mean scores, trust in organic food can be qualified as moderate. Altogether, participants showed a strong positive attitude toward the target behaviors and perceived them as being easy to perform. They declared only a moderate level of social pressure to execute the buying behavior and expressed a moderate intention to buy organic food or organic fruit and vegetables in the next month. On the contrary, purchasing frequency in the month before the second wave was low (**Table 4**): as an example 16.5% bought regularly some types of organic food and 10.1% bought regularly organic fruit and vegetables.

Measurement Model

In regards to items aggregations the following parcels were created: TRUST1 was computed by averaging participants' responses to the items "I perceive organic food to be reliable" and "I trust in purchasing organic food products"; ATT1 by averaging "unpleasant—pleasant" and "negative—positive"; ATT2 by averaging "useless—useful" and "crazy—wise"; INT2 by averaging responses to "I intend to buy organic food products/organic fruit and vegetables in the next month" and to "How likely is it that you will actually buy organic food products/organic fruit and vegetables in the next month?". Finally for TRUST2, SNORM1, SNORM2, PBC1, PBC2, INT1, BEH1,

TABLE 2 | Descriptive statistics and reliability coefficients of trust, TPB constructs, and items—Study 1 (n = 237).

Constructs and items	*M*	*SD*	Cronbach's alpha	CR
Trust in organic food	4.82	1.31	0.93	0.90
I perceive organic food to be reliable	4.86	1.37		
I trust in organic food products	4.79	1.38		
I trust in purchasing organic food products	4.81	1.45		
Attitude	5.05	1.15	0.86	0.88
Unpleasant–pleasant	5.11	1.19		
Useless–useful	4.89	1.53		
Negative–positive	5.22	1.34		
Crazy–wise	4.97	1.42		
Subjective Norm	4.59	1.32	0.89	0.89
Most of the people who are important to me (family, friends, acquaintances, partners) think I should/should not buy organic food products in the next month	4.72	1.28		
Most people who are important to me would like me to buy organic food products in the next month	4.47	1.49		
PBC	5.03	1.41	0.83	0.83
To what extent do you think buying organic food products in the next month is a behavior under your control?	5.14	1.51		
How much control do you think you have over buying organic food products in the next month?	4.92	1.55		
Intention	4.50	1.75	0.95	0.95
I intend to buy organic food products in the next month	4.51	1.79		
How likely is it that you will form the intention to buy organic food products in the next month?	4.57	1.83		
How likely is it that you will actually buy organic food products in the next month?	4.39	1.89		
Behavior	1.93	1.40	0.95	0.95
In the last month, have you personally bought organic food?	1.80	1.40		
In the last month, how many organic food products did you buy?"	2.06	1.47		

CR, Composite Reliabilities; PBC, Perceived Behavioral Control. Every construct was scored on a 7-point response scale, except for "Behavior," which used a 5-point one.

TABLE 3 | Descriptive statistics and reliability coefficients of trust, TPB constructs, and items—Study 2 (n = 227).

Constructs and items	*M*	*SD*	Cronbach's alpha	CR
Trust in organic food	4.89	1.50	0.93	0.88
I perceive organic food to be reliable	4.99	1.56		
I trust in organic food products	4.91	1.63		
I trust in purchasing organic food products	4.76	1.60		
Attitude	5.13	1.38	0.91	0.93
Unpleasant–pleasant	5.11	1.19		
Useless–useful	5.08	1.52		
Negative–positive	5.24	1.48		
Crazy–wise	5.07	1.57		
Subjective Norm	4.91	1.40	0.92	0.92
Most of the people who are important to me (family, friends, acquaintances, partners) think I should/should not buy organic fruit and vegetables in the next month	4.98	1.41		
Most people who are important to me would like me to buy organic fruit and vegetables in the next month	4.84	1.51		
PBC	4.55	1.55	0.88	0.89
To what extent do you think buying organic fruit and vegetables in the next month is a behavior under your control?	4.60	1.62		
How much control do you think you have over buying organic fruit and vegetables in the next month?	4.49	1.67		
Intention	4.37	1.73	0.96	0.96
I intend to buy organic fruit and vegetables in the next month	4.43	1.74		
How likely is it that you will form the intention to buy organic fruit and vegetables in the next month?	4.44	1.82		
How likely is it that you will actually buy organic fruit and vegetables in the next month?	4.24	1.83		
Behavior	1.30	1.18	0.91	0.92
In the last month, have you personally bought organic fruit and vegetables?	1.43	1.35		
How much organic fresh fruit and vegetables have you bought during the last month?	1.18	1.09		

CR, Composite Reliabilities; PBC, Perceived Behavioral Control. Every construct was scored on a 7-point response scale, except for "Behavior," which used a 5-point one.

and BEH2 the indicators used in the analyses corresponded to those observed.

According to the CFA results, the goodness-of-fit indices of the measurement model turned out to be satisfactory. In Study 1: $\chi^2(39) = 54.17$, $p \cong 0.054$, $\chi^2/df = 1.39$, RMSEA = 0.04 [90% CI: 0.00, 0.07], CFI = 0.99, SRMR = 0.03, and the estimated factor loadings for all indicators were significant and ranged between 0.75 and 0.99 (**Table 5**). In Study 2: $\chi^2(39) = 38.68$, $p \cong 0.48$, $\chi^2/df = 0.99$, RMSEA = 0.00 [90% CI: 0.00, 0.05], CFI = 1.00, SRMR = 0.02, with factor loadings that were all significant and ranging between 0.79 and 0.99. In both studies, the average variance extracted (AVE) for each construct reported in **Table 5** was higher than the suggested value of 0.50 (Fornell and Larcker, 1981); furthermore, the AVE of each construct was higher than the squared correlations among the constructs, indicating good convergent and discriminant validity.

As concerns Study 1, the correlations among latent factors (**Table 6**) were all significant, except in the case of trust in organic food and PBC. The constructs that showed the highest correlation coefficient are attitude and intention (φ = 0.67). In every case, the 95% confidence intervals, which we obtained by considering two standard errors above and below the coefficients, did not include the perfect correlation (i.e., 1.00), thus supporting the fact that all measures captured distinct constructs (Bagozzi, 1994). In Study 2, the correlations among latent factors (**Table 6**) were all significant with the highest coefficient linking attitude and intention (φ = 0.71). Again, the 95% confidence intervals did not include the perfect correlation (i.e., 1.00).

Test of the Structural Model

The overall goodness-of-fit of the model (**Figure 2**) was acceptable. In Study 1: $\chi^2(43) = 64.93$, $p \cong 0.01$, $\chi^2/df = 1.51$, RMSEA = 0.05 [90% CI: 0.02, 0.07], CFI = 0.99, SRMR = 0.04; and in Study 2: $\chi^2(43) = 42.60$, $p \cong 0.49$, $\chi^2/df = 0.99$, RMSEA = 0.00 [90% CI: 0.00, 0.04], CFI = 1.00, SRMR = 0.03.

In Study 1, the model explained 36% of the future purchase behavior variance, and only intention was significantly associated with behavior: this gave support to our first hypothesis (H1). Then, the model accounted for 61% of the variance in behavioral intention (**Figure 2**). Attitude showed the strongest positive association with intention, while those between subjective norm, PBC, and intention were significant but moderate. These findings supported H2, H3, and H4a and sustained the classical TPB model. PBC was not directly associated with future behavior, so H4b received no support. Trust in organic food was positively associated with attitude and subjective norm, as expected from H5 and H6. The association between trust and PBC was not significant, contrary to H7. Trust alone explained 34% of attitude variance, and 5% of subjective norm variance.

The standardized indirect effects of trust on intention, via the mediation of both attitude and subjective norm, and those of trust on purchase behavior, via the mediation of attitude, subjective norm and intention, were computed with LISREL. Results were

TABLE 4 | Frequencies and percentages of responses on behaviors items in the two studies.

	Study 1 (*n* = 237)		
Items	**Response scale**	**n**	**%**
In the last month, have you personally bought organic food?	(0) No, never	57	24.1
	(1) Yes, once	48	20.3
	(2) Yes, twice	56	23.6
	(3) Yes, three times	37	15.6
	(4) Yes, regularly, every time I went shopping	39	16.5
In the last month, how many organic food products did you buy?	(0) None	57	24.1
	(1) One	28	11.8
	(2) Two	47	19.8
	(3) Three or four	55	23.2
	(4) More than four	50	21.1
	Study 2 (*n* = 227)		
In the last month, have you personally bought organic fruit and vegetables?	(0) No, never	77	33.9
	(1) Yes, once	54	23.8
	(2) Yes, twice	40	17.6
	(3) Yes, three times	33	14.5
	(4) Yes, regularly, every time I went shopping	23	10.1
How much organic fresh fruit and vegetables have you bought during the last month?	(0) I have not bought any organic fruit and vegetables	77	33.9
	(1) About 1 kg	69	30.4
	(2) 1–5 kg	50	22
	(3) 5–10 kg	26	11.5
	(4) I have bought more than 10 kg of organic fruit and vegetables	5	2.2

TABLE 5 | Measurement model: Standardized factor loadings.

		Study 1 (*n* = 237)		Study 2 (*n* = 227)	
Constructs	**Parcels/Items**	λ_x	**AVE**	λ_x	**AVE**
Trust in organic food	TRUST1	0.80	0.81	0.84	0.77
	TRUST2	0.99		0.93	
Attitude	ATT1	0.94	0.79	0.92	0.87
	ATT2	0.84		0.95	
Subjective Norm	SNORM1	0.88	0.81	0.89	0.85
	SNORM2	0.92		0.95	
PBC	PBC1	0.93	0.72	0.99	0.80
	PBC2	0.75		0.79	
Intention	INT1	0.94	0.90	0.95	0.92
	INT2	0.95		0.97	
Behavior	BEH1	0.96	0.91	0.91	0.86
	BEH2	0.94		0.94	

PBC, Perceived Behavioral Control; AVE, Average Variance Extracted.

statistically significant and equal to 0.39 ($p < 0.001$) for the indirect effect of trust on intention, and equal to 0.24 ($p < 0.001$) for the indirect effect on behavior. Moreover, intention mediated the effects of attitude (0.34, $p < 0.001$), subjective norm (0.16, $p < 0.01$), and PBC (0.18, $p < 0.01$) on purchase behavior.

In Study 2 (**Figure 2**), the model explained 43% of the purchase behavior variance, and only intention was significantly associated with this behavior, supporting our first hypothesis (H1). The model accounted for 64% of the variance in behavioral intention; attitude and subjective norm showed the strongest positive associations with intention. In addition, the association between PBC and intention was significant. These findings supported H2, H3, and H4a and, consequently, the classical TPB model. For a second time, in contrary to H4b, PBC was not directly associated with future behavior. Trust in organic food was positively associated with attitude, subjective norm, and PBC, as predicted by H5, H6, and H7. Again, trust alone explained a good portion of attitude variance (37%) and smaller quotas of subjective norm and PBC variances. The analysis of the indirect effects showed that the standardized indirect effect of trust on intention via the mediation of attitude, subjective norm, and PBC was significant (0.49, $p < 0.001$); the indirect effect of trust via the mediation of attitude, subjective norm, PBC, and intention on behavior turned out to be significant (0.34, $p < 0.001$). In addition, in this case, intention mediated the effects of attitude (0.24, $p < 0.001$), subjective norm (0.19, $p < 0.01$), and PBC (0.14, $p < 0.01$) on purchase behavior. In both studies, the modification indices (MI) concerning the direct paths between trust and intentions and between trust and behaviors were lower than 3.84 indicating a no significant improvement in model fit as a result of freeing these parameters (Bagozzi, 1994); therefore, we

TABLE 6 | Correlations between latent factors.

Constructs	**Trust in organic food**	**Attitude**	**Subjective norm**	**PBC**	**Intention**	**Behavior[a]**
Trust in organic food	–	0.61 (0.05)	0.45 (0.06)	0.41 (0.06)	0.56 (0.05)	0.38 (0.06)
Attitude	0.57 (0.05)	–	0.63 (0.04)	0.42 (0.06)	0.71 (0.04)	0.49 (0.05)
Subjective norm	0.21 (0.07)	0.37 (0.06)	–	0.40 (0.06)	0.67 (0.04)	0.52 (0.05)
PBC	0.09 (0.07)[b]	0.20 (0.07)	0.24 (0.07)	–	0.53 (0.05)	0.44 (0.06)
Intention	0.44 (0.06)	0.67 (0.04)	0.51 (0.05)	0.44 (0.06)	–	0.64 (0.04)
Behavior[a]	0.32 (0.06)	0.48 (0.06)	0.41 (0.06)	0.18 (0.07)	0.58 (0.05)	–

Standard errors in parentheses. PBC, Perceived Behavioral Control. The values of Study 1 (n = 237) are shown above the diagonal, and the ones of Study 2 (n = 227) are below the diagonal. [a]In Study 1, the behavior was "to buy organic food products" and in Study 2, "to buy fresh organic fruit and vegetables." All coefficients are significant with p < 0.01, except the one denoted by "[b]," for which p = 0.18.

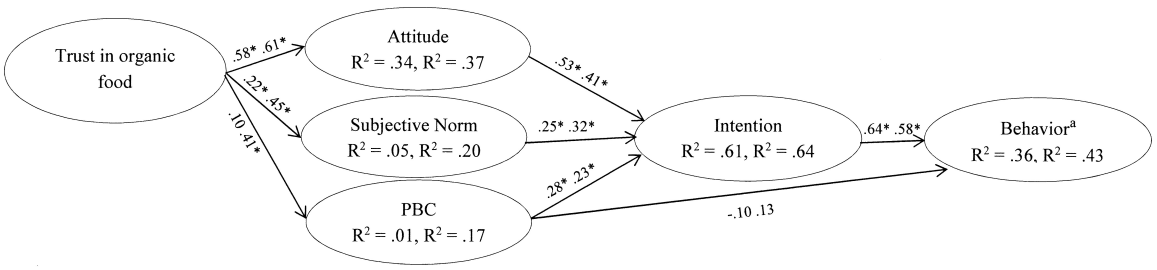

FIGURE 2 | Standardized path coefficients (Study 1, n = 237; Study 2, n = 227). PBC, Perceived Behavioral Control. The first coefficients refer to Study 1 and the second ones to Study 2. *$p < 0.01$. [a]In Study 1 the behavior was "to buy organic food products," in Study 2 "to buy organic fresh fruit and vegetables."

concluded that the effects of trust were completely mediated by the TPB constructs.

DISCUSSION

The persistent increase in organic food sales in the last decades has definitely attested both the growing interest and trust that consumers have in a food category consisting of products that are supposed to have been grown naturally, without the use of any kind of chemicals. Conversely, little research seems to have investigated the possible relationship between trust in organic food and the antecedents of both buying intention and the actual purchase, following one of the most important socio-psychological theoretical frameworks, the TPB.

Since consumers are not in a position to have access to complete information or control over the overall process of organic food production and sales, trust must necessarily play a role in the decision-making process when people assume that food labeled as "organic" is safe, healthy, natural, and tasty, and that its consumption also has environmental benefits. In fact, several studies carried out in the USA and Europe showed that beliefs regarding organic food characteristics were related to taste and healthiness, as well as to the perceived benefits for the environment and animal welfare (e.g., Saba and Messina, 2003; Arvola et al., 2008; Zagata, 2012).

Findings of the two studies presented in this paper highlighted that the TPB model has a strong explanatory value. In fact, the hypotheses concerning the relations between attitudes, subjective norm, PBC, and intentions received support (i.e., H2, H3, and H4a). Attitudes toward the behaviors had the strongest effects on intentions; subjective norm and PBC had significant but comparatively lower effects on them. Altogether, the results suggest that a positive attitude toward the purchase of organic food in general, or fresh organic fruit and vegetables in particular, predicts intentions and, indirectly, actual behaviors, and this is consistent with previous findings in the literature (e.g., Aertsens et al., 2009; Scalco et al., 2017; Carfora et al., 2019). Moreover, in line with the literature (Armitage and Conner, 2001), subjective norm was shown to have the weakest impact on intention compared to the other TPB components. However, the positive effect of subjective norm indicates that expectations about food purchases shared with important others, such as family members and friends, positively affect the willingness of consumers to buy organic food.

In regards to PBC, it seemed to play a minor role than attitude in intention formation. Again, this is in line with the meta-analysis by Scalco et al. (2017), but it diverges from results of studies conducted in the Italian context, which proposed increasing the consumption of organic food by increasing its availability and, consequently, the perceived control of customers (e.g., Giampietri et al., 2018; Carfora et al., 2019).

Intentions predicted self-reported behavior over 1 month, supporting H1. Instead, H4b on the direct effect of PBC on behavior was not confirmed. Following Ajzen (1991), we could deduce that our participants considered the proposed behaviors as completely under their volitional control. However, since measures of actual control were not available—as they are not for most behaviors (Fishbein and Ajzen, 2010)—we should be aware of the fact that PBC could also not to be the best proxy of actual control in this behavioral domain. Future appropriately designed studied could deal with this issue.

H5 received support since trust in organic food was positively associated with attitude in both studies, mirroring the extant literature (e.g., Teng and Wang, 2015; Ricci et al., 2018), and it explained about a third of the attitude variance. Trust was also positively associated with subjective norm and, in the case of Study 2 only, with PBC, thus offering support to H6 and, partially, to H7. Besides, trust explained lower quotas of subjective norm and PBC variances, compared to attitude.

Consumer trust plays a key role in developing an overall positive evaluation toward organic food. Its effect on attitudes showed that the more consumers trusted organic food, the more they showed positive attitudes toward it. The influence of trust on subjective norm told us that the higher the trust score was (and, consequently, the more our participant accepted being vulnerable to possible misconducts or frauds), the more they relied on opinions of their important referents. Indeed, as mentioned before, it is reasonable to assume that many consumers do not have sufficient information on organic food production and manufacturing and, in some sense, when they decide to buy it, their judgment is necessarily sensitive to those of others.

The effect of trust on PBC was significant only in Study 2. This finding suggests that trust in organic food could act as a facilitator for consumers' behavior, while a lack of trust could act

as an obstacle to it, as argued by Hansen et al. (2018) in their study on trust in social networking services.

H8 and H9 were supported by the data. Trust in organic food was indirectly associated with intentions and behaviors via its significant effects on attitudes and subjective norm (and on PBC, but only in Study 2). In our view, individual differences in terms of trust could have an indirect effect on intentions to buy organic food in general, and fresh organic fruit and vegetables in particular, and on actual purchase behaviors, and this hypothesis should be explored further in future studies.

The hypothesized model, which incorporated trust as a background variable in the TPB framework, yielded a robust performance with regard to its explanatory power. In Studies 1 and 2, it explained 61% and 64% of intention variance, respectively. These quotas are similar to those reported by Carfora et al. (2019) and slightly lower than that published by Qi and Ploeger (2019). As concerns future behavior, the model explained 36% and 43% of variance; once more, these quotas are in accordance with Carfora et al. (2019). Consistent with findings in other behavioral domains, the lowest quotas of explained behavior variance compared to those of intentions may be due to several factors, such as: (a) issues regarding the validity of self-reported behavior measures, (b) events that occurred between the assessment of intentions and behaviors, which may have produced changes in intentions, and (c) unanticipated obstacles that may have prevented the individuals from carrying out their intentions (de Leeuw et al., 2015).

Finally, TPB-based processes are similar in the case of a general target behavior (the purchase of organic food) and of a specific behavior (the purchase of fresh fruit and vegetables), and we see this as promising in terms of the possible generalizability of results in future replicas with different targets.

Turning to the potential practical implications of our research, we argue that the findings may be valuable for different stakeholders, for instance, practitioners, marketers, policymakers, and even firms interested in the organic food industry, and for several reasons. First, intention emerged as the only significant predictor of purchase behavior: namely, consumers seemed to buy organic food because they had planned to do it, and our findings suggested that buying intentions are boosted mainly by attitude, subjective norm and perceived control, but also indirectly by trust. However, both the frequency and quantity of self-reported purchase behaviors were low, and therefore, there is still room for interventions aimed at increasing organic consumption and strengthening the demand of these products. Second, although attitudes and PBC are already quite positive, public policy initiatives should try to improve the perceived value of organic food products for the individual and for society as a whole. Additionally, marketers should design marketing campaigns focused on the personal advantages of organic food consumption, such as health benefits (Kushwah et al., 2019), and on facilitating the perception of control, thus supporting individuals in overcoming obstacles and barriers (e.g., the cost of sustainable products and the difficulty of finding them in stores).

Our results also indicate that family, relatives, and friends could contribute to shaping individual intentions to buy organic food and to strengthening green or sustainable purchase practices. In this case, public policy initiatives should be directed at the interdependent nature of family and community relationships, stressing both the ethical value of organic food purchases and the societal or altruistic value of organic food products and consumption (e.g., environmental, animal, and farmers' welfare). Third, positive attitudes toward the purchase of organic food, subjective norm and also PBC can be increased if buyers consider organic food to be trustworthy. In this case, marketers could use this evidence to build communication campaigns intended to promote trust in these products, especially in non-buyers.

As we stated in the Introduction, it is important to remember that trust may serve as a "shortcut" when, as in the case of organic food, consumers have limited information about and exposure to the production or preparation of these products, and when direct relationships with food producers are rare (Hartmann et al., 2015). Thus, it may be the case that consumers perceive an organic label as a symbol of quality *per se* and as a strong heuristic cue (Vega-Zamora et al., 2014). Since any kind of organic food can be seen as reliable, consumers' trust in organic food may be largely based only on the intrinsic value of the "organic" label (Ayyub et al., 2018). The increasing availability of products labeled as "organic," without all the appropriate information being shared with customers, or without a parallel increase in consumers' awareness on how organic food should be produced or manufactured, may potentially enhance the risk of fraud in this sector, given the "brand" value that the word "organic" has assumed over recent years. Since the use of shortcuts in decision-making can sometimes be risky, consumers should be invited to increase their knowledge about this food category and to ask for transparent information regarding constituents, quality, and controls carried out in the organic food sector. Future studies should be devoted to these issues.

Our studies can offer a significant contribution to the emerging literature on the purchasing of organic food in various ways. First, antecedents of consumers' decisions to buy organic food, following a renowned socio-psychological approach, that is, the TPB, were explored in detail. Second, it presented an initial comparison between different types of organic food purchasing, something that is rarely investigated. Third, to our knowledge, it is one of the few studies that has considered a prospective purchase. Indeed, most recent claims in the literature have advocated the need to focus on actual choice behavior along with behavioral intentions because behavioral intentions alone may not represent actual purchase behavior accurately (Yadav and Pathak, 2016a).

Despite these points of strength, there are some limitations that must be acknowledged. First, we used two convenience samples, and thus, generalizability to the entire population is questionable. Behavior was measured through self-report items, which could be subject to social desirability or social approval biases, and to retrieval inaccuracy. Moreover, our study, although it considers a prospective measure of behavior, is cross-sectional in design, and therefore, it does not allow the assessment of proper causal relations. Finally, socio-demographic variables were not considered in our models even though numerous other

background factors, such as education, income, and the area of residence (town or rural), could also be associated with the constructs and relationships considered in our studies.

Future studies should use the same extended TPB model in order to predict consumers' purchase intentions regarding other specific organic products, such as processed fruit or bakery goods, personal hygiene, clothes, and furniture. Finally, in our studies, as in the majority of research inspired by the TPB, beliefs associated with attitude toward the purchase behaviors (i.e., behavioral beliefs), subjective norm (i.e., normative beliefs), and PBC (i.e., control beliefs) were not assessed. Instead, in order to project interventions designed to encourage the purchase of organic food, the knowledge of the specific beliefs underlying attitude, subjective norm and PBC would provide useful information. Future studies should also examine antecedents of trust (like information or exposure to the production processes of organic products) in order to fully understand their role in decision-making and developing tailored interventions.

CONCLUSION

The results of the present study confirm the efficacy of the TPB as a framework for understanding intentions and behavior in the field of organic food purchasing, and the current test significantly contributes to the body of evidence for the predictions specified in the model. Consumer trust had significant effects on organic food purchasing via the antecedent variables of the TPB, and it turned out to be crucial for promoting intentional behaviors. Overall, our results are in line with Fishbein and Ajzen (2010), who claimed that the TPB allows the incorporation of various background factors and the testing of the mediating influence of these factors on intentions and behavior. However, given that trust may be a risky "shortcut" in decision-making processes, consumers should become more informed about organic products and claim the right to have transparent information regarding their quality. Producers and retailers, for their part, should promote communication campaigns and solid relationships with consumers in order to build knowledge and loyalty between all the different actors involved in the manufacturing, processing, and selling of organic food.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethical Committee of the School of Psychology at Padua University (code 1529). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

LC and AM designed the studies, supervised the data collection, and contributed to the writing of the manuscript. LC performed data analysis. AB contributed to the data analysis and to the writing of the manuscript. AM supervised the research project. All authors revised and approved the submitted version.

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How to Effectively Encourage Sustainable Food Choices: A Mini-Review of Available Evidence

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Food choices are difficult to change. People's individual motivations (such as taste, cost, and food preferences) can be at odds with the negative environmental outcomes of their food choices (such as deforestation, water pollution, and climate change). How then can people be encouraged to adopt more sustainable food choices? This rapid review uses a dual-processing framework of decision-making to structure an investigation of the effectiveness of interventions to encourage sustainable food choices (e.g., local and organic food consumption, reducing meat and dairy intake, reducing food waste) via voluntary behavior change. The review includes interventions that rely on fast, automatic decision-making processes (e.g., nudging) and interventions that rely on more deliberate decision-making (e.g., information provision). These interventions have varying degrees of success in terms of encouraging sustainable food choices. This mini-review outlines some of the ways in which our understanding of sustainable food choices could be enhanced. This includes a call for the inclusion of possible moderators and mediators (past behavior, attitudes, beliefs, values) as part of effect measurements, because these elucidate the mechanisms by which behavior change occurs. In light of the climate change challenge, studies that include long-term effect measurements are essential as these can provide insight on how to foster sustained and durable changes.

Keywords: sustainable food choices, interventions, nudges, prompts, information provision, social norms

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INTRODUCTION

Encouraging people to adopt environmentally sustainable diets is an important step toward lowering greenhouse gas emissions. Several studies indicate that individual food-related behaviors–adopting plant-based diets, buying foods with a low carbon footprint, recycling of edible food waste–have significant impacts on overall emission reductions (Steinfeld et al., 2006; Parfitt et al., 2010; Berners-Lee, 2011; Garnett, 2013, 2016; Gerber et al., 2013; Hoolohan et al., 2013; Godfray et al., 2018). This suggests that encouraging the uptake of environmentally sustainable food behaviors can have a substantive impact on limiting climate change.

Encouraging people to alter their food choices is notoriously difficult (Nestle et al., 1998). Large-scale initiatives, such as the "5-a-day" campaign promoting fruit and vegetable intake, are well-known among the general public, but have not necessarily resulted in substantive changes in behavior (Wood, 2019). In the field of environmentally sustainable food choices, a growing body of intervention studies can help shed light on the efficacy of behavior change interventions.

This integrative mini-review (note that this is not a systematic literature review) summarizes what is known about the effectiveness of interventions to encourage environmentally sustainable food choices. It draws on a range of peer-reviewed studies, from randomized control trials to pre-test/post-test design, conducted in a variety of settings, from university cafeterias to convenience stores, and a variety of food-related behaviors. The methods that were used to select the studies, including keyword searches, inclusion and exclusion criteria, and the time period covered, can be found in the **Supplementary Materials**. The two overarching questions of this review are: how effective are behavior change interventions to encourage environmentally sustainable food choices and what psychological mechanisms can account for the effects?

THEORETICAL FRAMEWORK

In psychology, human behavior is often explained via dual-process theories of behavior (Evans, 2008). Dual-process theories of behavior posit that there are two distinct processes that govern decision-making. One is automatic, quick and unconscious, the other is deliberative, slow, and conscious (Kahneman, 2011). Some decisions are informed by the central route (requiring cognitive effort) and other decisions are guided by the peripheral route of information processing (based on cues and heuristics) (Petty and Cacioppo, 1986).

Several scholars argue that food choices are habitual: they are automatic responses to cues in the environment (Wood and Neal, 2009; Lally et al., 2010; Neal et al., 2011). Neal et al. (2011) found that when people in a cinema were given a box of 7 days old stale popcorn, those with strong popcorn eating habits ate 70% of the stale popcorn. What is more, nobody liked the stale popcorn. The cue (watching a movie in a cinema) made the response (eating popcorn) more or less automatic, regardless of people's motivations (disliking the popcorn). Other researchers propose that food choices are (also) driven by a deliberate decision-making process. For example, a recent meta-analysis found that people's organic food choices are strongly associated with attitudes toward organic foods as well as past behavior (a proxy for habits) (Nardi et al., 2019).

The distinction between fast and slow decision-making processes could help explain the (in)effectiveness of behavior change interventions. For example, one of the reasons why the "five-a-day" campaign may not have resulted in increased fruit and vegetable consumption is that this type of information provision relies on the slow mode of processing. If fruit and vegetable consumption is indeed habitual behavior, information provision will not change people's behavior. Rather, cues in the environment could be altered (placing fruits by the check-out counter; see Kroese et al., 2016) to facilitate the desired behavior.

This integrative mini-review (please see **Supplementary Materials** for methods detailing study selection) uses a dual-processing framework to structure an investigation of the effectiveness of interventions to encourage environmentally sustainable food choices. The review includes nudging, food labels, visual prompts, information provision, and the use of social norms (for detailed information about each study, see **Table 1**). This review has two main aims: (i) examine the effectiveness of behavior change interventions and (ii) explore underlying psychological mechanisms that can help explain why an intervention is (in)effective. In doing so, this review summarizes recent advances and the current state of our understanding in the field.

OVERVIEW OF BEHAVIOR CHANGE INTERVENTIONS

Nudging

Nudges involve a (simple) change to the context in which people make decisions (Thaler and Sunstein, 2009). Nudges do not change economic incentives or ban certain products. Rather, nudges steer people toward the desired behavior by changing the choice architecture. Different types of nudges have been implemented in food research, including changes to the default (e.g., labeling a vegetarian option the "dish of the day") and changes to the food environment (e.g., placing healthy foods by the check-out counter instead of unhealthy foods; increasing the availability of vegetarian options on a menu).

The assumptions that underlie nudging are grounded in behavioral economics. Behavioral economics identifies common patterns of thinking that deviate from the assumption that people are rational decision makers (Sunstein, 2014). Nudging interventions alter the choice architecture (e.g., the food environment) so that people's automatic, quick mode of decision making is activated. This suggests that nudging might be particularly effective in changing behaviors that rely on automatic processes, such as food choices (van Kleef and van Trijp, 2018; Vecchio and Cavallo, 2019).

Changes to the Default

One version of nudging consists of labeling a specific menu item as "dish of the day," or "Chef's recommendation." While scenario studies (involving hypothetical meal choices) have shown promising effects of this type of nudging on vegetarian meal choices (e.g., Campbell-Arvai et al., 2014; Bacon and Krpan, 2018), experimental field studies do not seem to observe significant effects. In a randomized controlled field experiment conducted in four European countries, Zhou et al. (2019) found that labeling plant-based options as "dish of the day" did not influence people's meal choices in a restaurant setting. Study findings by dos Santos et al. (2018) also indicate that a "dish of the day" nudge in cafeterias did not increase the uptake of plant-based meals.

Changes to the Food Environment

Other applications of nudging involve changing something in the food environment to encourage sustainable food choices. Kurz (2018), for example, found that when the vegetarian option on a menu was made more visible (putting it on the counter where customers placed their order) sales of vegetarian dishes showed a small but significant increase relative to baseline. Altering the availability or portion size is another form of

TABLE 1 | Summary table of key characteristics of the intervention studies included in this mini-review.

References	Country	Intervention	Study design	Sample characteristics	Duration of intervention	Outcome measure(s)	Effect	Mediator/Moderator
Bernstad et al. (2013)	Sweden	Information provision	Between-subjects design: 1. Written information 2. Written + face-to-face communication	Residents *N* = 680	104 weeks	Amount (kg) of correctly recycled food waste	Face-to-face communication was associated with increase in food waste recycling after 8 months, effect diminished after 18 months	Not included
Bernstad (2014)	Sweden	Information provision (written)	Pre-post design: 1. Written information 2. Food waste equipment in kitchens	Households *N* = 1632	10 weeks	Amount (kg) of correctly recycled food waste	Information was not associated with an increase in food waste recycling, but recycling equipment was	Not included
Brunner et al. (2018)	Sweden	Carbon labels (traffic light system: red = high; yellow = medium; green = low impact)	Pre-post design	Students; *N* = 3,715	Baseline: 28 days; Intervention: 33 days	Type of dish chosen as function of type of carbon label	An 11.5% increase in sales of green-labeled dishes. No difference in yellow- or red-labeled meat dishes. Labels associated with 3.6% emission reduction	Gender and age (moderators): No gender and age differences in response to carbon label
Carfora et al. (2019)	Italy	Text messages about health and/or environmental benefits Self-monitoring Goal setting	RCT 1. Control 2. Health benefits 3. Environment benefits 4. Health + environment	Students; *N* = 261	2 weeks + 1 month follow-up	Red meat consumption; attitudes toward reducing red meat consumption	Health and environment messages associated with lower red meat consumption after 1 month. No added effect of combined message	Effect of the intervention on meat consumption was mediated by attitudes toward reducing red meat
dos Santos et al. (2018)	Denmark	Nudging	Quasi-experimental 1. Control 2. Nudge (dish of the day)	Adolescents *N* = 94 Elderly *N* = 97	4 months	Plant-based meal choice in cafeteria	No difference between control and nudge group in plant-based meal choices	Possible moderators were included, but not tested
Elofsson et al. (2016)	Sweden	Carbon label	RCT 1. Standard label 2. Climate certified label	Shoppers at 17 supermarkets	4 weeks	Sales of climate-certified milk	An 6–8% increase in sales of milk when it carried a "climate-friendly" label, relative to a standard label	Not included
Garnett et al. (2019)	United Kingdom	Nudging	RCT 1. Control 2. Nudge (increased availability)	*N* = 94,644 meals (3 cafeterias)	44 lunchtimes during the autumn term	Vegetarian meal choice	Doubling of vegetarian availability (from 25 to 50%) increased portion of vegetarian sales from 19.1–26.9%	Past behavior was a significant moderator. The impact of increased availability was stronger among those who were not normally eating vegetarian options
Kurz (2018)	Sweden	Nudging	Quasi-experimental 1. Control 2. Nudge (menu order and dish visibility)	Staff and students *N* unknown (sales data was used)	10 months (1 academic year)	Vegetarian meal choices	Nudge associated with higher vegetarian meal choice (from 14 to 20%)	Not included
Linder et al. (2018)	Sweden	Information provision	RCT 1. Control 2. Information leaflet	Households; *N* = 264	1 leaflet, 2 years of data collection	Food waste (in kilograms)	Households in intervention group significantly reduced food waste relative to control up to 8 months after leaflet distribution	Not included
Monroe et al. (2015)	United States	Information provision + goal setting (web-based)	Quasi-experimental 1. Control 2. Information	Students *N* = 607	5 weeks	Self-reported green eating behaviors	Intervention group: small but significant increase in green eating behaviors Control group: no change	Not included
Nomura et al. (2011)	United Kingdom	Social comparison feedback	RCT 1. No-treatment control 2 Social comparison feedback	Households; *N* = 9,082	2 months	Participation in food waste recycling scheme	Participation rates in treatment group increased by 0.5% after 1 month and by 2.8% after 2 months relative to control group	Not included
Shearer et al. (2017)	United Kingdom	Visual prompt	RCT 1. Control 2. Sticker on waste bin	Households; *N* = 64,000	Baseline (13 weeks); sticker (15 weeks)	Weight of collected food waste	Visual prompt increased food waste recycling by 20% relative to control	Not included

(Continued)

TABLE 1 | continued

References	Country	Intervention	Study design	Sample characteristics	Duration of intervention	Outcome measure(s)	Effect	Mediator/Moderator
Spaargaren et al. (2013)	The Netherlands	Climate labels	Pre-post: 1. Baseline (no label); 2. "light" climate label; 3. "comprehensive" climate label + information	Patrons of a university canteen	Baseline: 5 weeks; "light" label: 10 weeks comprehensive label: 8 weeks	Sales data of lunch meals	A small but statistically significant 3% shift toward lower carbon lunches	Not included
Sparkman and Walton (2017; study 4)	United States	Dynamic social norms + $5 discount on lunch	Quasi-experiment 1. Control 2. Descriptive norm 3. Dynamic norm	Patrons of a university café *N* = 304	2 days	Sales of meatless lunches	Sales significantly higher for dynamic norm (34%), compared with descriptive norm (17%) and control (21%). No difference between control and descriptive norm	Not included
Stöckli et al. (2018)	Switzerland	Prompts	Between-subjects design 1. Control 2. Prompt 3. Normative prompt	Patrons of a pizzeria *N* = 54	6 weeks; observation period of 90 min each day	Whether people disposed of or took away pizza leftovers	Both prompts had a small effect on waste behaviors; but no differences between prompts	Not included
Sussman and Gifford (2013)	Canada	Prompts, modeling	Quasi-experimental design 1. Control 2. Prompt 3. Models 4. Sign + models	Diners at shopping mall food courts *N* = 562	2 days	Correct composting behavior	Modeling was associated with a significant (14%) increase in composting behavior. Sign was not associated with a change in composting	Not included
Sussman et al. (2013)	Canada	Prompts, modeling	Pre-post design 1. Baseline 2. Prompt 3. One model 4. Two models 5. Prompt	Patrons at university cafeteria *N* = 1,066	4 weeks	Correct composting behavior	Composting increased from 12.5% (baseline) to 21% (prompt), 25% (one model) and 42% (two models)	Not included
Vanclay et al. (2011)	Australia	Carbon labels	Pre-post design	Convenience store customers (*N* unknown); sales of 2,890 items	Baseline: 4 weeks; intervention: 8 weeks	Point-of-sale data for milk, spreadable butter, canned tomatoes, bottled water, pet food	A 5% increase in sales of low-carbon foods. Significant 20% increase in sales when low-carbon items were also cheapest	Not included
Vandenbroele et al. (2018)	Belgium	Nudging: reduced portion size	Field experiment 1. Control (larger portion) 2. Nudge (smaller portion)	Customers in retail store	1 month	Sales data of meat sausages	Higher sales (52%) of smaller portion relative to control (48%)	Not included
Visschers and Siegrist (2015)	Switzerland	"Climate-friendly" label	Pre-post 1. Baseline 2. Climate-friendly label + information posters	Staff and students at a university cafeteria	Baseline: 5 days Intervention: 17 days	Sales of climate-friendly meals	Sales of "climate-friendly" meals increased by 10%	Not included
Vlaeminck et al. (2014)	Belgium	Environmental label based on composite score (carbon, land use, water)	Between-subjects: 1. Default label 2. Difficult to understand label 3. Easy to understand label	Supermarket; *N* = 150	9 days (the three labels were switched at random)	Sales of protein (stead, chicken, veggie burger), tomatoes and apples	Environmental labels increase eco-friendliness of food choices by 5.3% relative to default. No impact of eco-labels on sales in protein category	Not included
Whitehair et al. (2013)	United States	Visual prompt	Pretest-posttest 1. Baseline 2. Prompt 3. Feedback	Students *N* = 540	6 weeks (2 weeks baseline; 2 weeks prompt, 2 weeks feedback)	Edible food waste	Prompts significantly reduced edible food waste by 15%; no effect of feedback	Environmental beliefs—but no effect
Zhou et al. (2019)	United Kingdom, France, Denmark, Italy	Nudging	RCT 1. Control 2. Nudge ("dish of the day")	People aged 65 or over *N* ranged between 47 and 118	6 months	Plant-based meal choice	Making plant-based option dish of the day (nudging) was not associated with meal choices in any of the countries	Universalism values were positively associated with choosing plant-based meals, irrespective of the intervention

changing the food environment. Garnett et al. (2019) varied the vegetarian offerings in three University of Cambridge college cafeterias and collected individual-level meal selection data. A doubling of the availability of vegetarian offerings (from 25 to 50%) was associated with an 8% increase in sales, compared with a control group. Similarly, Vandenbroele et al. (2018) found that adding smaller portion sizes to a retailer's assortment reduced the total volume of meat sold, relative to a control retailer.

Carbon and Environmental Labels

Studies show that people are generally unaware of the extent to which their food choices impact the environment (e.g., de Boer et al., 2016). Carbon labels can provide insight into the climate impact of a particular food. Environmental (or eco) labels provide a holistic overview of impacts, such as land use changes, deforestation, water use, pesticide use and greenhouse gas emissions. These environmental impacts are often estimated via Life Cycle Analysis (LCA), whereby impacts associated with all phases of a product's life cycle (production, distribution, consumption, and disposal) are added up (see for example Berners-Lee, 2011; Berners-Lee et al., 2012; Hallström et al., 2015). Food labels are a type of information provision that guide food choices in the food environment, when people make decisions about which product to buy.

Researchers have proposed that food labels affect people's food choices by virtue of being an environmental label (e.g., Vlaeminck et al., 2014). Such labels might "prime" people to choose an environmentally friendly food product via a quick, unconscious decision-making process. Guéguen et al. (2012), for example, found that when menus contained watermark visual cues related to the sea, diners were more likely to choose fish dishes. Other scholars, in contrast, would suggest that a more conscious and deliberate process is involved: carbon labels activate people's environmental values and beliefs, which in turn influence food choices. Empirical studies indicate that the effect of carbon labels on food choices depends on people's levels of environmental concern (e.g., Thøgersen, 2000; Grunert et al., 2014; Shewmake et al., 2015; Thøgersen and Nielsen, 2016).

Food labels seem to have a positive, but modest effect on people's food choices (see **Table 1**). In a randomized field experiment in Swedish retail stores, Elofsson et al. (2016) found that when milk carried a "climate certified" label, daily sales increased by approximately 6% relative to a standard milk label. A study in an Australian convenience store by Vanclay et al. (2011) observed an increase in sales of food products that carried a "green" low carbon label, relative to products with a higher carbon impact. However, this study also found that carbon labels did not necessarily discourage consumers from buying products with a high climate impact, such as milk (see also Vlaeminck et al., 2014 for a similar finding).

Carbon labels have also been used alongside other interventions (Spaargaren et al., 2013; Visschers and Siegrist, 2015; Brunner et al., 2018). For example, Brunner et al. (2018) developed carbon labels (using a green/yellow/red traffic light system to indicate climate impact) for dishes in a university student cafeteria in Gothenburg, Sweden. In addition, information about links between food and climate change was provided via a website and posters in the cafeteria. While there was a significant 11.5% increase in sales of climate-friendly green dishes during the label phase (compared with baseline), there were no changes in sales of yellow-or red-labeled meat dishes (i.e., dishes with a higher climate impact). Because a combination of information provision and food labels was used in these studies, it is difficult to attribute any effect of the use of food labels alone.

The Provision of Information

In contrast to food labels, which guide food choices "in the moment" (i.e., when people are in a supermarket), information provision generally occurs outside the food environment. This can be, for example, mass media information campaigns, or guidelines from the government (e.g., the ever-changing "food pyramid"; see Nestle, 2013). The provision of information or education is based on a "knowledge-deficit" approach and assumes that when people have more information and "better" knowledge, that behavior change will follow. As such, information provision generally assumes a deliberate, conscious decision-making process.

For example, Monroe et al. (2015) developed an interactive web-based intervention to encourage the uptake of environmentally friendly eating behaviors among university students. The intervention consisted of modules on local food, food waste, and environmentally friendly protein and was displayed as text, pictures, video clips and interactive quizzes. A significant increase in self-reported green eating behaviors was observed, relative to a control group. Carfora et al. (2019) found that text messages about health or environmental benefits (combined with a reminder to reduce meat consumption) were associated with a reduction in self-reported red meat consumption immediately following the intervention and a follow-up 1 month later.

Bernstad et al. (2013) found that while written information was not effective in encouraging food waste recycling, when the same information was delivered in a face-to-face format, it did change behavior. In a separate study, Bernstad (2014) found that written information did not result in behavior change, but the subsequent installation of waste sorting equipment was associated with a significant 49% increase in the amount of recycled food waste. Linder et al. (2018) developed information that specifically addressed key barriers to recycling food waste (based on interviews with residents) and found that the provision of targeted information was associated with a significant 26% increase in food waste recycling (relative to baseline).

Visual Prompts

Visual prompts are a brief form of information provision that act as a reminder to engage in a certain behavior (e.g., stickers, posters, signs, flyers). Prompts appear to be most effective when the behavior is easy to do (Abrahamse and Matthies, 2018) and when people are already motivated to perform the behavior (Schultz, 2014). Prompts can act as cues and promote behaviors via a quick decision-making process. Indeed, some researchers refer to prompts as "nudges" (e.g., Shearer et al., 2017).

In a randomized control trial, Shearer et al. (2017) found that placing a sticker on general waste bins reminding people to recycle their food waste ("No food waste please. Remember to use your food recycling caddy") increased the amount of recycled food waste by 20%, relative to a control group (no sticker on bin). Whitehair et al. (2013) examined the effectiveness of a visual prompt to reduce edible food waste in a university dining facility. When a visual prompt was introduced (reminding students to not waste food), the amount of edible food waste was reduced by 15%. When information was then provided on how much food waste was generated in the cafeteria, this did not have an additional effect. This may be because telling students that a lot of food is wasted may have (inadvertently) made a social norm salient (cf. Cialdini, 2003) that everybody wastes food. Sussman et al. (2013) observed that a visual prompt was associated with a significant increase in composting behavior in a repeated measures study. In a between-subjects study, however, they found that a prompt did not influence composting behavior (Sussman and Gifford, 2013).

Social Norms

Social norms refer to the notion that behavior is influenced by what other people do (descriptive social norms) and what people think is expected of them (injunctive norms) (Cialdini, 2003). Social norms influence behavioral choices when they are made salient. There is some evidence to suggest that people differ in the degree to which they are susceptible to social norms (e.g., Stöckli and Hofer, 2020). This implies that people may not necessarily follow social norms because these norms are "cued," but because they are important to people in their deliberate decision making.

Social norms are used as part of information provision or feedback provision and sometimes as part of short prompts. Sparkman and Walton (2017) used social norms as part of information provision to encourage a reduction in meat consumption in a campus cafeteria. The authors examined the effect of descriptive social norms (the % of other people who do a behavior) with so-called "dynamic" social norms (norms about the changes in behavior other people engage in). Patrons who were given information about dynamic norms ("30% of Americans have started to make an effort to limit their meat consumption") were significantly more likely to choose a meatless lunch, compared with a descriptive social norm message and control. Stöckli et al. (2018) found that a standard prompt (encouraging people to ask for a takeaway box for any leftovers) and a prompt with a descriptive norm message (i.e., "many guests ask us to wrap their pizza leftovers") were associated with an increase in patrons asking for takeaway boxes. The normative prompt was no more effective than the standard prompt.

Nomura et al. (2011) conducted a randomized control trial to examine the effect of social norm feedback on participation in a food waste reduction scheme. They found that households in the social norm group significantly increased participation rates, relative to a control group. Households who had received feedback accompanied by a smiley face (the street performed better than average) and those who had received a sad face (the street performed worse than average) had higher participation rates relative to control streets.

PSYCHOLOGICAL MECHANISMS: EXPLORING MEDIATORS AND MODERATORS

It is important to consider the psychological mechanisms through which interventions result in behavior change. Relatively few studies in this review included potential moderators or mediators and what follows illustrates what some of these mechanisms might be.

Past Behavior

Past behavior refers to the extent to which people engage in the target behavior prior to the intervention. In some cases, frequency of past behavior is used as an indicator of habit. Garnett et al. (2019) found that past behavior was a significant moderator of the effect of nudging on food choices. The effect of the nudge (increased availability of vegetarian meal choices) was stronger for those who would not normally eat vegetarian options. Scenario studies point to a similar effect. For example, Bacon and Krpan (2018) found that labeling a vegetarian option as "Chef's Recommendation" (nudge) did not affect vegetarian meal choices, but the effect of nudging was moderated by past behavior. Infrequent vegetarians were more likely to choose the vegetarian option when this was presented as the recommended option, compared with frequent vegetarians.

Universalism Values

Studies have found that human values (i.e., guiding principles in people's lives; Schwartz, 1994) are associated with sustainable food choices. Universalism values, for example, are (positively) associated with organic food choices (Vermeir and Verbeke, 2008) and vegetarianism (Hayley et al., 2015; Graham and Abrahamse, 2017). Universalism values are part of the self-transcendence dimension and reflect the value people place on care for nature.

Some studies have found that universalism values are predictive of food choices independently of the effect of an intervention (e.g., Campbell-Arvai et al., 2014; Zhou et al., 2019) Zhou et al. (2019) found that participants with stronger universalism values were more likely to choose plant-based options, irrespective of a nudge intervention. This suggests, perhaps, that for people with strong universalism values, the choice of plant-based meals is the result of deliberate decision-making and not easily changed by an intervention that relies more on automatic decision making.

It might be that values moderate the effect of an intervention on sustainable food choices, but the evidence for this is limited. Interventions to encourage sustainable food choices may well be more effective when people have stronger universalism values. For example, Graham and Abrahamse (2017) found that an informational message about the climate impacts of meat consumption was associated with stronger intentions to reduce meat consumption, particularly for people with strong self-transcendence values. However, none of the intervention studies included in this review reported possible moderating effects of universalism (or other) values.

Attitudes and Beliefs

The literature points to a close connection between people's attitudes and beliefs and their food choices. Carfora et al. (2019) found that attitudes toward red meat mediated the effect of their text message intervention on red meat consumption. These text messages were associated with a more positive attitude toward reducing the consumption of red meat. This strengthened attitude, in turn, was associated with a reduction in red meat consumption. Lab studies have also found evidence for a mediating role of attitudes and beliefs. For example, Vainio et al. (2018) found that people's prior beliefs about meat influenced the effectiveness of an informational message. Reading an informational message was only associated with stronger behavioral intentions among those who already held strong negative beliefs about meat ("meat-skeptics") and not among so-called "meat believers."

DISCUSSION

The findings of this review indicate that interventions can be used effectively to encourage environmentally sustainable food choices. The review draws on a substantive body of research on this topic. This ranges from carefully crafted interventions that focus on people's motivations and deliberate decision-making processes to interventions that involve simple changes in the choice architecture that facilitate certain behaviors in more "cued" and unconscious ways.

Nudging interventions have some potential to encourage sustainable food choices. Increasing the availability of vegetarian dishes was shown to be effective (Garnett et al., 2019) and so was a reduction in portion sizes of meat (Vandenbroele et al., 2018). However, a "dish of the day" approach seemed ineffective (Zhou et al., 2019). Overall, food labels are effective in encouraging sustainable food choices on their own (e.g., Vanclay et al., 2011) and as part of wider information campaigns about links between food and climate change (e.g., Spaargaren et al., 2013; Visschers and Siegrist, 2015). But it would appear that carbon labels do not necessarily discourage the uptake of products with a high climate impact, such as milk or meat (e.g., Vanclay et al., 2011; Vlaeminck et al., 2014; Brunner et al., 2018).

The provision of information alone is generally not considered to be an effective strategy for behavior change more generally (Abrahamse et al., 2005; Schultz, 2014). The findings in the area of sustainable food corroborate this (e.g., Bernstad, 2014). However, when information is crafted to address specific behavioral barriers (Linder et al., 2018), when it is combined with a motivational goal (Monroe et al., 2015; Carfora et al., 2019) or when it emphasizes social norms (Sparkman and Walton, 2017), information provision can have a positive impact.

The evidence-base for the effectiveness of interventions to encourage environmentally sustainable food choices is growing. However, more research is needed on possible mediators and moderators that can explain why a behavior change intervention was successful (or not). Including moderators or mediators, such as past behavior, cultural values, and prior beliefs and attitudes can provide valuable insights into the mechanisms by which interventions change behavior.

Only one intervention study (Zhou et al., 2019) examined cross-country differences in the effectiveness of a behavior change intervention (a "dish-of-the-day" nudge). While the nudge intervention was not effective in any of the four countries, the authors did observe that participants from the United Kingdom more often tried plant-based dishes compared with French participants. This could for example be due to a higher prevalence of vegetarianism in the United Kingdom relative to France. More research is needed to explore the role of social and cultural processes and how they are linked to food choices (for a review on this topic, see Carrus et al., 2018). More comparative research would also be useful to better understand the effectiveness of different interventions in different food environments (e.g., at home vs. a restaurant vs. a supermarket).

Lastly, relatively little is known about the long-term effects of interventions, as a majority of studies measured immediate, short term effects only. More research could be conducted on the durability of behavior change. Increasing the availability of vegetarian options may be effective in the short term (e.g., at the point of sale), but it is not clear whether this "nudge" will have the potential to affect behavior in other settings, or to instill durable changes (see also Ewert, 2020). This is an important area for future research, because moving toward the adoption of lower carbon diets will require sustained changes in behavior.

AUTHOR CONTRIBUTIONS

WA conducted the literature search, conducted the literature review, and wrote the manuscript.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2020.589674/full#supplementary-material

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Two Sides of the Same Coin: Environmental and Health Concern Pathways Toward Meat Consumption

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The dramatic increase of meat production in the last decades has proven to be one of the most impacting causes of negative environmental outcomes (e.g., increase of greenhouse emissions, pollution of land and water, and biodiversity loss). In two studies, we aimed to verify the role of key socio-psychological dimensions on meat intake. Study 1 (N = 198) tested the predictive power of an extended version of the Value-Belief-Norm (VBN) model on individual food choices in an online supermarket simulation. In an online survey, participants were directed to a virtual shop and asked to buy food within a set amount of money. Subsequently, they completed measures of behavioral intention, the VBN constructs (values, general pro-environmental beliefs, awareness of consequences, ascription of responsibility, and personal norm), and social norms (injunctive and descriptive). The outcome variable was operationalized in terms of percentage of expenses dedicated to meat and processed meat items, which provided a more robust behavioral measure than the common self-reported ones. Results confirmed the VBN sequential path, showing direct effects of biospheric values and descriptive norm on personal norm. Furthermore, a proof of validity for the new behavioral measure was provided (medium-sized correlation with behavioral intention). Study 2 (N = 218) aimed at verifying whether the meat consumption could be also motivated by a health concern, reflecting individual (cost/benefit) considerations, besides pro-environmental drivers. Results showed the direct impact of health concern and confirmed the indirect role of biospheric values and descriptive norm (*via* personal norm) on meat intake. This evidence would suggest the use of multiple-frame messages, highlighting both pro-environmental and health consequences, for meat consumption reduction. Nevertheless, the different implications of moral (e.g., environmental concern) vs. non-moral motivators (e.g., health concern) for reducing meat intake need to be stressed: indeed, the first drivers are more central for self-identity and for engaging in environmental citizenship behaviors.

Keywords: value belief norm theory, health concern, biospheric values, personal norm, social norms, simulated meat purchase

INTRODUCTION

The investigation of socio-psychological factors influencing people's willingness to reduce meat consumption has become a critical research line in climate change studies. Indeed, reducing meat intake is a key mitigation response to environmental issues (Poore and Nemecek, 2018; Arneth et al., 2019), being recognized among the highest impact actions to reduce green gas emissions (Wynes and Nicholas, 2017; Dubois et al., 2019). Benefits from a low-meat diet have been also demonstrated for the reduction of human health risks, related to type II diabetes, cancer, coronary heart disease, and mortality (Abete et al., 2014; Clark et al., 2019). Therefore, meat consumption has consequences for both sustainability and health-related outcomes (González et al., 2020).

About 97% of European adults are currently identified as meat consumers (Cocking et al., 2020). Looking at the future scenario, people in European countries are predicted to reduce the intake of pork and beef, while increasing the consumption of poultry and sheep meat; this will only lead to a slight drop of meat consumption by 2030 (from 69.3 to 68.7 kg per capita; EC, 2018). In order to further reduce the per capita consumption of meat in European countries, socio-psychological factors that could potentially drive and inform campaigns aimed at raising people's awareness toward the impact of this behavior need to be investigated. In this regard, simply providing information about consequences of a certain behavior does not always translate into a change in behavior, but it is rather a precondition of it (e.g., Schultz, 2002; Kahan et al., 2012; Geiger et al., 2019). For example, Heeren et al. (2016) showed that the knowledge of the impact of pro-environmental behaviors has no effect on behavior when controlling for factors such as attitudes, norms, and perceived behavioral control. Furthermore, established habits may hinder the intention to consume less meat (Klöckner and Blöbaum, 2010; Cheah et al., 2020). Behaviors are embedded within a social context, which gives people direction through different levels and degrees of internalized values (e.g., Schwartz and Howard, 1984), norms (Thøgersen, 2006), and motivations (e.g., Ryan and Deci, 2000). Such dimensions should be thus considered when delivering information aimed at increasing people's knowledge of the consequences of a meat-based diet, with the final purpose of triggering a change in meat consumption.

We aimed to contribute to the literature on meat consumption reduction by investigating relevant socio-psychological aspects that are associated with pro-environmental behaviors. In order to do that, we tested an extended version of the Value-Belief-Norm (VBN) theory (Stern, 2000) that includes social norms in explaining meat purchasing behavior (Study 1), and then we evaluated the additional effect of an egoistic-utilitarian pattern represented by health concern on the same outcome variable (Study 2). In addition, an important purpose was to provide the first validation of a simulated behavior measure of meat consumption by asking the participants to purchase food on an online shopping platform. Such a purpose was motivated by the intention to overcome the well-known limitations of usual self-report questionnaire measures (Webb and Sheeran, 2006; Lange and Dewitte, 2019). In the next section, the theoretical framework will be briefly explained.

Theoretical Background

Environmental and Health Concerns in Meat Consumption

According to literature, people are motivated to reduce their meat consumption for different reasons, e.g., animal welfare, environmental, and health concerns (see, for example, Sanchez-Sabate and Sabaté, 2019; for a systematic review on the field). These motivations are not mutually exclusive, however, it is possible to identify a trend, where animal-rights and ecological concerns are more likely to be found in those who completely exclude meat from their diet, whereas less morally relevant reasons, such as health concern, seem to mostly motivate those who deliberately choose to only reduce meat consumption (De Backer and Hudders, 2014, 2015; Rosenfeld et al., 2020). Among all the dietary inclinations, environmental concern is one of the less frequent reasons for reducing meat consumption. In other words, those genuinely motivated by ecological concern are still a small minority (Sanchez-Sabate and Sabaté, 2019). This could probably be due to the laypeople's overall underestimation of the influence of meat production on the environment (de Boer et al., 2013; Macdiarmid et al., 2016; Lentz et al., 2018). In fact, when people believe that reducing meat consumption is beneficial for the environment, they are more likely to intend to quit eating meat (Truelove and Parks, 2012). This is in line with a more recent study in which environmental concern predicted the willingness to reduce meat consumption through the belief that reducing meat intake is an effective mitigation strategy for climate change (Ginn and Lickel, 2020).

Meat intake is also generally associated with both positive and negative health beliefs: in fact, some individuals may consider meat as an important source of energy and essential nutrients, such as high-value proteins (Godfray et al., 2018). At the same time, it is associated with the risk of developing chronic diseases (e.g., type II diabetes, cancer, coronary heart disease, and mortality; Abete et al., 2014; Clark et al., 2019), and it can also generate emotions of disgust when associated with animal diseases, such as bovine spongiform encephalopathy (BSE), commonly known as mad cow disease (Palomo-Vélez et al., 2018).

Research has shown that meat reducers, those who deliberately choose to limit the amount of meat consumed, are mostly motivated by health concerns and personal reasons (Mullee et al., 2017; Malek et al., 2019). Among pro-environmental behaviors, meat consumption reduction was, in fact, indicated as the least related to pro-environmental values, being driven especially by health concern (Jagers et al., 2017). The positive role of the health path in influencing meat consumption reduction is also supported by other studies that have tested the effect of message frames (Bertolotti et al., 2016, 2020) and the effect of a text message intervention (Carfora et al., 2019). On the other hand, as previously discussed, health concern has also been reported as one of the key reasons for eating meat regularly (Piazza et al., 2015; Neff et al., 2018; Stea and Pickering, 2019).

These results showed a possible co-occurring valence associated with the healthiness of meat products.

Persuasive messages focusing on either environmental or health consequences of red (and processed) meat were found to promote positive attitudes toward its reduction and, in turn, to impact on the target behavior (Carfora et al., 2019). Similarly, Vainio et al. (2018) found that communicating health and sustainability benefits of eating less meat was positively associated with the intention to reduce meat consumption, but only among those with pre-existing strong negative beliefs regarding meat consumption (Vainio et al., 2018). However, Cheah et al. (2020) found different patterns of association. Perceived health benefits of reducing meat consumption were an important driver of the intention to reduce meat consumption, while environmental concern did not show the same significance.

Beliefs and Values in Meat Consumption

As mentioned earlier, previous studies show that environmental reasons are rarely mentioned as a motivation to reduce meat or to exclude meat from one's diet. This may be due to the fact that the lack of information about environmental consequences of meat consumption undermines the development of individuals' beliefs about the impacts of meat reduction on the environment (see, for example, Hartmann and Siegrist, 2017, for a systematic review on the topic). Beliefs about the positive effect of reducing meat consumption are based on the information that people hold and, more importantly, on their willingness, motivation, and ability to look for and process that information from different sources (e.g., scientific and commercial information sources; Vainio, 2019). The extent to which information about the environmental consequences of a behavior are sought and shaped into beliefs is influenced by the degree of environmental concern and is led by people's values. As claimed by Stern et al., (1995, p. 726), "values and worldview act as filters for new information and ideas. Information congruent with an individual's values and worldview will be more likely to influence beliefs and attitude." Values have been conceptualized as "the criteria that people use to select and justify actions and to evaluate people (including the self) and events" (Schwartz, 1992, p. 1). Therefore, values act as guiding principles both in searching and evaluating the information on which one's own beliefs are based.

Values can be depicted in two bipolar dimensions, i.e., self-enhancement (focus on the self) vs. self-transcendence (focus on the others) and openness to change vs. conservation (Schwartz, 1992). Making reference to the first dichotomy, Stern et al. (Stern et al., 1993; Stern and Dietz, 1994) developed a classification of values related to environmental issues and distinguished between egoistic (i.e., self-enhancement), altruistic (i.e., self-transcendence), and biospheric values (i.e., those values related to concern for nature and the environment). Generally, altruistic and biospheric values have emerged as positively associated with pro-environmental behaviors, whereas egoistic values have shown a negative relationship with such behaviors (Stern and Dietz, 1994; Stern et al. 1998; Corraliza and Berenguer, 2000). This pattern emerged also for meat consumption, since a self-enhancement value orientation was found related to a higher meat consumption compared to the self-transcendent one, whereas the latter predicts a lower meat intake (Graham and Abrahamse, 2017). To explain the nature of these relationships, Verma et al. (2019) argued that often the personal costs related to the pro-environmental actions overshadow the personal aids; therefore, actions motivated by egoistic values do not lead to behaving pro-environmentally. However, they also postulate that when the perceived benefits to self (e.g., good health and better quality of life) outweigh the personal costs, individuals then chose to behave in an eco-friendly way (Verma et al., 2019). Prakash et al. (2019) found, indeed, that both altruistic and egoistic values may lead to a positive impact on consumers' attitude toward eco-friendly packaged goods. This is in line with Kareklas et al. (2014) findings, which show the positive effect of egoistic considerations on organic food purchase and by the work of Herziger et al. (2020) on the positive effect of egoistic appeals on consumption curtailment. Therefore, also utilitaristic reasons based on selfish motivations can trigger pro-environmental behaviors.

However, biospheric and altruistic values are shown to provide a more stable ground for pro-environmental behaviors than egoistic values (Schultz, 2001; De Groot and Steg, 2009). Behaviors operated under the influence of self-transcendent values (altruistic and biospheric) are morally relevant, therefore, even though there is not an apparent direct individual benefit in the short-term, such behaviors actually offer people a moral satisfaction in terms of a positive emotional reward named as "warm glow." Warm glow is explained as "the feeling of well-being related to the contribution to a good cause" (Hartmann et al., 2017, p. 44). Self-transcendent values are also associated with self-determined motivations to act pro-environmentally (De Groot and Steg, 2010). When a behavior is self-determined, it involves a sense of voluntariness and reflects one's interests or values ("I enjoy contributing to the environment"; Pelletier et al., 1998). More internalized/intrinsic motivations have the advantage to promote long-term pro-environmental behaviors (Osbaldiston and Sheldon, 2003). Therefore, important implications of the different drivers (i.e., biospheric vs. egoistic values) should be accounted for.

Value-Belief-Norm Theory and Social Norms

The influence of value systems on pro-environmental behaviors has been addressed by the VBN theory, which was formulated by Stern et al. (1999) for explaining public support for environmental movements. This theory is an extension of the Norm Activation Model (NAM: Schwartz, 1977) of altruism, proposing that people engage in helping behaviors if they are, first, aware of a situation of threat or danger; in other words, they should be aware of consequences of not coping with the problem. Secondly, people should ascribe the responsibility of these helping actions to themselves. If both the aforementioned psychological conditions are met, then feelings of moral obligation (i.e., the moral or personal norm) to help are activated and, in turn, they stimulate the requested helping behavior.

The extension operated by Stern et al. (1999) refers not only to other people in need of help, as it is postulated by NAM, but also other valued objects (e.g., the self, other species,

and the biosphere) can be targeted, such as the self, other species, and the biosphere. Thus, people who especially value other species would be concerned about threatening environmental conditions. Hence, the activation of problem awareness depends on the possession of values and pro-environmental worldviews. In sum, the VBN theory proposes that pro-environmental action stems from a causal chain including values, general pro-environmental worldviews, awareness of consequences, ascription of responsibility, personal norm and, finally, the outcome behavior. This model has received empirical evidence for various kinds of pro-environmental behaviors, such as energy-related choices (Steg et al., 2005; Abrahamse and Steg, 2011; Fornara et al., 2016), urban travel choices (Lind et al., 2015; Ünal et al., 2019), climate change-related behaviors in farmers (Zhang et al., 2020), preservation of nature and biodiversity (Fornara et al., 2020), antinuclear behavioral intention (Prati and Zani, 2013), and residents' behavior in touristic sites (Zhang et al., 2014). Nevertheless, there is a substantial lack of studies testing the VBN for food choices, and specifically for meat consumption, except for a study focusing on a very tailored behavior, that is, consumers' willingness to buy meat in mobile slaughter units (Hoeksma et al., 2017). A key dimension in the VBN theory is personal norm, which represents the direct driver of behavior. Personal norm is related to the individual's belief about what is right to do for a positive self-evaluation (Fransson and Biel, 1997) and relies on interiorized values (Thøgersen, 2006). According to Bamberg et al. (Bamberg et al., 2007; Bamberg and Möser, 2007), personal norm is developed on the basis of social norms, since the latter delivers the standards of behavior that a social reference group applies and views as appropriate in a specific context, that is, what the group considers right or wrong. This was previously found in the context of meat consumption, showing that people form the intention to do something about their beef consumption if they feel a moral obligation to act, which in turn is developed by the expectations from others (Klöckner, 2017).

Social norms include injunctive norms, which concern the perception of what most people approve or disapprove about a person's behavior (i.e., perception of what other people think one should do) in a given context or situation, and descriptive norms, which refer to the perception related to what the majority of people actually do in that context or situation (Cialdini et al., 1991; Schultz et al., 2008). Both kinds of social norms have proven to influence a variety of pro-environmental behaviors, such as energy saving (Schultz et al., 2007; Ferguson et al., 2011), recycling (Carrus et al., 2009; Fornara et al., 2011), littering (Kallgren et al., 2000), water conservation (Lede et al., 2019), hotel guests' reuse of towels (Schultz et al., 2008), and adoption of photovoltaic systems (Jager, 2006). Recently, Cheah et al. (2020) found injunctive norms to be positively related to consumers' attitude and intention to reduce meat consumption.

The Measurement Issue

One important issue that we address in this paper concerns how to measure actual meat consumption. Most studies on this specific pro-environmental behavior have relied on measures of self-reported behavior (i.e., concerning the past) or behavioral intention (i.e., concerning the future), often represented by a single item. Examples are "How many days per week do you eat meat with your main meal (including chicken)?" (de Boer et al., 2013), "How many days per week do you eat meat (excluding fish)?" (Graham and Abrahamse, 2017), and "How many servings of red meat and processed meat have you eaten in the previous week?" (Carfora et al., 2019). In their systematic review of experimental studies on meat consumption, Harguess et al. (2020) found that only less than 1% of studies measured meat consumption reduction through observable meat avoidance, whereas all the others relied on self-report measures of behaviors or, mostly (i.e., about 67%), intentions/willingness/desire.

In a recent study, van der Werf et al. (2020) have underlined the vulnerability of self-reported data by showing that the self-reported behavior was weakly to fairly correlated to actual food waste behavior. Whybrow et al. (2016) argue that people are inconsistent self-reporters of food intake, which may mislead to wrong conclusions. The limitations of this kind of self-report measures have been commonly acknowledged. A recent review by Lange and Dewitte (2019) pointed out that (i) it is unlikely that all respondents have the same idea of concepts such as "paper," "recycling," and "often" (see also Kormos and Gifford, 2014); (ii) typically an item does not ask for a simple behavioral report, but rather for an extensive retrospective survey, which could be affected by memory biases or computing difficulties; (iii) respondents search for consistency across their responses in the questionnaire; and (iv) respondents are prone to compliance with the expectations or preferences of the researcher/interviewer as well as to social desirability pressure.

Therefore, the present paper aimed at both evaluating the effectiveness of a simulated behavior measurement and, as mentioned earlier, at contributing to the literature on the socio-psychological variables involved in meat consumption. Specifically, Study 1 investigated whether the VBN theory – plus social norms – could explain meat consumption. Study 2 investigated whether the choice of purchasing meat could be explained also by a selfish driver such as individuals' health concern.

STUDY 1

Objective and Hypotheses

The goal of Study 1 was 2-fold.

First of all, we wished to test the predictive power of an extended version of the VBN theory (Stern et al., 1999), including social norms, predicting meat purchase (see **Figure 1**). Specifically, the aim was to verify the importance of the VBN constructs in determining sustainable food choices, taking into consideration the effect of social norms, which have shown to be significant antecedents of personal norm (Bamberg et al., 2007; Bamberg and Möser, 2007; Fornara et al., 2016).

Secondly, we aimed to provide the first validation of a behavioral measure based on a simulation of purchase behavior, which is supposed to resemble actual behavior better than self-report behavioral intention as will be reported later on.

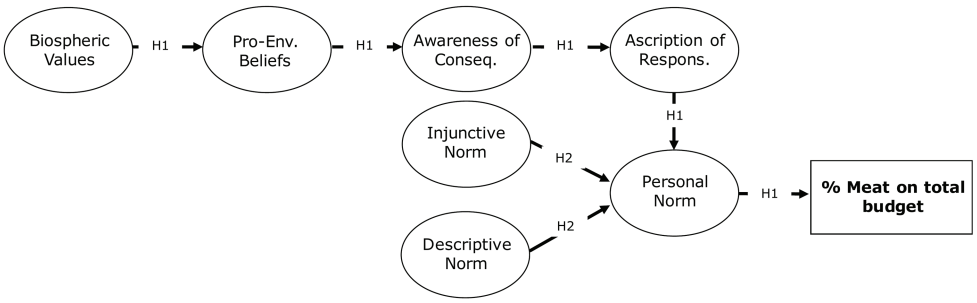

FIGURE 1 | Conceptual model and hypothesized paths of Study 1.

The following research hypotheses were then developed.

Hypothesis 1: In line with the VBN theory, meat consumption is expected to be predicted by a sequential chain, which includes, from the most distant to the most proximal, biospheric values, pro-environmental beliefs, awareness of consequences, ascription of responsibility to oneself and, finally, personal norm, which is the closest proxy to the simulated behavior.

Hypothesis 2: Personal norm is expected to be predicted by both injunctive and descriptive norms, in line with previous findings (Bamberg et al., 2007; Bamberg and Möser, 2007; Fornara et al., 2016).

Hypothesis 3: Meat consumption, i.e. the behavioral simulation measure of food purchase, is expected to show a medium-size correlation[1] with self-report behavioral intention, thus providing a convergent validity proof.

Materials and Methods

Sample and Procedure

The sample included 198 Italian participants (57.6% females and 41.4% males)[2], aged between 15 and 74 years (M = 31.61 and SD = 9.68). In terms of education, the majority of the participants are high school graduates (43.4%), followed by those with a BA degree (27.8%) and a MA degree (15.7%). In lower percentage, we find those who have a doctoral degree or equivalent level of qualification (4%), middle school (8.6%), and primary school (0.5%).

Participants who agreed to take part in the study delivered their informed consent and were then invited to the online questionnaire platform, where they read that they would be participating in a study about eating behavior lasting about 15 min. The survey consisted of two parts: in the first part, the participants were redirected to an online supermarket web page (see **Figure 2**), where they were asked to purchase some food products, as if they would do in reality for their own personal need (not including family members or other members of the household), within a budget set by the experimenters. After the food purchase, their behavioral intention was assessed and in the second part, before filling in the questionnaire, the participants were asked to complete an irrelevant filler task in order to prevent covert rehearsal. Subsequently, the participants were surveyed on the measures of the socio-psychological dimensions of the VBN constructs (values, general pro-environmental beliefs, awareness of consequences, ascription of responsibility, and personal norm), as well as the social norms (injunctive and descriptive), which are detailed in the next section. Therefore, in order to avoid the confounding possibility of the question order effects, such as instances of strategic self-presentation in terms of consistency between attitudes, beliefs, and the subsequent behavior, we decided to assess the simulated behavior (and the behavioral intention) at the first stance.[3] Finally, the questionnaire included some socio-demographic indicators. Data were collected during December 2017.

Measures

The questionnaire included the following measures.

Percentage of Meat Products on Total Expenditure

This variable was created by computing the percentage of money (euros) spent for purchasing meat products out of the total amount of expenditure. The choice to measure individuals' simulated purchase behavior is supported by the fact that it may be considered a direct proxy of food consumption behavior. Therefore, the participants were asked to virtually shop in a

[1]The hypothesized size of the correlation should not be too large in line with the literature on the overall relationship between intention and behavior (i.e., a medium/large change in intention is supposed to lead to a small/medium change in behaviors, see Webb and Sheeran, 2006).

[2]1% NA.

[3]Our rationale was to prevent participants from being biased in their choices. The process of being influenced by earlier questions is known as "question order – context effect," which biases the thinking of the respondents and can produce measurement errors (Cassino and Erisen, 2010; Van de Walle and Van Ryzin, 2011). In everyday life, before entering a supermarket or ordering food online, people are not asked to reflect on their own values and to think about environmental and health consequences of their purchases, nor reflect on what significant others do. The adoption of this procedure allowed us to simulate a real-world setting as much as possible, albeit within the limits of a simulated setting. The same procedure was recently being adopted by Gu et al. (2020), which first measured their DV (pro-environmental behavior frequencies) before completing items, which were expected to prime participants' responses. There is also experimental evidence suggesting that the priming people with a food product (e.g., *via* a social norms' intervention) leads people to increase the purchase of that product (Richter et al., 2018).

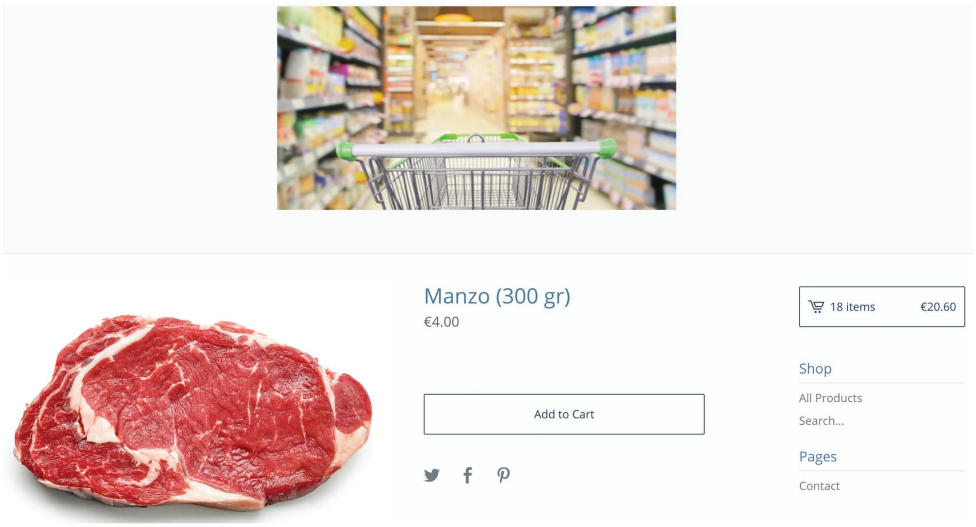

FIGURE 2 | Screenshot of the virtual supermarket. For example, one-item of beef ("Manzo") corresponded to 300 g. Participants could add to cart the products they wished to buy as many times they wanted within the money range they were given.

supermarket, which included a wide variety of products, from dairy to fruit, vegetables, and cereal based food. The supermarket offered meat-based products as well as other protein-rich alternatives to meat, such as tofu, wheat protein, and vegan cold cut options covering a broad variety of needs. The participants' virtual experience involved inserting the chosen items in the shopping cart from a minimum amount of 20 euros to a maximum amount of 25 euros. Some examples of the products are the following: "Broccoli (500gr) – €1.10," "Rice (500gr) – €0.80," "Sausages (300gr) – €2.20," "Spaghetti (500gr) – €0.80," and "Turkey (300gr) – €2.00." Each product was given a weight and a price based on the average price and package weight of four different supermarkets widely known in the Italian market (Nonna Isa, Despar, Conad, and Crai). All foods were presented on a white background and unpackaged.

Behavioral Intention

Individuals' behavioral intention was measured by a single item: "Think about what you will eat in the next week. How many times do you think you will eat meat or cold cuts?" Participants were asked to answer on a 5-point Likert scale from 0 = *never* to 4 = *twice a day*.

Biospheric Values

This variable was measured by using two items (α = 0.72) from a shorter version of the 12-item scale of values developed by De Groot and Steg (2008) based on the tripartition proposed by Stern et al. (1998). The items were "Unity with nature: fitting into nature" and "Protecting the environment: preserving nature." Participants indicated the importance level of each value item as a guiding principle in their lives on a 7-point Likert-type scale from 0 = *the least important* to 6 = *the most important*.

General Pro-environmental Beliefs

It was measured through an adaptation of the NHIP (New Human Interdependence Paradigm) scale developed by Corral-Verdugo et al. (2008) and included five items (α = 0.93; e.g., "Human beings can enjoy nature only if they make wise use of its resources"). The response scale was a 7-point Likert-type from 0 = *absolutely disagree* to 6 = *totally agree*.

Ascription of Responsibility

It was measured through a single item: "The choice of reducing my consumption of meat or cured meats does not depend on me." Participants were asked to indicate their degree of agreement or disagreement through a 7-point Likert-type scale from 0 = *absolutely disagree* to 6 = *totally agree*.

Awareness of Consequences of Meat Consumption

Individual's awareness was measured by a three-item scale (α = 0.82) adapted from Abrahamse and Steg (2009); e.g., "Eating meat or cured meats every day (or almost) is a risk for the environment." The response scale was a 7-point Likert-type from 0 = *absolutely disagree* to 6 = *totally agree*.

Personal Norm

Individuals' moral obligation to reduce meat consumption was measured through a three-item scale (α = 0.86) adapted from Abrahamse and Steg (2009); e.g., "I feel guilty if I eat meat every day (or almost)." The response scale was a 7-point Likert-type from 0 = *absolutely disagree* to 6 = *totally agree*.

Social Norms (Injunctive Norm and Descriptive Norm)

They were measured through three-item scales (injunctive norm α = 0.88 and descriptive norm α = 0.87) adapted from Fornara et al. (2011). An example of *injunctive norm* items is "Most

TABLE 1 | Descriptive statistics and correlation coefficients of Study 1.

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. Biospheric values	5.07	1.06	1						
2. General pro-env` beliefs	4.85	1.33	0.355***	1					
3. Awareness of consequences	3.61	1.33	0.188**	0.343***	1				
4. Personal norm	2.29	1.87	0.244**	0.258***	0.616***	1			
5. Descriptive norm	1.68	1.44	0.078	0.143*	0.398***	0.469***	1		
6. Injunctive norm	2.13	1.56	0.076	0.159*	0.336***	0.438***	0.497***	1	
7. Behavioral intention	1.77	0.83	−0.275***	−0.212**	−0.272***	−0.346***	−0.268***	−0.189**	1
8. % of money spent for meat	24.27	15.09	−0.231**	−0.119	−0.215**	−0.357***	−0.189**	−0.039	0.407***

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

of my friends would approve my choice to decrease my meat consumption," while an example of *descriptive norm* items is "Many of my friends are decreasing their consumption of meat." The response scale was a 7-point Likert-type from 0 = *absolutely disagree* to 6 = *totally agree*.

Data Analysis

There was no missing data, since the questionnaire would not proceed to the next question until an answer was provided.

Preliminary analyses (i.e., descriptive statistics and reliability tests and Pearson's *r* bivariate correlations) were carried out for all variables and scales. A confirmatory factor analysis with the six considered factors was then performed in order to test the measurement model. Mardia's tests of skewness and kurtosis (Mardia, 1970) were performed to assess multivariate normality. Maximum likelihood estimator with robust standard errors was employed (Yuan and Bentler, 2000). Finally, structural equation modeling (SEM) was run in R version 3.6.1 by using the Lavaan package (Rosseel, 2012) for testing the hypotheses (maximum-likelihood robust estimation method; Bollen, 1989). Stepwise model revisions were undertaken to improve goodness of fit. To assess the overall fit of the model, the chi-square/df ratio (<2.0), the Bentler (1990) Comparative Fit Index (CFI; > 0.90), the Root Mean Square Error of Approximation (RMSEA; < 0.05; Steiger, 1990), and the Standardized Root Mean Square Residual (SRMR; Bentler, 1995) were considered (Hooper et al., 2008).

Results

Table 1 reports means, standard deviations, and Pearson's *r* bivariate correlations between the variables[4] inserted in the SEM analysis. A medium-size correlation emerged between simulated behavior (% of money spent for meat products) and behavioral intention ($r = 0.41$; $p < 0.001$) as expected (H3).

The Mardia's tests of skewness and kurtosis (Mardia, 1970) indicated the deviation from multivariate normality ($_{1,p} = 84.99$, $p < 0.001$; $_{2,p} = 477.062$, $p < 0.001$). Therefore, a maximum likelihood estimator with robust standard errors was employed (Yuan and Bentler, 2000). The confirmatory factor analysis showed evidence of good fit ($\chi^2_{137} = 201.155$, $p < 0.001$; χ^2/df = 1.533; CFI = 0.971; RMSEA = 0.050; SRMR = 0.052) with standardized factor loadings further confirming the distinctive variables (see **Table 2**).

[4]Aggregates were computed for multi-item variables.

TABLE 2 | Parameter estimates from the six-factor CFA of Study 1.

Latent factor	Indicator	*B*	*SE*	*Z*	*β*	Sig.
Biospheric values	bio1	1.000	0.000		0.763	
	bio2	1.403	0.239	5.876	0.774	***
General pro-env` beliefs	nhip1	1.000	0.000		0.898	
	nhip2	0.889	0.047	19.056	0.825	***
	nhip3	0.921	0.047	19.702	0.893	***
	nhip4	0.914	0.060	15.353	0.846	***
	nhip5	0.789	0.072	10.890	0.842	***
Awareness of consequences	ac1	1.000	0.000		0.862	
	ac2	0.859	0.087	9.913	0.694	***
	ac3	0.978	0.105	9.328	0.769	***
Personal norm	pn1	1.000	0.000		0.796	
	pn2	1.003	0.076	13.267	0.849	***
	pn3	0.969	0.070	13.814	0.818	***
Descriptive norm	des1	1.000	0.000		0.755	
	des2	1.075	0.115	9.338	0.865	***
	des3	1.104	0.127	8.678	0.870	***
Injunctive norm	inj1	1.000	0.000		0.808	
	inj2	0.941	0.075	12.576	0.889	***
	inj3	0.991	0.066	15.082	0.872	***

The factor loading of the first indicator of each latent variable is fixed to 1.
SE = standard error; B = non-standardized estimate; β = standardized estimate;
*Sig. = values of p corresponding to the z-statistic. *p < 0.05; **p < 0.01; ***p < 0.001.*

The structural model showed a good fit to the data: χ^2_{161} 236.682, $p < 0.001$; χ^2/df = 1.548; CFI = 0.960; RMSEA = 0.050; and SRMR = 0.075. Standardized coefficients of the path model are shown in **Figure 3**.

Concerning H1 and H2, the outcome variable percentage of purchased meat was negatively predicted by personal norm ($\beta = -0.38$; $p < 0.001$), in turn, personal norm was positively predicted by awareness of consequences ($\beta = 0.57$; $p < 0.001$), biospheric values ($\beta = 0.17$; $p < 0.05$), and by descriptive norm ($\beta = 0.30$; $p < 0.001$), followed by awareness of consequences, which was positively predicted by pro-environmental beliefs ($\beta = 0.31$; $p = 0.001$) and by injunctive norm ($\beta = 0.35$; $p < 0.001$), successively, pro-environmental beliefs was positively predicted by biospheric values ($\beta = 0.42$; $p < 0.001$). The expected direct paths within the VBN were confirmed apart from the relationship between ascription of responsibility and, respectively, personal norm and awareness of consequences. Therefore, ascription of responsibility was excluded from the model; nevertheless, as mentioned above, awareness of consequences predicted significantly personal norm.

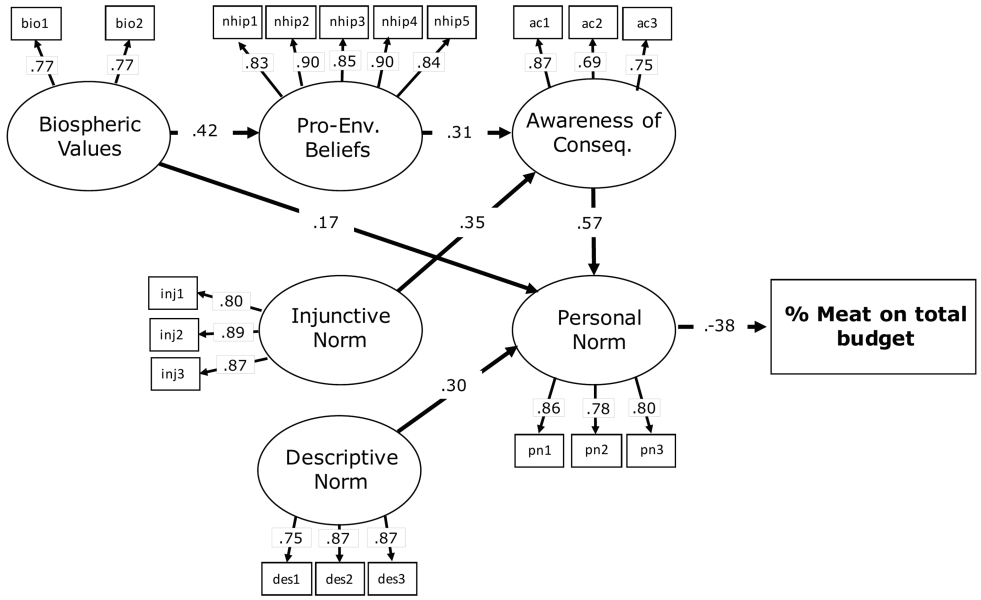

FIGURE 3 | Standardized direct effects and item loadings in the structural model of Study 1. To simplify presentation, the variances – curved double arrows – of the exogenous latent variables and the standardized error variances are not reported.

Discussion

Study 1 provided the first proof of convergent validity regarding the proposed new measure, since the simulated behavior showed a significant medium-size correlation with behavioral intention, thus confirming H3.

Overall, our results support the extended model of the VBN (Stern et al., 1999) including social norms. Specifically, the expected VBN sequence of unidirectional paths among the variables taken into consideration, i.e., respectively, values, general pro-environmental beliefs, awareness of consequences, personal norm, and (simulated) behavior emerged.

Consistently with the VBN theory and previous findings, biospheric values were positively correlated to both pro-environmental beliefs and personal norm (Stern et al., 1999; Hunecke et al., 2001; Nordlund and Garvill, 2002; Steg et al., 2005; Fornara et al., 2016). In other words, the stronger an individual's pro-environmental values are the more they will feel an obligation for protecting the environment and, therefore, for reducing their consumption of meat. As regards the role of both injunctive and descriptive social norms as direct antecedents of personal norm, consistently with H2, the prediction of descriptive norm was confirmed, in line with the conception of social norms as internalized standards that provide the content of an individual's moral standards (Bamberg et al., 2007; Bamberg and Möser, 2007). Consequently, the belief that people surrounding the individual are reducing their meat consumption should activate her/his moral obligation to follow in the same direction. On the other hand, the connection between injunctive norm and personal norm was indirect, *via* awareness of consequences, thus indicating, in line with previous research (see Fornara et al., 2016), that the stronger the perception that significant others approve one's own reduction of meat consumption, the higher the individual's awareness about the consequences of such behavior will be. Furthermore, people care whether their behavior is moral to others and are motivated to maintain a positive moral self-image (Jordan and Monin, 2008) and to belong to a moral group (Ellemers and van den Bos, 2012).

Study 1 thus confirmed the link between biospheric values and pro-environmental behaviors, showing that individuals with predominant biospheric values act evaluating costs and benefits of their behaviors for the environment. However, an important question remains unanswered, regarding those individuals who tend to consider the benefits and the costs for themselves. Research has shown that egoistic values are, generally, negatively related to pro-environmental behaviors (De Groot and Steg, 2008; Stern and Dietz, 1994; Stern et al., 1998), but what happens when the egoistic, utilitarian pattern is represented by concern for one's own health? As underlined in the introduction, food consumption is a target pro-environmental behavior, which could be also positively oriented by a selfish driver reflecting individual (cost/benefit) considerations like health concern (Bertolotti et al., 2016, 2020; Jagers et al., 2017; Carfora et al., 2019; Sanchez-Sabate and Sabaté, 2019), indicating that meat consumption is a behavior influenced by both individual and environmental considerations. This highlights the importance of using a comprehensive set of psychological variables in relation to this specific behavior. In order to shed light on this point, we designed the following study.

STUDY 2

Objectives and Hypotheses

The main goal of Study 2 was to verify whether the amount of meat purchase could also be motivated by a healthy food

concern, that is, the importance of eating healthily for one's own health (Tudoran et al., 2009). Therefore, in addition to the main predictors included in Study 1 (i.e., biospheric values, personal norm, and descriptive norm), a measure of health concern was included and tested in a more parsimonious model (see **Figure 4**).

Secondly, Study 2 aimed at providing a further convergent validation of the virtual shopping measure, by using a comparative measure of behavioral intention more robust than the single item of Study 1.

Hence, we formulated the following hypotheses.

Hypothesis 1: Consistently with the VBN framework and Study 1, biospheric values are antecedents of personal norm, which in turn predicts lower meat purchase.
Hypothesis 2: Descriptive norm predicts personal norm, confirming Study 1.
Hypothesis 3: Healthy food concern predicts lower meat purchase.
Hypothesis 4: Meat purchased has a medium-size correlation with a behavioral intention scale, thus providing a further proof of convergent validity of the proposed new measure.

Materials and Methods

Sample and Procedure

The sample consisted of 218 Italian participants (64.8% females and 34.8% males), aged between 18 and 54 years (M = 26.7; SD = 7.0). The majority of the participants are high school graduates (44.4%), followed by those with a BA degree (30%) and a MA degree (17.6%). In lower percentage, we find those who have a doctoral degree or equivalent level of qualification (6.8%), and middle school (1.2%). Participants were surveyed with the same procedure of Study 1, therefore, the survey was completed in the same order (purchasing behavior, intention, socio-psychological dimensions, and socio-demographic indicators). Data were collected during April 2018.

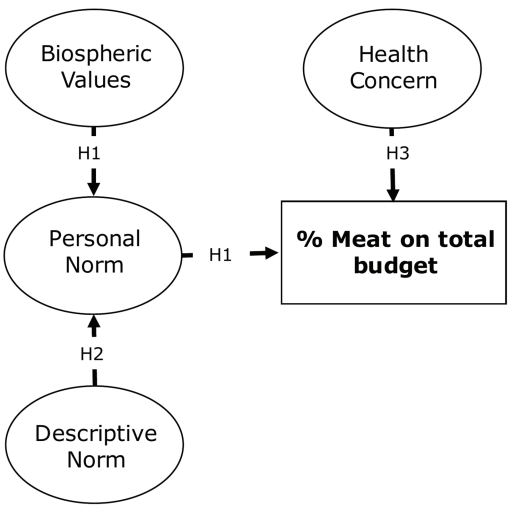

FIGURE 4 | Conceptual model and hypothesized paths of Study 2.

Measures

The online questionnaire used for this study included some measures, which were identical to the ones used for Study 1, that is biospheric values (α = 0.73), personal norm (α = 0.83), percentage of meat purchased on total expenditure, and the socio-demographics. Moreover, the following measures were added or improved from Study 1.

Behavioral Intention

In order to rely on a measure more reliable than the one used for Study 1, this variable was measured by a five item scale (α = 0.81) including items such as "How many times do you think you will buy meat next week?" Participants were asked to answer the question using a 5-point Likert scale from 0 = *never* to 4 = *twice a day*.

Health Concern

This variable was measured by using the two items (α = 0.67)[5] referring to food health concern from Tudoran et al. (2009) health value scale; i.e., "I think of myself as a person who is concerned about healthy food" and "I'm very concerned about the health-related consequences of what I eat." The response scale was a 7-point Likert-type from 0 = *absolutely disagree* to 6 = *totally agree*.

Data Analysis

As for Study 1, descriptive and reliability analyses were conducted for all variables and scales, and Pearson's r bivariate correlation was run between simulated meat consumption and the aggregate measure of behavioral intention. Levels of skewness and kurtosis were based on Mardia's test (Mardia, 1970). A confirmatory factor analysis was performed to test the measurement model and the robust version of the maximum likelihood estimator was chosen (Yuan and Bentler, 2000). Finally, the structural model was tested with the assumed paths. The overall fit of the model was assessed by using the same criteria of Study 1. Both CFA and SEM were performed using the Lavaan package (Rosseel, 2012) within the R environment (version 3.6.1).

Results

Means, standard deviations and Pearson bivariate correlations of all variables are presented in **Table 3**.

The Mardia's tests of skewness and kurtosis (Mardia, 1970) indicated deviation from multivariate normality ($_{1,p}$ = 14.763, $p < 0.001$; $_{2,p}$ = 139.085, $p < 0.001$). Therefore, a maximum likelihood estimator with robust standard errors was employed (Yuan and Bentler, 2000). The confirmatory factor analysis showed evidence of good fit (χ^2_{29} = 36.607, $p > 0.05$; χ^2/df = 1.301;

[5]Since the variable was composed only by two indicators and Cronbach's alpha is sensitive to the number of items, it was decided to keep it as a latent variable in spite of consistency scores slightly below 0.70 (factor loadings further confirming internal consistency of the scale can be seen in **Table 2**).

TABLE 3 | Descriptive statistics and correlation coefficients of Study 2.

Variable	*M*	*SD*	1	2	3	4	5
1. Biospheric values	5.05	0.98	1				
2. Personal norm	2.86	1.84	0.254***	1			
3. Descriptive norm	1.92	1.48	0.139*	0.525***	1		
4. Health concern	3.89	1.26	0.306***	0.348***	0.214**	1	
5. Behavioral intention	2.27	0.61	−0.132	−0.494*	−0.263***	−0.494***	1
6. % of money spent for meat	26.37	15.19	−0.135*	−0.350***	−0.169*	−0.350***	0.536***

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

CFI = 0.989; RMSEA = 0.035; SRMR = 0.041) with standardized factor loadings further confirming reliable variables (see **Table 4**).

Figure 5 reports the tested model, including the standardized coefficients of the links. The model presented a good overall fit to the data: χ^2_{55} 67.31, $p < 0.01$; χ^2/df = 1.81; CFI = 0.968; RMSEA = 0.060; and SRMR = 0.058.

In line with H1, biospheric values predict the personal norm ($\beta = 0.24$; $p < 0.05$), which in turn has a direct negative association with percentage of meat purchased ($\beta = -0.28$; $p < 0.001$). Concerning H2, descriptive norm is significantly related to personal norm ($\beta = 0.55$; $p < 0.001$) and, consistently with H3, healthy food concern is negatively linked to the simulated behavior ($\beta = -0.25$; $p < 0.001$).

As for H4, the Pearson's bivariate correlation indicate a relevant association between simulated behavior (% of money spent on meat) and behavioral intention ($r = 0.54$; $p < 0.001$).

Discussion

Study 2 provided a further convergent validation of the virtual shopping measure. In fact, the correlation between percentage of meat products purchased and the scale measuring behavioral intention (i.e., a more reliable than the single item used in Study 1) was even higher than the one found in Study 1, but again its size was not too large, thus confirming that these measures tap different patterns – though related – i.e., respectively, intention and (simulated) behavior.

Besides the confirmation of the "pro-environmental" path stemming from biospheric values and personal norm, Study 2 evidenced the distinct influence of a selfish driver reflecting individual considerations, such as food health concern, in orienting meat consumption patterns. Specifically, SEM results confirm H1, by showing a pathway in which biospheric values are antecedents of personal norm, which in turn predicts meat consumption reduction. This is consistent with Study 1 and the VBN theory (Stern et al., 1999). In line with H2, the link between descriptive social norm and personal norm is also confirmed, consistently with Study 1 and previous research that conceptualizes both social norms as internalized standards that provide the content of an individual's personal norms (Bamberg et al., 2007; Bamberg and Möser, 2007). Finally, healthy food concern negatively predicts the percentage of meat consumption in the virtual supermarket confirming H3 in line with previous findings (Mullee et al., 2017; Malek et al., 2019; Sanchez-Sabate and Sabaté, 2019; Bertolotti et al., 2020).

TABLE 4 | Parameter estimates from the four-factor CFA of study 2.

Latent factor	Indicator	*B*	*SE*	*Z*	*β*	Sig.
Biospheric values	bio1	1.000	0.000		0.822	
	bio2	0.998	0.273	3.653	0.702	***
Personal norm	pn1	1.000	0.000		0.779	
	pn2	1.088	0.083	13.122	0.836	***
	pn3	0.883	0.087	10.168	0.752	***
Descriptive norm	des1	1.000	0.000		0.732	
	des2	1.104	0.087	12.735	0.892	***
	des3	1.122	0.095	11.748	0.903	***
Health concern	hc1	1.000	0.000		0.523	
	hc2	2.436	0.412	5.919	0.765	***

*The factor loading of the first indicator of each latent variable is fixed to 1. SE = standard error; B = non-standardized estimate; β = standardized estimate; Sig. = values of p corresponding to the z-statistic. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.*

GENERAL DISCUSSION

Overall, the results substantially support the direct role played by individuals' sense of moral obligation to reduce meat consumption, the indirect role of individuals' value system, and the influence of significant others on the simulated purchasing behavior together with individual's health concern.

In detail, the first study confirmed the role of the constructs of the VBN model in predicting the overall meat purchase, and this is consistent with the literature regarding other pro-environmental behaviors (e.g., Stern et al., 1999; Nordlund and Garvill, 2003; Kaiser et al., 2005; Steg et al., 2005; Ibtissem, 2010; Jansson et al., 2011; Fornara et al., 2016; Han et al., 2017). The lack of the hypothesized direct links concerning ascription of responsibility (i.e., as antecedent of personal norm and predicted by awareness of consequences) is partially compensated by the link between awareness of consequences and personal norm, which thus mirrors a one-level jump within the VBN sequential chain. This was also found in previous research explaining other environmental behaviors, such as consumer behavior, environmental citizenship, willingness to sacrifice, willingness to reduce car use (Stern et al., 1999; Nordlund and Garvill, 2003), and household renewable energy use (Fornara et al., 2016).

Consistently with the VBN theory, biospheric values were positively correlated to both pro-environmental beliefs and personal norm (Stern et al., 1998, 1999; Hunecke et al., 2001; Nordlund and Garvill, 2002; Steg et al., 2005, 2011; Steg and De Groot, 2012; Fornara et al., 2016), indicating that those

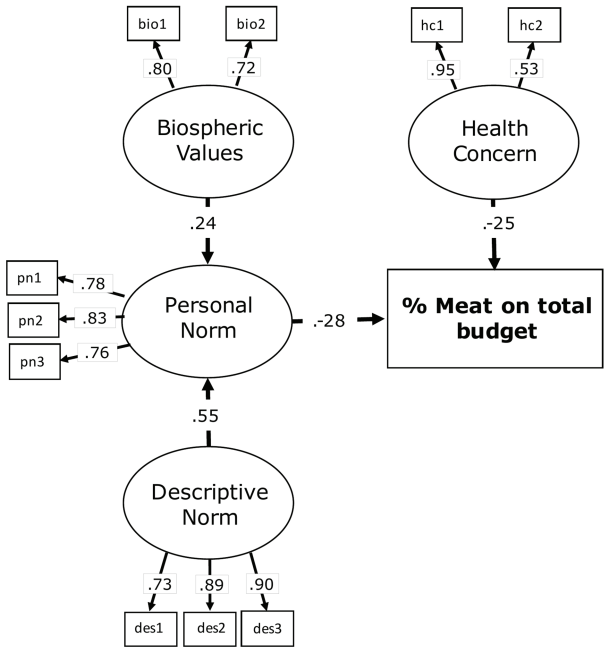

FIGURE 5 | Standardized direct effects and item loadings in the structural model of Study 2. To simplify presentation, the variances – curved double arrows – of the exogenous latent variables and the standardized error variances are not reported.

who highly value the quality of the environment feel more obliged to reduce their meat consumption. This is in line with previous research indicating a positive association between self-transcendent values and self-determined motivations to act pro-environmentally (De Groot and Steg, 2010).

Furthermore, Study 1 confirmed the role of social norms, indicating that the belief that significant others are reducing their meat consumption (i.e., descriptive norm) may activate individuals' moral obligation to follow the same direction, which is consistent with the concept that social norms provide the internalized content of an individual's moral standard (Bamberg et al., 2007; Bamberg and Möser, 2007). At the same time, the extent to which significant others approve the choice to limit one's own meat consumption (i.e., injunctive norm) indirectly impacts individuals' moral obligation to reduce meat consumption by informing about the environmental consequences of meat consumption. The lack of the direct effect of the injunctive norm on personal norm might be related to a form of psychological reactance, being one's autonomy threatened by the perceived social pressure.[6] Fornara et al. (2016) found the same effect of the injunctive norm on awareness of consequences in the context of adopting renewable energy sources at the household level, supporting our finding (i.e., what others approve may still be important in informing the awareness of the environmental consequences). However, we find both social norms to be quite low on average, indicating that people perceive a moderate pressure to reduce their meat consumption. Therefore, further studies should provide additional understanding with regard to this relationship. Nevertheless, these results together should bring our attention to the importance of considering possible different sequential paths depending on the specific context of the pro-environmental behavior.

The second study comprised a short version of the VBN "pro-environmental" path leading from biospheric values (and descriptive norm) to meat consumption through the feeling of obligation to act (personal norm), with the addition of a "pro-self" health-related path – which leads from health concern to individuals' meat purchase. This is in line with studies showing that health motives are among the main motivators in reducing or quitting meat consumption (Mullee et al., 2017; Malek et al., 2019; Sanchez-Sabate and Sabaté, 2019; Bertolotti et al., 2020). Our findings are consistent with previous research highlighting the importance of both environmental and health beliefs in relation to meat consumption (de Boer et al., 2017; Jagers et al., 2017). In essence, as Hofmann et al. (2018, p. 2) pointed out, "[…] resisting the desire to enjoy a steak to help promote a sustainable planet is an instance of moral self-control; resisting the very same desire in order to improve one's own health is an instance of non-moral self-control." However, framing a behavior as a moral issue has the advantage to last in the long-term (Steg, 2016), to evoke positive affect when adopted (Bolderdijk et al., 2013), to provide a warm glow effect (Taufik, 2018), to be a distinct group-based guideline (Ellemers et al., 2013), and to motivate people to influence others in society (Skitka et al., 2005; Feinberg et al., 2019). This may be the case because framing a behavior as a moral issue might activate individual's moral self-view (Aquino and Reed, 2002), which is directly related to their own behavior and might make salient the backlash of a negative evaluation in terms of morality (Pagliaro, 2012; Leach et al., 2015; Pagliaro et al., 2016).

Study 2 further confirmed the role of the social descriptive norm on pro-environmental behaviors, showing that individuals' meat purchase is related to the extent to which people think that significant others are reducing their amount of meat intake. However, Lacroix and Gifford (2019) found social considerations, in terms of social conformity and social influence, to be the lowest reported motivator for those making conscious efforts to reduce meat consumption, while health and environmental aspects were reported among the most important motivators. In a similar way, Nolan et al. (2008) found that participants considered the behavior of their neighbors as the less important impacting their energy conservation despite the fact that the descriptive norms constituted, indeed, the strongest predictors. This was not our case as health concern showed a stronger correlation, on our outcome variable, than the descriptive norm when looking at the direct relations on the correlation matrix.

[6]People's freedom to eat whatever they please – which is strongly rooted in habits, customs, and traditions - may be undermined by the perception of what others approve, which, in turn, may lead to engage in cognitive dissonance strategies. These strategies might act as a barrier to the moralization of meat consumption (Feinberg et al., 2019). In the same way, de Boer et al. (2013, p. 6) argued that "Contextual factors perceived by consumers as external pressure on their own judgment are expected to lead to negative impacts on their motivation."

However, the take-home message here is that one of the advantages of using social norms in an applied setting relies on the fact that the general public is not fully aware of the effects of social influence on their own behavior. For this reason, interventions using social influence to target meat consumption may actually produce long-lasting behavioral change due to the fact that individuals' would perceive their change as intrinsically motivated (Jaeger and Shultz, 2017; see also Barth et al., 2016).

Nevertheless, it is important to mention that we found that, in both studies, the means of the behavioral intention and moral and both social norms were considerably low[7], while the means of health concern in Study 2 were higher. Furthermore, the mean of biospheric values was the highest, both in Study 1 and Study 2, indicating that the participants on average have high concern for their own health as well as for environmental issues. Nonetheless, with regards to those who intend consuming less meat and have a moral sense of obligation to reduce their meat consumption and are supported by the social environment around them, we find our hypothesis met. Future studies might be directed to further confirm the paths highlighted in the present research.

Finally, a crucial contribution of this research was contingent upon the first proof of validity of a simulated purchasing behavior tool, which provides a more ecological outcome measure to rely on than the traditionally used self-report measurements and, consequently, supports with more methodological strength our findings. In fact, as mentioned in the introduction, measures of self-reported behavior may present issues regarding validity together with limitations regarding specifically pro-environmental behaviors (Whybrow et al., 2016; Lange and Dewitte, 2019; van der Werf et al., 2020). By using a simulated behavior as an outcome measure, the limitations of using a survey to assess individuals' intentions were overcome.

Regarding future implications, this research provides a contribution to help professionals develop solid strategies, through the management of the cognitive and regulatory processes involved in the production of pro-environmental choices. Indeed, different psychological variables play an important role in the explanation of meat consumption, highlighting the importance of incorporating a comprehensive set of theory-based psychological variables. In this regard, we underline the importance of individuals' set of values to encourage conscious pro-environmental behaviors. In particular, individuals with self-transcendence values (i.e., biospheric values) are more drawn to develop a sense of moral obligation to act in favor of the environment (Nordlund and Garvill, 2002; Poortinga et al., 2004; Steg et al., 2005); therefore, focusing on personal norms is critical to this purpose as suggested by Harland et al. (1999). At the same time, it is essential to take into account factors reflecting individual (cost/benefit) considerations especially for individuals who do not fall in the self-transcendence domain but are rather (or also) drawn by concerns for their own health.

Reduction in meat consumption for environmental reasons is, nowadays, a minority norm. Framing a message based on trending norms (by portraying a behavior as increasing in popularity) might be one of the most suitable and powerful ways to benefit from social norms with regard to this specific behavior (Mortensen et al., 2019).

Among the limitations of this research, first of all, this is a cross-sectional study, therefore, it is not known whether and how much the consumer behavior will be maintained over time. Moreover, the correlational nature of this study does not allow for conclusions regarding causality about the unidirectional paths tested, providing no evidence of the temporal relationship between predictors and outcome. This issue should be addressed through the development of longitudinal research designs, measuring the predictors first and the dependent variables after a certain period of time (e.g., 1 or 2 weeks) to both avoid order effects and preserve the chronological order of the hypothesized process. However, the fact that these links are theory-based and are coherent with previous research findings focusing on other environmental behaviors provides us with relevant arguments in this direction.

A further limitation concerns the validation of the outcome variable. In fact, the simulation measurement of purchasing behavior was validated with an *ad hoc* self-report measure rather than with a more objective established measure. Thus, even though the use of this procedure for the verification of convergent validity is consistent with previous literature (e.g., Armitage and Conner, 2001; Webb and Sheeran, 2006), future studies are needed to provide a further validation of this measure.

Another issue regards the generalization of the findings in this context of study to other geo-cultural contexts. In fact, we cannot exclude that cultural aspects related to the consumption of meat in the geographical regions to which the sample belongs may have had an influence. It has been shown, in fact, that people's pro-environmental behavior may vary across different cultural backgrounds (Oreg and Katz-gerro, 2006) and concerns about the environment do not always lead to pro-environmental behavior, because of the influence of other socio-psychological barriers (Tam and Chan, 2017). In order to assess whether these findings can be considered pancultural, we address to future research the duty to verify the reliability of these results in other cultural contexts.

Further analyses and discussion could also be addressed to the role of other types of values for predicting the target behavior. Hedonic values, for example, reflect a focus on individuals' care about comfort and pleasure. The role of such values for understanding environmentally relevant beliefs, preferences, and actions has been previously acknowledged (Steg et al., 2014). However, enjoying food as an indicator of hedonic values may act as a barrier to reducing meat consumption, which may be an important factor that has not

[7]At the same time, we found that (in Study 1) awareness of consequences on average is higher, which is inconsistent with previous findings (see Hartmann and Siegrist, 2017) in which the majority of the studies suggest that consumers are not aware that the production and consumption of meat has a huge impact on the environment. This may be explained by the fact that the environmental consequences of meat consumption might be becoming increasingly popular since the studies reported in the systematic review of Hartmann and Siegrist (2017) date back to 2008–2015.

been included in this study. Consistently, the hedonic motivation of perceived tastiness of meat was in fact found to be an important barrier to moralization of meat (Feinberg et al., 2019).

CONCLUSION

Meat consumption is a prominent global cause of mortality and environmental degradation. The present study provides support for the predictive validity of the VBN constructs and social norms in explaining meat consumption. Moreover, findings confirmed the important role of healthy eating concern in individuals' food purchases and gave the first proof of validity of a simulated food purchase measure. The results underline the importance to address individuals' health and environmental concerns of dietary choices during interventions. As Verain et al. (2016) previously discussed, it is possible to screen consumers on their different cognitive mind-sets and provide them with tailored interventions to promote sustainable food choices. The segmentation framework proposed here regards individuals' values and concerns. Therefore, regarding the implications for future consumer policy, consumers with a predominant environmental concern may benefit more from environmentally tailored communication while consumers with a predominant health concern may benefit from a communication based on the health consequences of such behavior. In essence, in order to reach a wider population, it would be preferable to develop an approach that combines multiple values regarding food choices, including health and nature-related values, as also suggested by de Boer et al. (2013). Developing an approach that underlines that eating less meat is a choice made by other people because of environmental and health concerns would allow both to target individual's values and dispositions to conform to social rules.

Interestingly, recent research has shown that foods related to the highest negative environmental impacts are consistently related to the highest increases in disease risk (Clark et al., 2019). This means that actually having a healthier diet would generally improve environmental sustainability.

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 Ethical Committee of the Department of Education, Psychology, Philosophy of the University of Cagliari. Written informed consent from the 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

FF and SP developed the research idea and revised the manuscript. FF, SP, FT, and AL were involved in the planning of both Study 1 and Study 2. FT set-up the online supermarket. AL collected the data. AL and FT performed the data analysis, wrote the manuscript, and contributed equally to this work. All authors contributed to the article and approved the submitted version.

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ORIGINAL RESEARCH
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Within-Day Variability in Negative Affect Moderates Cue Responsiveness in High-Calorie Snacking

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Background: Many discretionary foods ("snacks") contribute both to individual health risks and to global issues, in particular through high carbon footprints and water scarcity. Snacking is influenced by the presence of snacking cues such as food availability, observing others eating, and negative affect. However, less is known about the mechanisms underlying the effects of negative affect. This study examines whether the individual odds of consuming high-calorie snacks as a consequence to being exposed to known snacking cues were moderated by experiencing (i) higher or lower total negative affect per day or (ii) higher or lower negative affect variability per day.

Methods: Secondary analysis of an ecological momentary assessment study of 60 participants over 14 days with food logs and randomly timed assessments of known snacking cues. High total daily negative affect levels (daily within-participant means) and negative affect variability (daily within-participant SDs) were examined as moderators to predict high-calorie snacking in three-level hierarchical random effects logistic regressions.

Results: Consistent with previous studies, the odds of snacking increased when food was available (OR = 5.05, 95% CI 3.32, 7.66), when others were eating (OR = 5.11, 95% CI = 3.73, 6.99), and when participants experienced more negative affect (OR = 1.02, 95% CI = 1.01, 1.03). Associations for food availability (OR = 0.92, 95% CI 0.86, 0.99) and others eating (OR = 0.95, 95% CI 0.91, 0.99) were significantly moderated by negative affect variability such that associations between cues and high-calorie snacking were weaker on days with higher negative affect variability, but not negative affect levels.

Conclusion: The relationship between cues to high-calorie snacking and snacking behavior varies with variability in negative affect, suggesting a complex relationship between affect and high-calorie snacking. Clearer conceptualizations on the relation between affect and eating are needed.

Keywords: snacking, ecological momentary assessment, food choices, negative affect, affect variability

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INTRODUCTION

Snacks (i.e., discretionary food choices) are defined as foods that are consumed outside of main meals (Hess et al., 2016). Snacks are key contributors to our overall energy intake, contributing to approximately 24% of an individual's daily energy intake in the United States (Piernas and Popkin, 2009) and approximately 35% in Australia, the context of the current research (Australian Bureau of Statistics (ABS), 2014). Given that snacking is associated with both high caloric intake and increased consumption, snacking has been linked to greater risk of energy imbalance and weight gain (Hall et al., 2011). Further, discretionary foods contribute substantially to overall food-related greenhouse gas emissions (GHGE). For example almost 30% of food-related GHGE in Australia result from discretionary foods, with an even higher contribution in individual diets high in snacks (Hendrie et al., 2016). Similar patterns have emerged in the United States (Chapa et al., 2020) and elsewhere (e.g., Mehlig et al., 2020). The production of high-energy discretionary foods also consumes substantial amounts of water, and the contribution of discretionary foods to water scarcity has been estimated around 35% (Riddout et al., 2019). Therefore, it is vital to further our understanding of the factors that influence snacking, in order to both mitigate the negative effects of snacking on health and the overall environment, and to promote research aimed at changing obesity related eating behavior.

Early theories of eating behavior (including snacking), assumed the key determinant of eating to be energy depletion, whereby hunger was believed to be predominately driven by a physiological lack of food and a need to restore energy imbalance (Woods et al., 2000). More recent theories (Stroebe et al., 2013), however, posit that eating behavior, in particular snacking, is largely guided by exposure to food-related eating cues or stimuli. Broadly, such theories propose that individuals automatically respond to food-related cues that they encounter in their day-to-day lives and misinterpret their response to such cues as a sign of biological hunger, triggering food consumption.

The relationship between food cues and eating behavior has been explored both under controlled laboratory conditions (Herman et al., 2003; McFerran et al., 2009; Cruwys et al., 2015) and in the real-world (Elliston et al., 2017; Schüz et al., 2018). Social cues, such as observing others eating, have been associated with increased food consumption, influencing both the type and quantity of food consumed (Herman et al., 2003; Cruwys et al., 2015; Herman, 2015). The association between food availability and eating has also been investigated. For example, geographical areas with a higher density of fast-food outlets are associated with increased fast-food consumption (Lucan and Mitra, 2012). Conversely, areas with a high density of fruit and vegetable outlets and supermarkets, are associated with higher fruit and vegetable consumption (Morland et al., 2006; Bodor et al., 2008; Lucan and Mitra, 2012). Recent studies examining snacking behavior in everyday contexts indicate that both social cues (e.g., being in the presence of someone else eating) and having food available significantly increases the likelihood of snacking (Schüz et al., 2015a; Elliston et al., 2017).

Negative Affect and Eating Behavior

Food-related or snacking cues may also be internal, such as different emotional states that may trigger hunger or prompt someone to eat (Lutter and Nestler, 2009). Most research on affective states has focused on negative affect as a key precipitant to snacking behavior. For example, negative affect has been linked with increased appetite and unhealthy snack choices (Cleobury and Tapper, 2014). Further, negative emotions such as anger, fear, and sadness have been associated with increased impulsive eating and the consumption of unhealthy foods (Macht, 2008). Other research has suggested that negative affect leads to snacking as eating might serve the purpose of down regulating negative emotions (i.e., "comfort eating") in some individuals (Macht et al., 2005). Finally, some research indicates that negative affect may influence snacking when it is used as a coping strategy to distract oneself from stress (masking hypothesis; Polivy and Herman, 1999). Findings from recent studies examining snacking in everyday contexts indicate that higher levels of negative affect are associated with an increased likelihood of having a snack (Elliston et al., 2017).

While the association between negative affect and snacking has been well documented, it is currently unclear whether negative affect has a direct effect on snacking or, instead, acts via mediators. For example, some research has suggested that negative affect might perhaps impair cognitive control over eating, leading to increased snack consumption (Macht, 2008). This idea has been posed by two potential theoretical explanations. One explanation is that experiencing high levels of negative affect disinhibits dietary restraint, leading to increased snacking (Herman and Polivy, 1984). According to this view, negative affect is thought to pose a more urgent and current concern to the individual than regulating their food consumption. Specifically, there is a greater demand on the individual to manage this more urgent stressor (the negative emotion) than to focus on their diet. Consequently, cognitive control over eating is impaired, leading to greater snacking. For our study, this means that total daily negative affect could act as a moderator of cue effects on snacking, with e.g., higher total daily negative affect being associated with stronger effects of cues on snacking (as a result of impaired control).

Negative Affect Variability and Eating Behavior

An alternative explanation has been proposed by self-regulation theories, which pose that individuals' self-regulatory capacities are a limited resource, that are depleted when people attempt to control their emotions, thoughts and behavior (Martin Ginis and Bray, 2010). Specific research on emotion regulation indicates that attempting to change/control momentary negative affect reduces blood glucose levels, which consequently reduces performance on subsequent self-regulation tasks (Muraven et al., 1998). In this study, participants were asked to engage in an emotion self-regulation task (changing their emotions whilst watching an upsetting movie), and then to engage in a subsequent self-regulation task based on physical exertion and stamina (to continuously squeeze a handgrip). Results have been interpreted

as indicating that trying to control/alter one's emotional state leads to a reduced capacity to self-regulate in another area.

If self-regulatory capacity is a limited resource that is depleted when people attempt to regulate their emotions, subsequent self-regulation of behavior might also be impaired (Cameron and Overall, 2018). For example, research demonstrated that when participants—restrained eaters, or "dieters"—had to cope with negative emotions, their ability to control their eating was inhibited, leading to higher consumption of high caloric snack foods (Boon et al., 2002). Therefore, when people's self-regulatory resources have already been depleted (through regulating their negative affective states), they may lack self-regulatory resources and may be more vulnerable to eating in response to cues. In other words, on days when individuals experience their emotions to be more varying, their resources to self-regulate eating behavior might be depleted and they accordingly would be more susceptible to snacking cues and eat more. Previous research in other health behaviors however suggest a heterogeneous picture – higher variability in affect was both related to higher levels of health-promoting behaviors (e.g., diabetes self-care behavior; Wagner et al., 2017) and lower levels of health-promoting behaviors (e.g., physical activity; Maher et al., 2019). This suggests that more research on the role of variability in affect in health behaviors is needed.

In sum, there are two theoretically plausible avenues that outline how negative affect might moderate the effects of food cues on snacking within participants: Higher total daily levels of negative affect might impair cognitive control over eating by posing a more urgent demand, or, secondly, higher daily variability in negative affect could deplete self-regulatory resources, making participants more susceptible to momentary eating cues. As in particular the intake of high-calorie and low-fiber foods has been associated with adverse health outcomes (e.g., Saklayen, 2018) and adverse environmental outcomes such as high GHGE (Hendrie et al., 2016) and water scarcity (Riddout et al., 2019), this research focuses on the discretionary intake (snacking) of high-calorie foods.

Study Aims

The current study investigates the role of daily negative affect *levels* and daily negative affect *variability* as potential moderating variables of the relationship between internal and external food-related cues (food availability, observing others eating and momentary negative affect) and high-calorie snacking in an everyday setting using Ecological Momentary Assessment methods (EMA; Shiffman et al., 2008). In addition to the hypothesis that internal and external cues would be associated with higher odds of snacking (H1), we tested two competing hypotheses, specifically: that the presence of known snacking cues, in particular food availability, observing others eating and negative affect will be associated with increased odds of snacking, and that these effects will be moderated by total daily negative affect *levels* (H2); and, that the presence of known snacking cues, in particular food availability, observing others eating and negative affect will be associated with increased odds of snacking, that these effects will be moderated by negative affect *variability* (H3).

MATERIALS AND METHODS

Overview

Using EMA (Shiffman et al., 2008) allowed us to identify the presence and intensity of internal and external cues in real world settings and in near real time. Further, EMA allowed us to examine momentary within-person variability and fluctuation in negative affective states. The present study used data from a previously published study (Schüz et al., 2018).

Participants

This study was a secondary analysis of a previously published study (Schüz et al., 2018) which examined the relationship between momentary social norms and dietary behaviors. Participants were recruited for this study, via newspaper, radio and online media release. To be eligible to participate, individuals were required to be >18 years of age, have a Body Mass Index (BMI) between 18 and 40 kg/m^2 (i.e., within the normal-to-obese BMI range), not being on a diet, and have no history of an eating disorder.

Procedure

Data for this study was collected between April and August 2016. The protocol for data assessment followed those outlined in previous published research (Schüz et al., 2015b; Elliston et al., 2017), and was approved by the Tasmanian Social Science Human Research Ethics Committee (Reference No. H0015647). Initially, interested participants contacted the researchers via web form. After establishing eligibility through telephone screening, participants were booked in for the first appointment (∼30 min in duration), during which they provided informed consent, completed baseline measures, and received initial training with the EMA devices (LG P500 smartphones stripped of all phone functions) running the customized EMA software HBART.[1]

Briefly, participants then completed 14 days of EMA field assessment, in which they were instructed to log every time they consumed food or drinks. After 2–3 days, they attended the lab to receive additional training (if necessary) and assess protocol compliance. Food reports were assessed in two stages: Firstly, participants logged all the food and drink they consumed. Secondly, a random subsample (60% to minimize participant burden; Schüz et al., 2013) of these food assessments were followed by assessment of the presence of social, environmental and internal cues to eating. Participants also received randomly-timed prompts over the course of the day (approximately five/day), which repeated the assessment of social, environmental and internal cues to eating (see section "Measurement"). This allowed for the comparison of the presence and strength of food related cues during eating and non-eating assessments. Each assessment was time and date stamped. Participants were instructed to turn the device to "suspend mode" whenever they were in circumstances where they would not be able to answer random prompts (such as when driving). Further, participants completed a brief evening report at the end of each day (for future

[1]https://www.utas.edu.au/health/research/groups/tasmanian-school-of-medicine/behavioural-and-situational-research-group-bsrg/hbart

studies). On conclusion of the monitoring period, participants retuned their EMA devices, were debriefed, and received $50 reimbursement.

Measurement Instruments

Food reports were assessed in two steps. Firstly, participants reported whether they were eating a meal or snack, and secondly identified what kind of food they were eating based on the Dietary Targets Monitor (DTM; Lean et al., 2003). For example, if participants selected "Enter snack report" on the study smartphone, they were asked to "Please indicate which type of food you want to report" with a selection of food groups based on the DTM, e.g., "fruit and vegetable", "cheese", "sweets or chocolate", "cake, scone, sweet pies, danish", "biscuits", "ice cream", etc. Snack reports were then differentiated as either "low calorie snacks" or "high calorie snacks" based on their estimated energy and saturated fat content. For example, fruit and vegetables were classified as low caloric snacks, while sweets and chocolate, chips, ice-cream, cakes/scones/pastries, crisps/savory snacks, and biscuits were classified as high caloric snacks. This study focused solely on high caloric snack intake, given its known association with negative health outcomes (Hall et al., 2011).

Social cues were assessed during both food reports and non-eating assessments by asking participants "When you decided to eat, were there people eating?" Responses were qualitative and required answering a single option from: "no," "yes in my view," or "yes in my group." For analysis, responses were dichotomized to yes/no.

Food Availability was assessed during both eating events and randomly timed non-eating assessments. Participants were asked what food was available at the time they decided to eat. Responses were qualitative and required participants to check boxes of available food types.

Affect was assessed by asking participants to rate their mood at the time they decided to eat across 10 affect descriptors: alert; angry; bored; calm; focused; happy; irritable; stressed; restless; sad; overall mood; and energy level. Descriptors were assessed on a 0–100-point visual analog scale, whereby participants moved a pointer to indicate their response. A maximum likelihood factor analysis with robust standard errors taking into account the hierarchical data structure (multiple measures nested under participants) confirmed a two-factor structure. Responses were then summarized into a positive affect score (using the mean scores for alert, calm, focused, happy, energy) and negative affect (using the mean scores of angry, bored, irritable, stressed, restless, sad).

Total daily negative affect was operationalized as the mean of negative affect from all eating and non-eating assessments experienced by a participant during one day (hypothesis 2), with higher scores indicating higher average negative affect on this day.

Negative affect variability was operationalized as the within-day and within-person standard deviation of negative affect scores from all eating and non-eating assessments (hypothesis 3). This indicates the degree to which participants' negative affect scores during any one day deviated from their daily mean, with higher scores indicating days with greater negative affect variability.

Data Preparation

On average, participants completed 14.57 (SD = 2.41) days of field monitoring. Following the exclusion of days with poor compliance (<50% of random prompts responded to), out of 904 days of participant observations, 776 (85.4%) days of participant observation were available for analysis. In the resulting data set, participants responded to 2,058 of 2,374 (86.69%) non-eating assessments issued, an average of 2.87 (SD = 1.28) random assessments per day. Participants reported consuming 0.96 (SD = 1.26) high-calorie snacks per day.

Analysis

Due to the hierarchical structure of EMA data, in which multiple daily assessments of food reports and randomly timed reports are nested within both days of the study and within participants, a three-level multilevel analysis with cross level analysis was used to control for the non-independence of observation. The R package lme4 (Bates et al., 2015) was used to obtain estimates of odds ratios and fixed and random effects in the multilevel analysis, and sjPlot (Lüdecke, 2019) was used to graph interactions. Descriptive analyses were conducted using SPSS.

The analyses for our main research questions were conducted through multiple steps. First, we fitted a series of separate multilevel logistic regression analyses per predictor to test hypothesis 1 and to replicate previous findings of positive associations between known momentary internal and external cues (food availability, others eating, momentary negative affect) and snacking. In these models, for each report, the odds that this report was a random prompt (coded 0) or a snack report (coded 1) was regressed on the cues separately in three-level hierarchical linear models (as reports are nested within days, and days are nested within participants).

Next, we tested the second hypothesis, namely that total daily negative affect levels moderated the effects of these known cues on snack reports [**Table 2**, Model a) for others eating, model b) for food availability, and model c) for negative affect]. To do so, we introduced person-level centered daily means of negative affect as moderators of the known cues and direct predictors of snacking (cross-level interactions) into the hierarchical logistic regression analyses. To test the third hypothesis, similar models were fitted that introduced person-level centered NA variability (daily within-participant SDs) in the multilevel logistic regression. Day-level predictors (NA level and NA SD) were person-mean-centerd in order to indicate days on which participants experienced higher (or lower) levels and variability of NA than on average.

All analyses included study day (within-participants) as covariate to control for time effects in the study. The odds ratio indicates how much more or less likely it is that any report is a snack report compared to being a non-eating assessment, if the specific covariate increases by one unit. For the categorical covariates (food availability and other eating), the odds ratio indicates the likelihood of snacking if the covariates are present vs. absent. In the case of negative affect, the odds ratio indicates the likelihood of snacking with a one-unit increase in negative

affect (note that these effects appear small, as they indicate the increase in odds if negative affect increases by 1 unit on a scale from 0 to 100).

RESULTS

A total sample of 61 adults was assessed, and 60 (98.36%) of this sample provided data on a sufficient number of days (>2) to allowed inclusion in these analyses. Of these subset (n = 60), 41 (69%) were women. Participants were aged between 18 and 64 years (M = 32.37, SD = 12.96) and had an average BMI of 25.04 kg/m^2. Most participants (n = 55, 91.7%) were of Caucasian origin. The majority (n = 33, 55%) had completed some university education, followed by completing high school (n = 20, 33,3%) or vocational training (n = 7, 11.2%). Descriptives for internal and external cues (% present in measurement occasions) as well as negative affect levels and variability can be found in **Table 1**.

> Hypothesis 1: Are known cues (available food, others eating and momentary negative affect) associated with snacking?

As hypothesized, all known cues were associated with an increased likelihood of snacking. Results indicated that the presence of others eating significantly increased the odds of a measurement occasion being a snack (OR = 5.11, 95% CI = 3.73, 6.99) when compared to non-eating assessments. Similarly, food availability significantly increased the odds of a measurement occasion being a snack (OR = 5.05, 95% CI = 3.32, 7.66) when compared to non-eating assessments. The intensity of momentary negative affect significantly increased the odds of a measurement occasion being a snack (OR = 1.02, 95% CI = 1.01, 1.03) when compared to non-eating assessments (note that momentary negative affect was assessed on a 0–100 scale, thus small increases in odds with one unit increase in momentary negative affect).

> Hypothesis 2: Are the associations between known cues (available food, others eating and momentary negative affect) and snacking moderated by total daily negative affect *levels*?

TABLE 1 | Means and standard deviations (sample-level) and% present of internal/external cues and moderators (negative affect levels and variability).

Variable	Mean	SD	% present during measurement occasion
Internal cue			
Momentary negative affect	18.30	17.81	
External cues			
Others eating			24.75
Food available			80.66
Moderators			
Negative affect level	18.30	15.15	
Negative affect variability	8.22	4.08	

To test hypothesis 2, daily within-person per-day average negative affect levels were examined as a moderator of the relationship between known internal and external cues (food availability, observing others eating, and negative affect) and snacking. Results (see **Table 2**) indicated that total daily negative affect did not moderate the relationship between others eating and snacking (OR = 0.97, 95% CI = 0.93, 1.01), food availability and snacking (OR = 0.97, 95% CI = 0.93, 1.02), or momentary negative affect and snacking (OR = 1.00 95% CI (0.99, 1.00).

> Hypothesis 3: Are the associations between known cues (available food, others eating and negative affect) and snacking moderated by negative affect *variability*?

To test hypothesis 3 | daily within-person per-day negative affect variability was examined as a moderator of the relationship between known internal and external cues and snacking. Results (see **Table 3** and **Figure 1**) indicated that negative affect variability was a significant moderator of the relationship between food availability and snacking (OR = 0.92, 95% CI = 0.86, 0.99) and observing others eating and snacking (OR = 0.95, 95% CI = 0.91, 0.99). Negative affect variability did not moderate the relationship between and momentary negative affect and snacking (OR = 1.00, 95% CI = 0.99, 1.00). This means that negative affect *variability* moderated the relationship between known external cues such that these relationships were weaker on days with more variability in negative affect, but not internal (momentary negative affect). **Figure 1** shows the predicted probabilities of a measurement occasion being a snack report based on the presence of external cues (availability and others eating) and the variability of negative affect per day (centerd predictors, thus mean = 0).

DISCUSSION

In a secondary analysis of a previous data set, this study examined the influence of negative affect variability and negative affect levels on cue susceptibility in high-calorie snacking behavior in everyday settings. The consumption of high-calorie snacks has been linked to negative outcomes on individual health (Saklayen, 2018), while the production of such snacks has negative effects on GHGE (Hendrie et al., 2016), and water scarcity (Riddout et al., 2019). Consistent with previous research, participants were more likely to consume a high-calorie snack when exposed to known internal and external snacking cues such as availability of food and others snacking (external cues) and negative affect (internal cue). This finding supports previous research that suggests that snacking is highly influenced by an individual's situation and context (Lowe and Butryn, 2007) and corroborates a number of studies that show that internal and external snacking cues increase the likelihood of snacking (Schüz et al., 2015a; Elliston et al., 2017). More importantly though, these effects were moderated by daily negative affect variability (**Table 3**), but not total daily negative affect levels (**Table 2**).

This means that greater negative affect variability led to a lower susceptibility to external snacking cues. This finding is in contrary to our hypothesis that susceptibility is increased on days with more fluctuation due to potential self-control depletion effects

TABLE 2 | Summary of 3 three-level multilevel analyses: snacking regressed on internal and external cues using average negative affect (NA) per day as a moderator.

	Odds Ratios (95% CIs) of External and Internal Cues		
	(a) Availability of Food	**(b) Others Eating**	**(c) Negative Affect**
Fixed Effects (Occasion level)			
Intercept	0.23 (0.17, 0.30)***	0.25 (0.13, 0.32)***	0.24 (0.20, 0.30)***
Cue (main effect)	5.38 (3.44, 8.41)***	4.96 (3.49, 7.06)***	1.02 (1.01, 1.04)***
Fixed Effects (Day Level)			
Day in study	0.97 (0.94,0.99)*	0.97 (0.94,0.99)*	0.98 (0.95,1.00)
NA Level * Intercept	1.00 (0.99, 1.02)	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)
NA Level * Slope Cue	0.97 (0.93, 1.02)	0.97 (0.93, 1.01)	1.00 (0.99, 1.00)
Random Effects	**Variance Component (SD)**	**Variance Component (SD)**	**Variance Component (SD)**
σ2 ntercept Level-1	0.29 (0.54)	0.35 (0.58)	0.00 (0.00)
σ2 Intercept Level-1/2	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)

*$p < 0.05$, ***$p = 0.001$. NA, Negative Affect; SD, Standard Deviation.*

TABLE 3 | Summary of three-level multilevel analyses: snacking regressed on internal and external cues using negative affect variability (day-level) as a moderator.

	Cues Odds Ratios (95% Cis)		
	Availability of Food	**Others Eating**	**Negative Affect**
Fixed Effects (Occasion level)			
Intercept	0.23 (0.18, 0.30)***	0.14 (0.09, 0.20)***	0.25 (0.20, 0.31)***
Cue (main effect)	5.35 (3.38, 8.46)***	6.26 (4.10, 9.56)***	1.02 (1.01, 1.04)**
Fixed Effects (Day Level)			
Day in study	0.97 (0.94,0.99)*	0.98 (0.95,1.00)	0.98 (0.95,1.00)
NA SD * Intercept	1.00 (0.98, 1.03)	1.02 (0.99, 1.04)	0.99 (0.97, 1.02)
NA SD * Slope Cue (moderation)	0.92 (0.86, 0.99)*	0.95 (0.91, 0.99)*	1.00 (0.99, 1.00)
Random Effects	**Variance Component (SD)**	**Variance Component (SD)**	**Variance Component (SD)**
σ2 Intercept Level-1	0.37 (0.60)	0.37 (0.61)	0.00 (0.00)
σ2 Intercept Level-1/2	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)

*$p < 0.05$, ***$p = 0.001$. NA, Negative Affect; SD, Standard Deviation.*

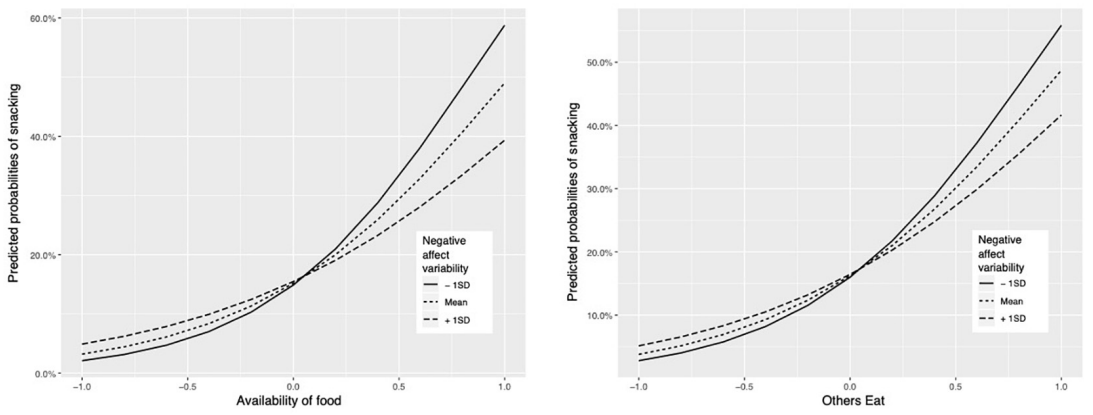

FIGURE 1 | Predicted probabilities of a measurement occasion being a snack report by external cue (others eating/availability of food) and negative affect variability (centered predictors).

(Muraven et al., 1998), but would suggest the opposite – greater fluctuations of negative affect within days and within participants are associated with smaller effects of known snacking cues. There are some potential explanations for this unexpected finding, in particular related to attention effects. Greater affect variation has been associated with fluctuations in attention and working memory (Brose et al., 2012), thus participants might have paid less attention to snacking cues on days with larger fluctuations

in negative affect. Variability in negative affect did not affect the odds of snacking directly, however. A previous studies report heterogeneous findings for the relationship between affect variability and health behavior (e.g., higher levels of diabetes self-care behaviors with higher fluctuations of positive affect; Wagner et al., 2017 but also lower levels of physical activity with higher fluctuations in affect; Maher et al., 2019), our results add to this literature that in addition to main effects of variability on health behavior, potential moderating effects of affect variability on the relationship between behavioral cues and behavior need to be considered.

Importantly, total daily negative affect levels did not moderate the associations between known cues and high-calorie snacking. Therefore, experiencing high levels of negative affect on any given day did not increase participants' susceptibility to snacking cues. Theoretically, this finding suggests that negative affect levels and negative affect variability have slightly different implications for snacking. Whilst high negative affect levels are directly associated with increased odds of high-calorie snacking (as an internal cue), negative affect variability appears to modify the susceptibility to a range of known cues. This suggests t that negative affect not only serves as a cue to high-calorie snacking *per se*, but the experience of greater variability of negative affect could affect attentional processes related to cue detection.

At the same time, the observed fluctuations in negative affect could also be the result of individual affect regulation processes – if individuals experience high levels of momentary negative affect and have the resources and ability to down-regulate this experience to lower levels, this would result in overall higher fluctuations in negative affect per day. Instead of indicating lower self-regulatory resources however (Muraven et al., 1998), it could be indicative of better affect regulation skills, which in turn have been associated with higher levels of health-protective behaviors in general (DeSteno et al., 2013), dietary behaviors in particular (e.g., Isasi et al., 2013), and smaller effects of food cues on dietary behaviors (e.g., Kerin et al., 2018). However, as our study did not assess emotional regulation but instead examined naturally occurring variability in affect, this possible pathway could neither be confirmed nor rejected.

Given that existing reviews on the role of affect in dietary behaviors (Macht, 2008) are mainly concerned with intensity (level) of affect as determinant of eating, more conceptual and theoretical work on the relationship between affect variability and eating is needed. Because there are fluctuations in affect over the course of days (standard deviations of negative affect in our study ranged from 0 to 40 on a 0–100 scale), both within- and between-day fluctuations in affect need to be considered. The evidence from this study can only be considered initial, as both the relatively small sample size and exploratory nature of the study as a secondary analysis limit the implications of the findings. Future research may focus on manipulating negative affect variability in controlled laboratory settings, in order to examine individuals' reactivity to snacking cues.

More broadly, findings from the current study suggest a greater need for interventions that target and address food cues, given that all three cues included in this study (food availability, observing others eating, and negative affect) were associated with increased odds of high-calorie snacking. Addressing these food cues could therefore be an important focus of measures to reduce snack food consumption, given the current obesogenic environment whereby individuals are continuously exposed to/bombarded by snacking cues. Both in terms of reducing the health risks associated with excess energy and fat consumption (Saklayen, 2018) as well as the environmental impact of discretionary foods (Hendrie et al., 2016; Riddout et al., 2019; Chapa et al., 2020; Mehlig et al., 2020), effective measures are needed. For example, recent research suggests that attentional bias modification training can help people to withstand snacking cues, such as television advertisements for chocolate (Kemps et al., 2018). At the same time, changes in dietary patterns toward more sustainable diets correspond with lower carbon emissions (Mehlig et al., 2020). However, further research is required to ascertain whether these effects can be generalized to other known snacking cues.

A key strength of this study was that it was the first to examine the effects of negative affect levels and negative affect variability on cue susceptibility using EMA (Shiffman et al., 2008). EMA allows for the real-time study of individuals in their everyday eating environments, capturing the experience of moods, behavior and events that occur prior to eating.

Despite this strength, there are some important limitations to consider when interpreting the results of the present study. First, participants' high-calorie snack intake could not be verified as EMA relies on self-reports of eating behavior. Second, our assessment of eating via food logs was limited to a brief questionnaire based on a dietary targets monitor (Lean et al., 2003). This measure is limiting as it does not assess the amount of food consumed by a participant, which is an important contributing factor. However, using this measure reduced assessment and time burden on participants and likely increased their compliance to the EMA procedure. Given the relatively small sample size, and the exploratory nature of this study as a secondary analysis, findings from the present study require replication to ensure reliability.

In conclusion, this study provides initial evidence that daily within-participant negative affect variability but not negative affect level moderates cue susceptibility to external snacking cues. This suggests the need for more conceptual work on the relationship between variability in affect measures and dietary behaviors. Nevertheless, understanding the links between affect and discretionary food choices is an important prerequisite for the development of effective measures to reduce the negative health and environmental impact from excess consumption of high-calorie snacks.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article is available at https://rdp.utas.edu.au/metadata/bae6e09e-ab11-4d01-8b1a-9bbaf0e6ff73. Analysis code will be made available upon request.

ETHICS STATEMENT

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

AUTHOR CONTRIBUTIONS

TP conducted analyses, wrote the manuscript, and contributed to conceptualization of the study. SF contributed to the conceptualization of the study and writing of the manuscript. BS conceived the study, conceptualized the analyses, and contributed to writing the manuscript. All authors contributed to the article and approved the submitted version.

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Detecting and Preventing Defensive Reactions Toward Persuasive Information on Fruit and Vegetable Consumption Using Induced Eye Movements

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Objective: Persuasive messages regarding fruit and vegetable consumption often meet defensive reactions from recipients, which may lower message effectiveness. Individual differences in emotion regulation and gender are expected to predict these reactions. In the working memory account of persuasion, inducing voluntary eye movements during the processing of the auditory persuasive information might prevent defensiveness and thereby increase message effectiveness.

Methods: Participants in two independently recruited samples from the general population (n = 118 and n = 99) listened to a negatively framed auditory persuasive message advocating fruit and vegetable consumption. Half of them were asked to keep following a regularly moving stimulus on their screen with their eyes. At pretest, the individual differences of cognitive self-affirmation inclination (CSAI) and gender were assessed to predict defensive reactions.

Results: In Study 1, induced eye movements significantly increased self-reported consumption after 2 weeks when CSAI was low, but only in males, as indicated by a significant three-way interaction ($p < 0.001$). With negative self-evaluative emotions as dependent variable, this three-way interaction was also significant ($p < 0.05$), suggesting that induced eye movements prevented defensiveness in low CSAI males. Study 2 did not assess consumption but replicated the latter three-way interaction ($p < 0.05$).

Conclusion: The studies replicated our earlier findings regarding the moderating effects of individual differences in emotion regulation (i.e., CSAI) on persuasion, but they also revealed gender differences in persuasion that are related to the working memory. The working memory account of persuasion provides new theoretical as well as practical angles on persuasion to target individuals in persuasion to increase fruit and vegetable consumption.

Keywords: eye movements, working memory, persuasion, emotion regulation, gender differences

INTRODUCTION

In the framework of health promotion, the proven relationship between fruit and vegetable consumption on the one hand, and cardiovascular diseases, cancer, and all-cause mortality on the other hand (Aune et al., 2013), might be translated into health messages directed at the general public. However, the effectiveness of health messages is often lowered by recipients' defensive reactions, such as denial, biased processing, and message rejection (Liberman and Chaiken, 1992; Ruiter et al., 2001; Good and Abraham, 2007). Also with regard to messages and interventions that advocate fruit and vegetable consumption, several studies suggest or identify such detrimental reactions (Epton and Harris, 2008; Dijkstra et al., 2011; Pietersma and Dijkstra, 2011b; Thompson and Kumar, 2011; Elbert and Dijkstra, 2014; Ungar et al., 2015; Fielden et al., 2016; van Koningsbruggen et al., 2016). As these defensive reactions can lower the effectiveness of persuasive messages regarding fruit and vegetable consumption, they may be partly responsible for the high proportion of people that does not consume fruit and vegetables according the guidelines (Lee-Kwan et al., 2017; Eurostat Statistics Explained, 2020). Therefore, understanding such detrimental psychological reactions toward health messages is one important direction for research in health promotion and persuasion regarding fruit and vegetable consumption.

The Working Memory Account

In the present theorizing, persuasive processes take place in the working memory (WM). The WM is the virtual place where attention is directed, where incoming information is compared to stored information and where ongoing reactions are initiated and regulated [(Baddeley, 1986, 2012; Diamond, 2013) for a different conceptualization]. The WM account of persuasion assumes that persuasive processes take place in the WM and that two phases can be recognized.

In the first phase, the persuasive information enters the WM, where it is linked to information from the long-term memory (Symons and Johnson, 1997; Kruglanski and Thompson, 1999); activated long-term memory contents may then give self-relevant meaning to the incoming information. This meaningful information that is now held in the WM may be represented in a more or less vivid mental image (Kosslyn et al., 1983; Pearson et al., 2015). In persuasion, this mental image will be about the persuasive outcomes in a message (Bruyer and Scailquin, 1998; Bolls and Lang, 2003), for example, the negative consequences of consuming a low level of fruit and vegetables. As the mental image is compared to a standard (related to values and goals), it may trigger the experience of a threat, possibly with its accompanying emotions, such as fear (Witte, 1992), and negative self-evaluative emotions (Dijkstra and Buunk, 2008). These are aversive experiences that people are motivated to avert.

When the threat passes a certain threshold, the second phase may be activated to down-regulate the threat—the defensive reactions are mobilized to lower the aversive feelings of threat caused by the persuasive message, in health behavior especially negative self-evaluative emotions. One emerging perspective on defensive reactions is that they also can be "located" in the WM, as they can be conceptualized as self-regulatory actions (Baumeister and Vonasch, 2015; Dijkstra, 2018) or as a manifestation of emotion regulation (Koole and Aldao, 2005; Gross, 2007). These cognitive self-regulatory actions may consist of processes that reject the persuasive message or processes that direct the behavior toward a solution in line with the persuasive message (Witte, 1992).

Thus, the WM account of persuasion assumes that the development of mental images (Bruyer and Scailquin, 1998; Bolls and Lang, 2003; Gunter and Bodner, 2008; Hout et al., 2011b) and the self-regulatory actions in response to the persuasive information (Hinson et al., 2003; Barrett et al., 2004) take place in the WM. A central premise is that the development of mental images and of self-regulatory actions is not for free: it needs WM space. This implies that when there is not enough WM space, one or both processes may not completely unfold. Mental images may fail to reach high quality (e.g., vividness), and/or self-regulatory actions may be prevented or disturbed, and not or less effective. This may have various effects on persuasion. Thus, the available WM space can be expected to influence persuasion, which implies that, taxing the WM with another, competing task will influence persuasion. One way to tax the WM is by inducing regular eye movements. In persuasion, induced regular eye movements can tax the WM while the persuasive information is presented through the auditory channel.

Induced Eye Movements in Persuasion

Induced horizontal eye movements (EMi) have been studied in the context of understanding and treating posttraumatic stress disorder (Shapiro, 1999), in which fearful and traumatic memories are central (Davidson and Parker, 2001). In this approach, induced eye movements are a core element in the treatment referred to as Eye Movement Desensitization and Reprocessing. In this context, EMi have been shown to lower the vividness and emotionality of mental of images from autobiographical memories of negative past events (Gunter and Bodner, 2008; Hout et al., 2011a,b). However, in persuasion, the mental images are not about past events but about outcomes in the future (i.e., the effects of consuming a low level of fruit and vegetables). These mental images might be conceptualized as "distressing images about feared future events," the so-called "flashforwards," which also have been shown to become less vivid and less emotional after EMi (Engelhard et al., 2010). All these effects, including those in our own studies on persuasion (Dijkstra and Asten, 2013; Dijkstra and Elbert, 2019), seem to be best explained by a WM account in which the EMi demand WM space as a competing task.

As proposed above, in persuasion, mental images and self-regulatory reactions to these mental images are brought about in the WM. First, EMi can disturb the development of mental images of the persuasive outcomes. This can have two effects: either there is no persuasive power left, or there is some persuasive power left but the level of threat stays below a threshold, thereby preventing the mobilization of self-regulatory actions. In the latter case, EMi influence self-regulatory reactions indirectly (through effects on mental images). Second, EMi can disturb the development of self-regulatory reactions directly.

The persuasive effect of disturbing the self-regulatory reactions will depend on the type of reaction—unfavorable or negative reactions or thoughts in persuasion have been shown to manifest as counterarguments that need self-regulatory resources and thus can be conceptualized as self-regulation (Wheeler et al., 2007; Dijkstra, 2018). When people react with defensive self-regulatory processes (negative/unfavorable thoughts), which have the potential to lower persuasion, EMi will disturb these inhibiting processes and therefore will lead to increased persuasion. However, people can also show favorable or positive reactions or thoughts, which can be conceptualized as self-regulation as well, and these also have been located in the WM (Kane and Engle, 2003; Hofmann et al., 2008). These reactions support persuasion, and disturbing these reactions with EMi will lower persuasion, an undesired side effect of EMi in practice. Therefore, it is important to predict who will react defensively and who will react positively. The individual difference "cognitive self-affirmation inclination" (CSAI) has been shown to predict negative as well as positive reactions toward threatening persuasive information (Pietersma and Dijkstra, 2011a; Dijkstra and Elbert, 2019).

The CSAI is an individual difference measure of emotion regulation. A high score on the measure of CSAI indicates a strong inclination to cope with a self-threat by thinking of compensating positive self-images, selectively and functionally derived from one's long-term memory. Similar to the effect of a self-affirmation procedure (Harris and Napper, 2005; Sweeney and Moyer, 2015), these people process the persuasive information open-minded and become painfully aware of their own role in generating unhealthy effects, leading to negative self-evaluation (Jessop et al., 2009; van Koningsbruggen et al., 2016) and thereby to more persuasion (meant to lower these negative emotions). On the other hand, a low score on CSAI indicates the use of other strategies to deal with the threat. Our studies suggest that the intention of people with low CSAI was actively lowered by defensive self-regulatory actions (Pietersma and Dijkstra, 2011a). Those low in CSAI are expected to hold off the threat by negative cognitive reactions during the processing of the information, which inhibits persuasion. **Figure 1** summarizes the main concepts in the present WM account of persuasion (WMAP; 39).

In a recent study, these predictions from the WMAP were verified (Dijkstra and Elbert, 2019). In people scoring low on CSAI on pretest, EMi significantly increased fruit and vegetable consumption, whereas in people scoring high on CSAI on pretest, EMi significantly lowered fruit and vegetable consumption. This means that we can now predict who will react defensively to a message promoting fruit and vegetable consumption and in whom EMi can have beneficial effects. The present study aims not only to replicate these findings but also to bring this line of research one step further.

One issue concerns the threat that is caused by vivid mental images. In a behavior that is in principle under control of the individual, learning about the negative consequences of one's own behavior will lead to negative self-evaluative emotions. We have shown that these emotions are consistent and powerful predictors of behavior change (Dijkstra et al., 1999; Dijkstra and Dijker Den, 2005; Dijkstra and Buunk, 2008). It is expected that people high in CSAI will experience a strong negative self-evaluation when they process a health message (they are open-minded and acknowledge their own role), but EMi will lower this as the mental images that lead to the threat, and the subsequent emotions are prevented to fully unfold. In contrast, people who are low in CSAI will experience less negative self-evaluation when they process a health message because they apply defensive self-regulation to avert the negative emotions. This defensive regulation leads to peace of mind. EMi will disturb the defensive self-regulation, thereby leaving the mental images and their subsequent threat and negative emotions to fully unfold and get their persuasive momentum.

During the development of our expectation on the basis of the WMAP, we ran into a variable that seemed to be related inherently to WMAP's two main processes: (1) experiencing negative emotions in reaction to external information and (2) related emotion regulation: gender. There are some studies that show gender differences in emotional reactions toward potentially threatening information, with males experiencing stronger negative affective reactions toward such messages, including aggression, although overall the results are mixed (McRae et al., 2008). For example, a meta-analysis concluded that men probably are "more easily aroused by [aggressive relevant] emotionally evocative stimuli" (p. 379; 50). However, with regard to gender differences in persuasion, the results seem more consistent. There are several reports that suggest that males react more defensively toward persuasive attempts: Males were more likely than females to perceive negative affect and source derogation to be helpful strategies for resisting persuasion (Zuwerink Jacks and Cameron, 2003); males showed a stronger "third-person effect," meaning that they rated messages more influential for other people than for themselves (Lewis et al., 2007); males scored higher on a measure of message derogation (Kamboj et al., 2016), and they more strongly downgraded the problem that was communicated in the persuasive messages (Goldenbeld et al., 2008). This gender difference in defensiveness is backed up by literature on emotion regulation (Diehl et al., 1996). For example, in contrast to females, males showed a tendency to deny depressive symptoms (Joiner et al., 2000); males used less rumination, reappraisal, and acceptance (Nolen-Hoeksema and Aldao, 2011), and differences in the neural bases of emotion regulation are observed (Williams et al., 2005; McRae et al., 2008; Whittle et al., 2011). In summary, there is evidence that males and females can differ in reactions toward persuasive messages, with males being more defensive. In our theorizing, this means that males will be less persuaded by our health message than females, but that EMi will disturb these defensive reactions, leading to more persuasion and to stronger negative self-evaluative emotions.

The Present Studies

The global aim is to study the effects of EMi in persuasion. In two EMi versus no EMi online experiments in the general population, participants listen to a negatively framed persuasive audio message promoting fruit and vegetable consumption, whereas in half of them EM will be induced (following a stimulus on a computer screen with one's eyes). In Study 1, the primary

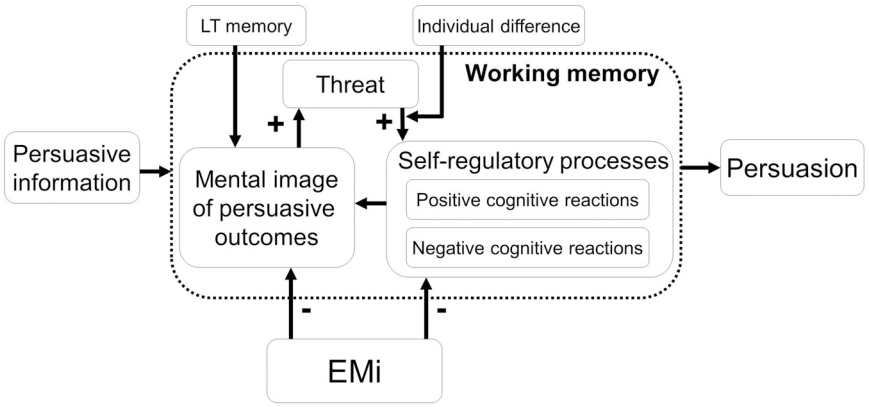

FIGURE 1 | The working memory account of persuasion and induced eye movements.

dependent variable is the actual (self-reported) fruit and vegetable consumption assessed after 2 weeks. In Studies 1 and 2, the effects of EMi on negative self-evaluation assessed immediately after the message exposure will be assessed.

Because EMi can only influence the persuasive process in the desired direction when recipients are defensive, EMi is expected to lead to more fruit and vegetable consumption in those who score low on CSAI. Here we aim to replicate our earlier study (Dijkstra and Elbert, 2019). Expanding the former study, EMi is also expected to lead to a more negative self-evaluation in those who score low on CSAI. These effects depend on the defensiveness of people with low CSAI, but the same is expected for males. Because especially males are expected to be defensive toward persuasive attempts, EMi will increase their consumption and their negative self-evaluation. Lastly, it will also be explored whether both moderators work synergistically and whether the combination of low CSAI and male gender is related to the behavioral and psychological effects of EMi.

STUDY 1

Methods

Recruitment

Participants were recruited in the Netherlands and in Germany in, initially, two online experiments. The aim to include at least 50 participants per condition was reached by combining the data from both experiments. In both countries, the participants were recruited through Facebook, to reach a population with variance in gender, age, and education level. The call to join a study of the University of Groningen on fruit and vegetable consumption was published on more than 40 Facebook pages, during a period of approximately 5 weeks.

Design

All participants listened to a negatively framed auditory health message on fruit and vegetable consumption, while they were randomly assigned to one of two conditions: induced eye movements (EMi) or no induced eye movements (no EMi). The process measure, negative self-evaluative emotions, was assessed immediately after the manipulations. The outcome measure self-reported fruit and vegetable consumption was assessed after 2 weeks. The study was approved by the Ethical Committee Psychology of the Faculty of Behavioral and Social Sciences.

Procedure

Participants who followed the link in the call entered the Qualtrics system in which they were welcomed and were provided with information on the coming study. They were informed that they would be asked to answer some personal questions and then listen to an auditory message on the negative consequences of low fruit and vegetable consumption and answer some remaining questions. In addition, they were told that they would receive a link to another brief questionnaire after 2 weeks and that they could join a lottery for an amount of 50 euros when they would fill in their email address. Besides further formal and legal information on research ethics, data storage, and privacy, they were asked to join the study using a device with a large screen, not on their smartphone. Lastly, they were asked for their formal consent to join the study by clicking the "proceed" button.

Demographics and several brief measures of individual differences were assessed before participants entered the conditions. After being assigned randomly to one of both conditions, participants were instructed for the specific manipulations, and next, they were exposed to the manipulations. All participants were asked to listen to the auditory persuasive message, while half of them were instructed to keep watching the moving stimulus (see later). After that, they were asked some questions concerning the process measures, and they were thanked and invited to join the study in 2 weeks. Participants who gave their email address were sent a link to the follow-up questionnaire after 2 weeks. After self-reporting their fruit and vegetable consumption, they were debriefed.

The Persuasive Message

The auditory persuasive message (Dijkstra and Asten, 2013) advocated fruit and vegetable consumption and was negatively framed. It comprised approximately 240 words (110 s) that

mentioned the possible negative outcomes of not eating sufficient levels of fruit and vegetables (mainly losses, e.g., "larger risk for cancer").

Besides the information on these major outcomes related to low fruit and vegetable consumption, consumption was said to be related to looking less healthy, to worsened physical stamina, and to aging ("unhealthier skin and hair"). Two intermediary physical states were presented to be related to these consequences: "high blood pressure" and "high cholesterol." These effects were said to be related to lowered intake of vitamins C and E.

To be able to induce eye movements (using a stimulus on the screen), the message was offered through the auditory channel. Female voices that presented the message (in Dutch and in German, respectively) were carefully selected and recorded in professional recording studios. The actor was instructed to speak at a normal rate, with normal intonation, as the actor would read it like a professional newsreader.

The EMi Manipulation

In the EMi condition, participants were instructed to listen to the auditory message and at the same time look at the moving stimulus. In the German study, the stimulus was a black dot moving on a gray screen. For technical reasons, the stimulus in the Dutch study was altered into a red square on a white screen. The instructions were the same: "On the screen you will see a dot/square moving from left to right and vice versa. Please, follow the dot/square with your eyes all the time while listening to the auditory message." On a 30-cm screen, the size of the dot/square was 20 mm. It moved from one side of the screen to the other in 2 s (independent of screen size), and it kept on moving until the auditory message was finished. Participants in the no-EMi condition were not presented with a moving dot/square and listened only to the audio message that was accompanied by a (gray or white) stable screen.

Measures

Pretest measures

In the first part of the questionnaire, participants were asked for their gender and age. In addition, they were asked to provide a judgment on their fruit and vegetable consumption: They could finish the sentence, "In general, I eat. . .," which was followed by five options they had to choose one from: "far too little fruit" (1), "too little fruit" (2), "somewhat too little fruit" (3), "sufficient fruit" (4), "more than sufficient fruit" (5). The same format was used to assess perceived vegetable intake. The scores on both items were averaged to form a score of "discrepancy," with a lower score representing a large discrepancy from one's standard. The correlation between the fruit item and the vegetable item was $r = 0.45$, $p < 0.001$.

Cognitive self-affirmation inclination was assessed with six items on the experienced frequency of having specific self-related positive thoughts (Pietersma and Dijkstra, 2011a). Our earlier study showed that high scores on the CSAI led to the open-minded processing of threatening information, similar to the effects of a self-affirmation procedure. Low scores led to a defensive reaction toward a (moderate) threat. The following statements were part of the CSAI scale: "I notice that I do some things very well;" "When I feel bad about myself, I think about all the things that I can be proud of;" "I think about the things I in the past I did well;" "I think about all the things that I have successfully accomplished;" "When I have done something wrong that makes me feel dissatisfied with myself, I tell myself that I do not do everything wrong;" and "I realize that besides all the 'stupid' things I do, I also do some things very well." These items could be scored on a perceived frequency scale: "never" (1), "sometimes" (2), "regularly" (3), "often (4), "very often" (5). The Cronbach α was 0.78.

Some other individual difference measures were applied that will not be presented here, as they are not pertinent to the present study.

Posttest measures immediate

After listening to the message, participants in the EMi condition were asked how well they succeeded in watching the dot/square: "To what extend did you succeed in watching the dot/square all the time?" This question could be answered on a scale ranging from "not at all" (1) to "completely" (seven in the Dutch study, nine in the German study). Next, all participants were asked how well they succeeded in listening to the audio text. (Only in the Dutch study the first questions after this part were about the quality of the mental images participants experienced during the exposure. These data will not be analyzed in the present study). A one-item measure of negative self-evaluative emotions was applied (Dijkstra and Buunk, 2008): "After having listened to the text, how dissatisfied are you with yourself?" This item could be answered from "not at all dissatisfied" (1) to "very dissatisfied" (7). Lastly, one item on fear and a four items on intention were applied, but not used for the present study.

Posttest measure follow-up

Two weeks after completion of the experiment, respondents were sent the link to the online follow-up questionnaire as part of the study. The questionnaire was a detailed and validated self-report frequency questionnaire on the own average weekly fruit and vegetable intake during the past 2 weeks (Bogers et al., 2004; Elbert et al., 2016). Respondents were asked to indicate how often on average they ate or drank products from several fruit and vegetable categories during the previous weeks per week. The answering options ranged from "never or less than 1 day a week" (0), "1 day a week" (1) to "every day" (7). Next, they were asked to indicate the amount of intake per category of fruit or vegetables in terms of pieces of fruit and servings of vegetables (answering options ranged from "no pieces/glasses/serving spoons" to "five or more pieces/glasses/serving spoons"). The main categories were "cooked vegetables," "raw vegetables/salad," "fruit/vegetable juice," "tangerines," "oranges/grapefruits/lemons," "apples/pears," "bananas," "other fruit," and "apple sauce." The average number of days per week and the pieces of fruit and vegetable portions (defined as 50 g each) were multiplied for each category and added to create a composite index of weekly fruit and vegetable intake.

Results

Selection and Attrition Analyses

The main analyses on our two outcome measures, negative self-evaluative emotions (assessed immediately after the manipulations) and self-reported fruit and vegetable consumption (assessed after 2 weeks), were conducted in the cohort with complete 2-week follow-up data. This cohort was composed by the following attrition and selection procedure. In total, 590 participants entered the system and gave their consent by clicking the button, and 70 immediately stopped after that. Of the remaining 520 participants, 372 got to the page on which the audio procedure was introduced; they were randomized to one of both conditions. Of these 372 participants, another 44 did not provide immediate posttest data, leading to 328 participants. Of the 167 participants in the EMi condition, 18 scored under the midpoint on the scale asking to what extent they succeeded in "keeping their eyes on the dot/square all the time." These were excluded from the analyses, leaving 149 participants in the EMi condition and 161 in the no-EMi condition. Of these 310 participants, 118 (38%) provided complete follow-up data (57 in the EMi condition, 61 in the no-EMi condition). Of these participants in whom the main analyses were run, 33.1% ($n = 39$) had joined the study on their smartphone.

To check whether a relevant selection had occurred from the participants who gave their consent and entered the study system, these 118 in the final cohort were compared to the 340 participants who provided no follow-up data but of whom the following measures were available: age, gender, CSAI, discrepancy, and pretest intention. No significant differences were found between these groups on these variables, although with regard to discrepancy the test approached significance ($p = 0.067$), suggesting a stronger discrepancy in the participants who were excluded. The experimental conditions also did not differ significantly on the proportions of participants who provided follow-up data.

Sample Characteristics and Randomization Check

The sample of 118 participants consisted of 66.6% females (one missing value on gender); the average age was 32.6 years [standard deviation (SD) = 16.35 years; one missing value on age]; the mean score on CSAI was 2.92 (SD = 0.67); the mean discrepancy score was 3.24 (SD = 0.87), and pretest intention was on average 3.76 (SD = 1.50). To check the randomization, the EMi conditions were compared on these five variables. The conditions did not differ significantly (p's > 0.31) on all these variables, suggesting that the randomization was successful.

Relations Among the Main Variables

To investigate the need to use pretest intention and discrepancy as covariates in the coming analyses of variance, correlations were computed. Pretest intention was significantly related to the dependent variable–negative self-evaluation, $r(118) = 0.320$, $p < 0.001$, not to fruit and vegetable consumption. Discrepancy was related significantly to both dependent variables: negative self-evaluation $r(118) = -0.29$, $p < 0.01$; self-reported consumption, $r(118) = 0.319$, $p < 0.001$. It was therefore decided to include pretest intention and discrepancy in all coming analyses as covariates. In addition, it was tested whether the two potential moderators, CSAI and gender, were related to each other and to both covariates. All these relations were not significant (p's > 0.11).

CSAI and Gender as Independent Moderators

First, the moderating effects of CSAI and gender were tested separately. To start with, the expected two-way interaction between EMi and CSAI, including pretest intention and discrepancy as covariates, was tested for both dependent variables, negative self-evaluation and fruit and vegetable consumption. Both interactions approached significance, $F(1,112) = 2.96$, $p = 0.088$, $\eta^2 = 0.026$, and $F(1,112) = 3.14$, $p = 0.079$, $\eta^2 = 0.054$, respectively. The means for both dependent variables showed the expected pattern. In case of low CSAI (indicating defensive self-regulation), EMi was associated with higher means (disturbing the defensive self-regulation). In case of high CSAI (indicating supporting processes), EMi was associated with lowered means (disturbing supporting processes).

To test whether the main effect of EMi was significant when CSAI was low, and when it was high, the complete dataset ($n = 118$) was modeled to represent two levels of CSAI scores, by subtracting and adding one from the individual standardized scores (z scores), respectively (Cohen et al., 2003; Siero et al., 2009). However, for both dependent variables, the main effects of EMi in high and low CSAI were not significant (p's > 0.11).

Next, the expected two-way interaction between EMi and gender, including pretest intention and discrepancy as covariates, was also tested for both dependent variables. Both interactions were not significant, p's > 0.16. The mean scores on both variables were in the expected directions, with EMi being associated with more negative self-evaluation and a higher consumption, only in men. The main effects of EMi in females and males were not significant.

To conduct a last check for these two-way interactions, both interactions were tested in one model for each dependent variable (Yzerbyt et al., 2004). With self-evaluation as dependent variable, this model showed that both interactions approached significance (p's $> 0.09 < 0.10$). With consumption as dependent variable, this model showed that only the CSAI × EMi interaction approached significance ($p = 0.057$). In summary, with regard to negative self-evaluation and fruit and vegetable consumption, the patterns of means related to both moderators, CSAI and gender, were all in expected directions (Dijkstra and Elbert, 2019) but the moderation effects at the best approached significance. Therefore, it was tested whether both moderators worked synergistically, in a three-way interaction.

The Three-Way Interaction

For both dependent variables, a three-way interaction was conducted in a saturated model (with the three-way interaction as highest order factor), with pretest intention and pretest discrepancy as covariates, using an analysis of covariance (ANCOVA). With regard to negative self-evaluation, this three-way interaction was significant, $F(1,107) = 4.41$, $p < 0.038$, $\eta^2 = 0.04$, as it was for self-reported fruit and vegetable consumption, $F(1,107) = 12.99$, $p < 0.001$, $\eta^2 = 0.10$. **Figures 2**,

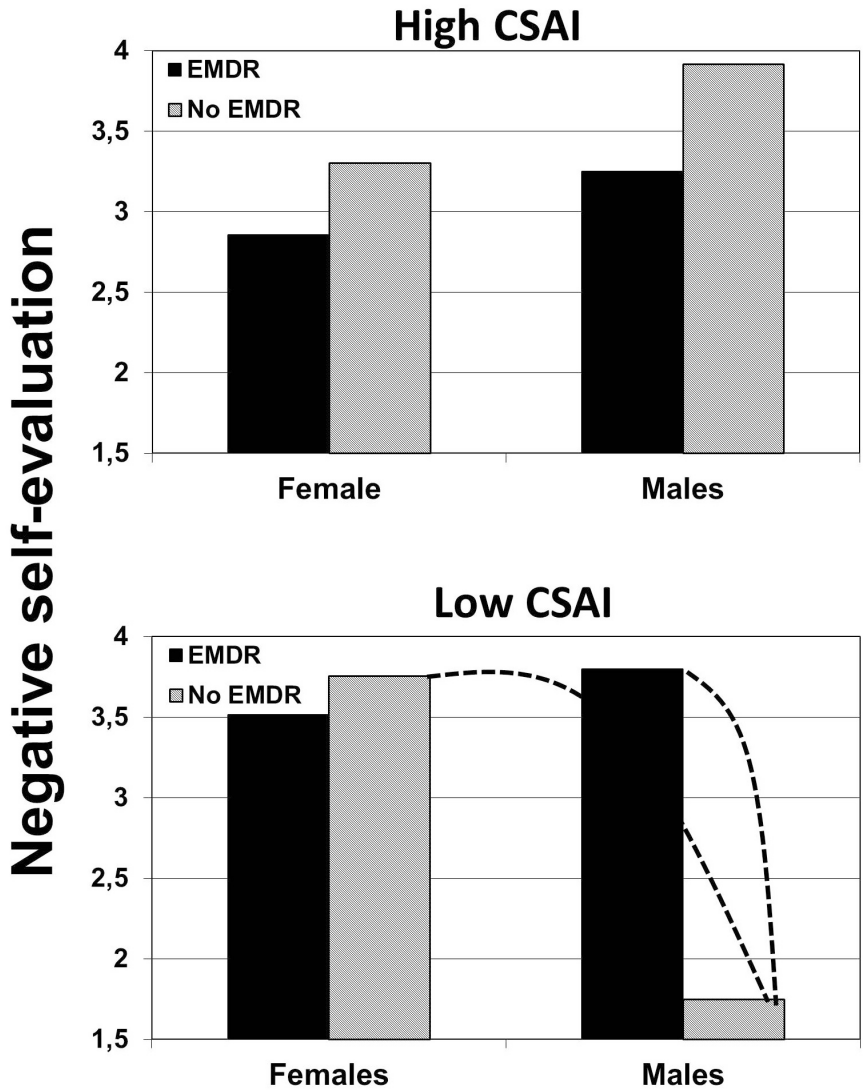

FIGURE 2 | The effects of induced eye movements (EMi) on negative self-evaluation, moderated by CSAI and gender (the dotted line indicates a significant difference).

3 show the estimated means of the effects of EMi on self-evaluation and fruit and vegetable consumption, according to CSAI and gender.

Effects on Self-Evaluation

To further understand the significant three-way interaction, it was tested whether the interaction between gender and EMi differed within each of the two levels of CSAI. Using the same method as explained above, two levels of CSAI were modeled. When CSAI was modeled as low, the gender × EMi interaction was significant, $F(1,107) = 6.78$, $p = 0.011$, $\eta^2 = 0.04$. As can be observed in **Figure 2**, the expected effect of EMi occurred among males. To further test the expected pattern, the interaction between CSAI and EMi in only males was tested, which was significant, $F(1,33) = 8.84$, $p = 0.005$, $\eta^2 = 0.21$. Contrast analyses showed that in males, EMi (mean = 3.8) led to a significantly higher negative self-evaluation (mean = 1.75), $p = 0.007$, diff. 95% confidence interval (CI) = −3.53 to −0.57, $\eta^2 = 0.066$. When CSAI was modeled as high, the gender × EMi interaction was not significant, $p > 0.80$, and no contrasts were significant.

To further test the observed effects, the interaction between gender and CSAI was analyzed when people listened only to the persuasive audio, thus without eye movement induction. This two-way interaction was significant, $F(1,54) = 7.94$, $p = 0.005$, $\eta^2 = 0.13$, showing that the reactions of males and females to the persuasive audio depended on their CSAI. When CSAI was low, the mean self-evaluation of males (mean = 1.75) was significantly lower than the self-evaluation of females (mean = 3.75), $p = 0.003$, diff. 95% CI = −3.29 to −0.71, $\eta^2 = 0.081$. Within the condition with the eye movement induction, the interaction was not significant, $F(1,51) < 1$, $p = 0.32$, $\eta^2 = 0.019$.

Effects on Consumption

To further understand the significant three-way interaction with regard to self-reported fruit and vegetable consumption, it was tested whether the interaction between gender and EMi differed within each of the two levels of CSAI. Using the same method as explained above, two levels of CSAI were modeled. When CSAI was modeled as low, the gender × EMi interaction was significant, $F(1,107) = 9.85$, $p = 0.002$, $\eta^2 = 0.084$. When CSAI was modeled as high, the gender × EMi interaction approached significance, $F(1,107) = 3.71$, $p = 0.057$, $\eta^2 = 0.033$. As can be observed in **Figure 3**, the expected pattern was present in males, not in females. To test the expected pattern, the interaction between CSAI and EMi in only males was tested, which was significant, $F(1,33) = 12.43$, $p = 0.001$, $\eta^2 = 0.27$. Contrast analyses within males showed that when CSAI was modeled as low, EMi (mean = 50.06) led to a significantly higher self-reported fruit and vegetable consumption compared to no EMi (mean = 18.81), $p = 0.002$, diff. 95% CI = −50.61 to −11.89, $\eta^2 = 0.087$. When CSAI was modeled as high, EMi (mean = 40.9) led to a significantly lower self-reported fruit and vegetable consumption compared to no EMi (mean = 62.9), $p = 0.008$, diff. 95% CI = 5.98 to 37.99, $\eta^2 = 0.065$.

To further test the observed effects, the interaction between gender and CSAI was analyzed when people listened only to the persuasive audio, thus without eye movement induction. This two-way interaction was significant, $F(1,54) = 15.31$, $p < 0.001$, $\eta^2 = 0.22$, showing that the reactions of males and females to the persuasive audio depended on their CSAI. Contrast analyses showed that when CSAI was low, males reported a significantly lower fruit and vegetable consumption (mean = 18.81) compared to females (mean = 44.93), $p = 0.003$, diff. 95% CI = −42.97 to −9.26, $\eta^2 = 0.081$. When CSAI was high, males reported a significantly higher fruit and vegetable consumption (mean = 62.9) compared to females (mean = 41.44), $p = 0.011$, diff. 95% CI = 5.0 to 37.9, $\eta^2 = 0.059$.

Post hoc Analyses

To test whether negative self-evaluation mediated the effects of the CSAI × gender × Emi interaction on fruit and vegetable consumption, two tests were conducted. First, the data showed a non-significant correlation between negative self-evaluation and consumption, $r(118) = -0.049$, $p \geq 0.60$. Second, the three-way interaction with consumption as DV was rerun, now with negative self-evaluation in the model as independent variable. As could be expected on the basis of the former analysis, only minor changes in the statistics of the three-way interaction occurred (e.g., the *F*-value changed from 12.99 to 12.73). Therefore, it can be concluded that there is no mediation, and no further testing of mediation was conducted.

Additional analyses were also conducted to rule out that the findings were caused by underlying differences between the experiments in the Netherlands and Germany, and between participants who joined the study on their smartphone and those who used a larger screen. The above saturated models with three-way interactions were expanded by now including also the three-way interaction of EMi, CSAI, and screen or the three-way interaction of EMi, CSAI, and country. None of the interaction tests was significant (*p*'s > 0.21), and only minor changes in *p*-values regarding negative self-evaluation and consumption occurred, suggesting no confounding of the core results by screen and country.

STUDY 2

The aim of this study was only to replicate Study 1 with regard to negative self-evaluation: It is expected that the effect of EMi on negative self-evaluation is moderated by CSAI and gender. Especially in males with low CSAI, the negative self-evaluation will be low (indicating defensive self-regulation), and EMi will lead to a significant increase in negative self-evaluation.

Method

The recruitment, the procedure, the persuasive message, the EMi procedure, and the immediate measures were all the same as in Study 1. There were two differences with Study 1. First, no follow-up data on fruit and vegetable consumption were available; the response at follow-up was only 20%, with very low counts in the EMi condition. Second, originally Study 2 had a 2 × 2 design; besides EMi, another manipulation was conducted (half of the participants received a forewarning of persuasive intent), but this had no detectable effects. Because this manipulation that was used for the first time seemed to be inert, it was ignored in the below analyses.

Results

Sample Characteristics and Randomization Check

The sample of 99 participants consisted of 59.6% females, the average age was 34.7 years (SD = 13.9 years), the mean score on CSAI was 2.94 (SD = 0.83), the mean discrepancy score was 3.35 (SD = 0.89), and pretest intention was on average 4.52 (SD = 1.62). To check the randomization, the EMi conditions were compared on these five variables. The conditions did not differ significantly (*p*'s > 0.15) on all these variables, suggesting that the randomization was successful.

Effects on Negative Self-Evaluation

The same as in Study 1, a three-way interaction was conducted in a saturated model (with the three-way interaction as highest order factor), with pretest intention and pretest discrepancy as covariates, and negative self-evaluation as dependent variable, using an ANCOVA. This three-way interaction was significant, $F(1,89) = 5.06$, $p < 0.027$, $\eta^2 = 0.054$. **Figure 4** shows the estimated means of the effects of EMi on negative self-evaluation according to CSAI and gender.

To further understand the three-way interaction, it was tested whether the interaction between gender and EMi differed within each of the two levels of CSAI. Using the same method as explained above, two levels of CSAI were modeled. When CSAI was modeled as low, the gender × EMi interaction was significant, $F(1,89) = 9.06$, $p = 0.003$, $\eta^2 = 0.09$. As can be observed in **Figure 4**, the expected effect of EMi occurred among males. To further test the pattern of means, the interaction between CSAI and EMi in only males was tested, which was also significant,

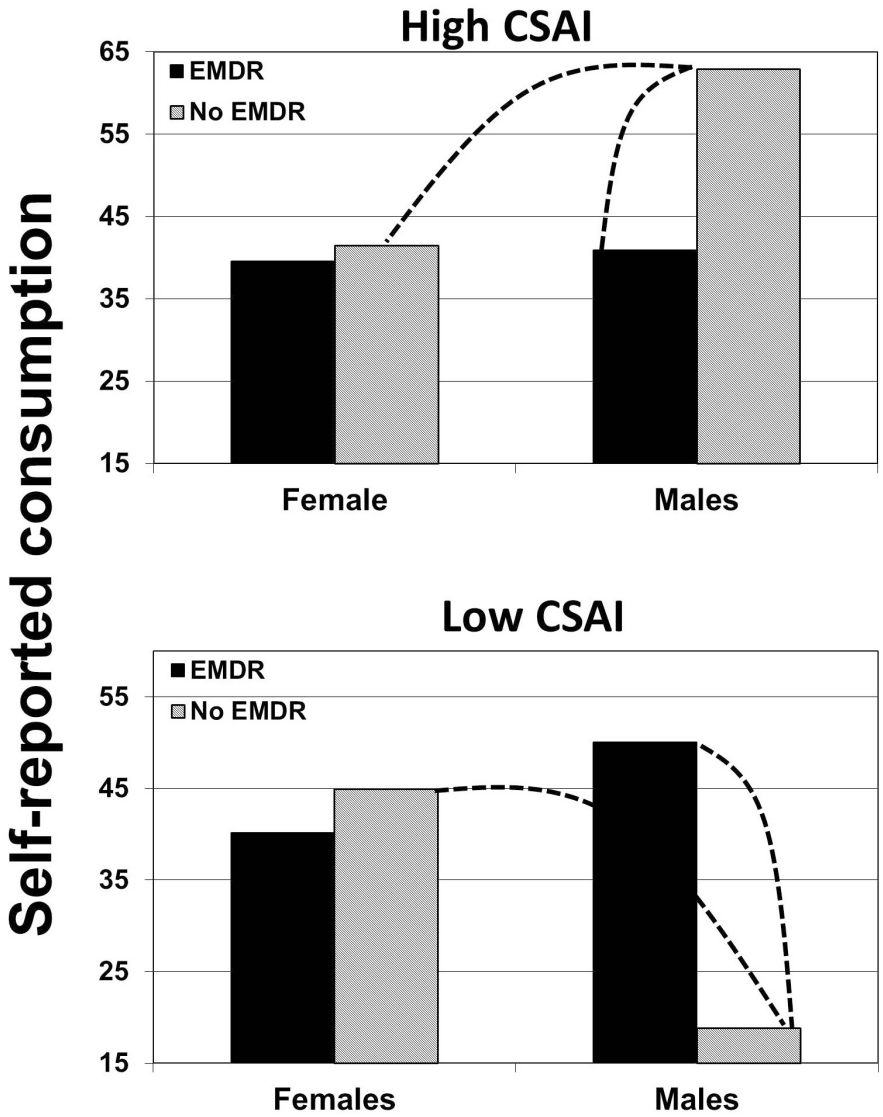

FIGURE 3 | The effects of induced eye movements (EMi) on self-reported fruit and vegetable consumption, moderated by CSAI and gender (the dotted line indicates a significant difference).

$F(1,34) = 7.0$, $p = 0.012$, $\eta^2 = 0.19$. Contrast analyses showed that in males, EMi led to a significant increase in negative self-evaluation (mean = 5.36) compared to no EMi (mean = 2.72), $p = 0.004$, diff. 95% CI = −4.42 to −0.87, $\eta^2 = 0.09$, but also compared to females in the EMi condition (mean = 3.32), $p = 0.018$, diff. 95% CI = 0.36 to 3.74, $\eta^2 = 0.061$. Lastly, within the no-EMi condition, males (mean = 2.72) showed a less negative self-evaluation compared to females (mean = 3.9), a difference that only approached significance, $p = 0.073$, diff. 95% CI = −2.48 to 0.11, $\eta^2 = 0.036$. When CSAI was modeled as high, the gender × EMi interaction was not significant, $p > 0.59$, and no contrasts were significant. Thus, in Study 2, with participants recruited at another time through largely different Facebook pages only in the Netherlands, a very similar pattern of means was found as in Study 1.

GENERAL DISCUSSION

Defensive reactions toward health messages regarding fruit and vegetable consumption can lower the effectiveness of persuasion. The present study showed that induced eye movements can prevent or disturb defensive reactions, thereby restoring the messages' potential to induce behavior change. The results not only replicate earlier findings (Dijkstra and Elbert, 2019) but also extend these by showing that the effects occur especially in males.

The two expected independent two-way interactions of EMi with CSAI and with gender at best approached significance, although all means were in the expected directions. Such a finding mostly brings up the question: "In whom will this interaction be more pronounced?" The three-way interaction gave the answer; it showed that CSAI and gender worked synergistically. Looking

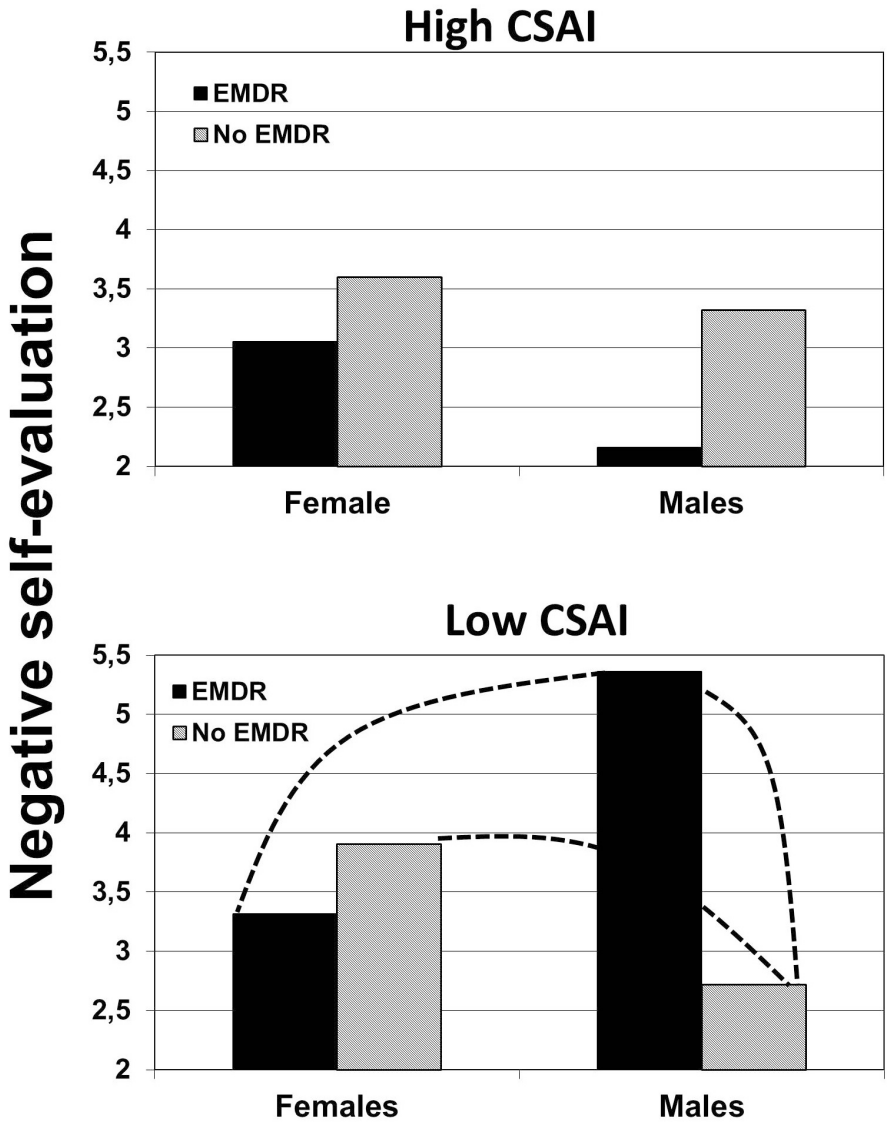

FIGURE 4 | The effects of induced eye movements (EMi) on negative self-evaluation, moderated by CSAI and gender (the dotted line indicates a significant difference).

at all three figures, the low scores on negative self-evaluation and consumption of males with a low CSAI resemble a defensive reaction. In reaction to an auditory message, advocating fruit and vegetable consumption (and without EMi), especially men with lower CSAI scores, showed a less negative self-evaluation and lower consumption. The low score on negative self-evaluation suggests successful emotion regulation; despite the message implying that the recipient is endangering oneself, males who scored low on CSAI evaluated themselves as less negative, in contrast to females low on CSAI. In our theorizing, this low negative self-evaluation is caused by a mental image that is down-regulated in threat to repair the self-evaluation and avoid the aversive state of conflict (Dijkstra and Buunk, 2008). This mental image of lower quality also has less persuasive power to change behavior (as additionally observed from the low scores on consumption). In these males scoring low on CSAI, EMi led to a significant increase in negative self-evaluation and in fruit and vegetable consumption, EMi disturbed the defensive processes that undermined the quality, vividness, and emotionality, of the mental images.

When males scored high on CSAI (and without EMi), they had especially high scores on consumption. In our theorizing, this is caused by the positive and persuasion-supporting processes that are associated with high CSAI (Pietersma and Dijkstra, 2011a). In these males scoring high on CSAI, EMi led to a significant decrease in fruit and vegetable consumption (but not in negative self-evaluation), suggesting that the positive processes had been disturbed.

Whereas in males the effects of EMi significantly depended on CSAI, in females there was no trace of an interaction. Thus,

although males and females can both score high or low on our measure of emotion-regulation CSAI, it seems to work differently for them. We must conclude that in females, CSAI was not related to any WM demanding processes that could be disturbed by EMi. There may be different reasons for that. CSAI is an individual difference that manifests only when a threshold of threat is passed. It may be that only in males the threat caused by the present auditory message passed a threshold and activated this emotion regulation. This might mean that females would do the same but only when the threat is higher. Moreover, it may also be that males' threshold to engage in emotion regulation is lower. The present study cannot unravel this issue, but these results are in line with literature suggesting that males are more inclined to react negatively to persuasive stimuli, to use different emotion-regulation strategies, and to show more defensive reactions (Knight et al., 2002; Goldenbeld et al., 2008; McRae et al., 2008). The present study not only adds to the complex puzzle on gender differences in persuasion, but it also shows that gender might be used to match persuasive techniques (e.g., EMi) in practice.

It might be argued that the present male samples were (too) small (approximately 40). However, despite this smaller number of male participants, all three two-way interactions (CSAI × EMi) were significant, and the effect sizes (partial η^2) of the specific contrast (EMi vs. no EMi in males with low CSAI) were above medium (0.066–0.09). Still, small sample size may even undermine claims based on significant tests (Button et al., 2013). Therefore, it is important to observe that the patterns of means were in the expected directions. We observed a full replication of the interaction between EMi and CSAI (Dijkstra and Elbert, 2019), but in the present study in males only. This replication on self-reported fruit and vegetable consumption is particularly relevant as the earlier study was conducted among university students who were exposed to EMi in a controlled environment in the laboratory. The present study was not conducted among students, and in an uncontrolled setting, wherever participants were when they listened to the audio. Thus, despite the error variance that must have occurred from this, the expected pattern of means on consumption was observed: When CSAI is low, EMi leads to more persuasion, but when CSAI is high, EMi lowers persuasion. Furthermore, Study 1 effects on negative self-evaluation were replicated in Study 2. These patterns are fully compatible with EMi taxing the WM, thereby preventing the dominant processes (negative or positive) to occur. Still, there is a need for an even more rigorous test of the present 3-way interaction, ideally conducted with a preregistered and fully powered study with balanced numbers of males and females.

One major uncertainty of the present study is the exposure to the manipulations: How well did the participants listen to the audio, and how well did participants comply with the eye movements assignment? Indeed, some participants admitted that they did not succeed in watching the stimulus all the time. In addition, although before the exposure the participants were asked twice to use a large screen, almost 40% admitted afterward to have used their smartphone. Although we do not know whether screen size is relevant for the effects of eye movements, when participants are not exposed correctly or sufficiently, the predicted effects may not come about. Therefore, on forehand, we chose to omit participants who scored below the midpoint on the self-reported exposure question. In addition, we tested whether screen size made a difference with regard to the expected effects. However, including screen as a variable in the computations hardly influenced the two-way interactions of EMi with CSAI and gender, and the main three-way interactions. Thus, the present study provides practical proof that despite not controlling the exposure completely, with the right instruction we were able to influence emotions and behavior change in expected directions.

This holds promise for EMi to be used in practice, for example, in online persuasion. One application is to match the EMi to those who can be predicted to react defensively. On the basis of the present study, the algorithm could be "If CSAI score is low AND gender is MALE, THEN apply EMi." This would lead to the prevention of the inhibited scores on negative self-evaluation and the lowered scores on consumption, without the undesired effect of EMi in males who score high on CSAI. Besides having practical potential, EMi have a great potential as research tool to study all kinds of processes in the WM.

Some further limitations must be taken into account when interpreting the present study. Besides the non-optimal gender ratio and the limited insight into the adherence to our EMi manipulation, no direct measure of defensiveness was applied. Thus, we have to rely on interpretations of contextual variables and effects and have no direct sight on what happened during the processing of the persuasive information and EMi. Future studies on EMi might apply one or more different types of measures of defensiveness (Ruiter et al., 2001; Good and Abraham, 2007). Furthermore, one choice we made concerns the measurement of self-reported fruit and vegetable consumption: This variable was not assessed at pretest deliberately, because the follow-up measurement was only after 2 weeks, and we wanted to avoid people to remember their pretest score when they would self-report their behavior at follow-up. However, it is hard to argue how the present findings could be caused by the omission of the pretest measurement. In addition, the present analyses were all controlled for two variables that indicate the participants' baseline perceptions regarding fruit and vegetable consumption: perceived discrepancy and the intention to increase one's intake. Controlling for these ruled out that the results of the three-way interaction tests were caused by these individual differences. Moreover, perceived discrepancy correlated significantly with later fruit and vegetable consumption. In that, it may be regarded as a (weak) indicator of baseline consumption, which was controlled for. Another limitation to mention is the duration of the follow-up; it was only 2 weeks after the exposure to our manipulations. It may well be that the present effects will be waned after several months, and only small effects are left. However, our data do suggest that we can influence actual behavior, and in a practical application, our procedure might be used to reach large populations, making small effects relevant (Glasgow et al., 1999). An additional note is needed with regard to the unique female voice that presented the auditory persuasive message. It is possible that a male voice (Rodero et al., 2012) or a qualitatively different female voice leads to different reactions in recipients. Lastly, we did not assess individual differences in

WM capacity, which might be related to gender or to CSAI (Barrett et al., 2004).

To conclude, the two studies make a plausible case that EMi can support persuasion to increase fruit and vegetable consumption. As EMi targets the WM, its effects depend on what is happening in the WM. The present study suggests that CSAI and gender predict what takes place in the WM. The WMAP provides new angles on persuasion, and it may help to make health education more effective, for example, in increasing fruit and vegetable consumption in the population.

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 Ethical Committee Psychology (ECP) of the Faculty of Behavioral and Social Sciences. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AD and SE contributed to the theorizing and preparation of the research, developing the research line using auditory messages, and writing the present manuscript. AD conducted the statistical analyses. Both authors contributed to the article and approved the submitted version.

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How and Why Does the Attitude-Behavior Gap Differ Between Product Categories of Sustainable Food? Analysis of Organic Food Purchases Based on Household Panel Data

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Organic agriculture promotes the transformation toward sustainability because of positive effects for the environment. The organic label on food products enables consumers to make more sustainable purchasing decisions. Although the global market for organic food has grown rapidly in recent years, only a part of the organic product range benefits from this positive trend. To develop the organic market further, it is important to understand the food-related values and attitudes that drive the purchase of organic food. Previous research on this topic has suffered from two main weaknesses. Firstly, most studies have been based on surveys and rely on stated behavior instead of actual purchase behavior. Secondly, the focus of most extant studies is predominantly on organic food in general or on food products with a relatively high organic market share, such as milk and eggs. To address this knowledge gap, the present study analyzes the value-attitude-behavior relationship by means of structural equation modeling using household purchase panel data from GfK. The paper provides evidence for the existence of an attitude-behavior gap in the organic market, with this gap found to be much stronger in the case of meat, frozen food, cheese, and sweets than for organic purchases in total. Analysis in different product categories reveals that while purchase behavior is driven by the same food-related values, their relative importance differs.

Keywords: organic food, consumer behavior, attitude-behavior gap, panel data, food-related values, structural equation model, product categories, sustainable food

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INTRODUCTION

Current food production systems and consumption patterns negatively affect the environment and human health. Climate change, biodiversity loss, and diet-related diseases are severe consequences which call for a shift toward sustainable food systems. A major issue with regard to food production systems are negative environmental effects of agricultural practices, i.e., the use of chemical pesticides and fertilizers. Organic agriculture is one of the most successful certified production

standards that promotes the transformation toward sustainability because of positive effects for the environment (Caesar, 2019; Liu and Zheng, 2019; Vermeir et al., 2020) specifically with regards to biodiversity (Reisch et al., 2013). The organic label on food products enables consumers to make more sustainable purchasing decisions (Hsu et al., 2020; Vermeir et al., 2020) driven by growing health and environmental concerns (Hidalgo-Baz et al., 2017).

The global market for organic food has grown rapidly in recent years (Willer et al., 2018), driven in large part by public debates on climate change and biodiversity loss as well as individual concerns about diet-related diseases. Although a significant proportion of consumers are inclined toward organic products and report buying them regularly, only a part of the organic product range benefits from this positive market trend. For example, organic milk, vegetables, and eggs are most successful on the organic market, while organic beverages and organic meat remain niche products (Willer et al., 2018). In order to sustain the growth of the organic market, it is important to understand the factors that drive the purchase of organic food in different product categories. However, the focus of previous studies has been on organic food in general or on food products such as milk and eggs that have a relatively high organic market share, while little is yet known about purchase drivers and barriers in product categories with a low organic market share. When asking consumers directly about their attitudes toward organic food, they often state positive attitudes and purchase intentions (Schäufele and Hamm, 2018).

Numerous studies found a link between positive attitudes and reported purchase behavior (Scalco et al., 2017; Tandon et al., 2020a). Reasons why consumers prefer organic food are its naturalness (Liang and Lim, 2020) and positive effects for health and environment (Dangi et al., 2020; Tandon et al., 2020b). However, most of these studies are based on survey data or laboratory experiments on stated behavior or attitudes and do not analyze actual purchase behavior. Studies that draw conclusions about the drivers of purchase behavior based solely on antecedents of purchase behavior without analyzing actual purchase behavior are potentially biased, moreover, as a result of the well-known attitude-behavior-gap (Aschemann-Witzel and Niebuhr Aagaard, 2014; Hidalgo-Baz et al., 2017) or intention-behavior-gap (Loy et al., 2016). A recent analysis of ElHaffar et al. (2020) reviewed studies on the attitude-intention-behavior gap and revealed how the gap could be reduced and how research could yield more reliable results. One of the most important sources of bias are socially desirable answers, which occur in the absence of any incentives to reveal true attitudes or actual past behaviors (Auger and Devinney, 2007). Using actual purchase data and not just stated behavior is critical, therefore, in order to avoid such bias when seeking to identify the motivating factors of organic food purchases.

Only a few studies to date have made use of actual market data to analyze organic purchase behavior (Janssen, 2018), and of these, only two examined different product categories. Moser (2016) used survey and retail panel data to examine the influence of environmental concerns on purchase behavior in five food categories (chocolate, eggs, meat, milk, and yogurt), albeit without analyzing other drivers. The findings showed that even though environment-related attitudes had an influence on self-reported purchase behavior, no effect on real purchase behavior could be detected in any of the food categories. A study by Van Doorn and Verhoef (2015) used scanner data to analyze organic purchase behavior in 28 product categories, revealing ethical values to be the most important drivers while health-consciousness and quality-consciousness were only found to influence organic purchases in particular categories.

Given the scarcity of knowledge based on real purchase data and conflicting results in the extant literature, further research based on household panel data is required to understand the motivating factors of organic food purchases in different product categories. The continuing expansion of the organic product range in discount stores and supermarkets makes it especially relevant to identify purchase drivers and barriers in order to develop well-targeted marketing strategies to attract new buyers of organic food. Knowledge about how the attitude-behavior gap for organic food differs between product categories and which factors moderate this relation is also important for future research and market actors.

Accordingly, the study strives to answer the following research questions:

- How do food-related values affect consumers' organic food purchases, i.e., which food-related values serve as drivers/barriers of organic food purchases?
- What is the mediating role of attitudes toward organic food within the value-behavior relation?

To address the research questions, we estimated a structural equation model capturing expenditures for organic food across all food categories. Since the existing body of literature suggests that certain food values exert different effects on different product categories, we also ran separate models for four product categories with persistent low shares in the organic market: cheese, meat, frozen food, and sweets. The study thus includes a range of different product categories, e.g., in terms of hedonic consumption and types of food.

THEORETICAL FRAMEWORK: VALUES, ATTITUDES, AND BEHAVIOR

The concept of motivation is closely interlinked with the concept of values and attitudes (Solomon et al., 2006). Values, understood here as comprising a person's beliefs about what constitute desirable states and behaviors beyond any particular circumstances, have been shown to relate closely to attitudes that motivate purchase decisions (Vinson et al., 1977; Schwartz, 1992; Rohan, 2000). While many theories have been developed regarding values and/or attitudes and their influence on behavior (Schwartz, 1994; Stern et al., 1999; Zepeda and Deal, 2009), little is yet known about the value-attitude-behavior chain in the case of organic food purchase behavior.

According to Vinson et al. (1977), three different levels of values can be distinguished: global values, domain-specific values, and evaluative beliefs. Global values comprise a person's

most "centrally held and enduring beliefs" and thus "form the central core of an individual's value system" (Vinson et al., 1977), existing thus at an abstract level and influencing actions and evaluations beyond any specific situations. Domain-specific values are less closely held and less generalizable values acquired through a person's experiences of "specific situations or domains of activity" (Vinson et al., 1977). Evaluative beliefs, the third and most numerous category in this model of values, refer to a person's least centrally held and most specific beliefs, sometimes considered equivalent to the concept of attitudes (Honkanen et al., 2006).

In the context of food purchases, several studies have provided evidence of the important role of values as predictors of behavior (e.g., Connors et al., 2001; Lusk and Briggeman, 2009; Lusk, 2011; Hauser et al., 2013). Investigating the importance that consumers place on different characteristics of food and food production (e.g., healthiness, taste, price, and environment-friendly production), these studies refer to such values in various terms, including "domain-specific values" (Honkanen et al., 2006) "food values" (Lusk, 2011), "food-related values" (Hauser et al., 2013) "motives related to food choice" (Steptoe et al., 1995), and "food choice motives" (Eertmans et al., 2005).

The consumer behavior literature further postulates that attitudes are the central concept by which to explain behavior. Attitudes here refer to a person's long-term evaluations of objects to satisfy particular motives. Consumers' attitudes to products are developed through beliefs (cognition) and feelings (affect) about a product. Attitudes as such may consequently translate into actual behavior, although a direct attitude-behavior relation has been shown to hold true only under certain conditions (Solomon, 2015). The predictive power of simple attitude-behavior models has been much improved upon through the incorporation of several additional constructs in Ajzen's Theory of Planned Behavior (Ajzen, 1985), now one of the most prominent theories in social psychology. In this model, values act as background variables that influence behavior indirectly through their effect on attitudes, hence attitudes are seen as fully mediating the value-behavior relation. Many studies on organic food consumption have applied the Theory of Planned Behavior, though most have analyzed only purchase intention for generic organic food rather than real purchase behavior for specific organic food categories (Scalco et al., 2017).

Hauser et al. (2013) have further enhanced Ajzen's approach, demonstrating that values exert both indirect and direct effects on food purchase behavior. In this view, the purchase of food is not completely cognitively controlled but rather executed habitually; and therefore attitudes do not fully mediate the relation between values and behavior; values can have significant direct effects on behavior.

LITERATURE REVIEW: FOOD-RELATED VALUES AND ORGANIC FOOD CONSUMPTION

A large body of literature has examined the links between consumers' values and organic food consumption to understand why consumers choose or not choose organic food, though again it should be noted that the great majority of studies have analyzed survey data rather than actual purchase data. This section gives an overview of the state of the art on food-related values and organic food consumption. **Table 1** summarizes the results of the literature review according to the direction and strength of effect of different food-related values on organic food consumption.

TABLE 1 | Literature review: food-related values and organic food choice.

Food-related values	Direction and strength of the effect on organic food consumption according to the number of studies that support the relation
Healthiness and naturalness	++
Environmental protection	++
Animal welfare	++
Local and domestic food	+
Convenience orientation	-
Quality and enjoyment	°
Price consciousness	- -

$^{+}$Positive relation, $^{-}$Negative relation, °Contradictory findings.
$^{++/--}$Strong evidence, $^{+/-}$Weak evidence.

Most studies have found that organic food consumption is motivated in large part by consumers' health values, with organic food perceived as healthier and more natural than conventional food on account of being free from chemical residues and artificial additives (Janssen, 2018; Rana and Paul, 2020). Ethical values have also been found to play a key role as drivers of organic food consumption, in particular, the values of environmental protection (Janssen, 2018; Rana and Paul, 2020) and animal welfare (Padilla Bravo et al., 2013; Van Doorn and Verhoef, 2015). Several studies have also shown a positive link between values for local food and organic food consumption (Padilla Bravo et al., 2013; Hempel and Hamm, 2016) and a preference for fresh food, i.e., a negative effect of convenience values on the consumption of organic food (Hauser et al., 2013; Janssen, 2018). Numerous studies have further shown that organic consumers are less price-conscious than most other consumers (e.g., Janssen, 2018).

Regarding the effect of quality and enjoyment orientation on organic food consumption, however, previous studies have produced contradictory results (Nadricka et al., 2020). Some research has shown that consumers of organic food prefer high quality and exclusive food (Padilla Bravo et al., 2013; Rana and Paul, 2020). Other studies have not been able to find any effect of quality and enjoyment orientation on the purchase of organic food (Van Doorn and Verhoef, 2015), or have even found that consumers with high quality and enjoyment orientation buy less organic food (Hauser et al., 2013). A possible explanation for these conflicting results regarding consumers' quality orientation may be related to product-specific differences in preferences for organic products (Nadricka et al., 2020). For example, a study by Van Doorn and Verhoef (2011) has shown that consumers

associate organic production with lower quality when it comes to products that promise immediate pleasurable experience, such as cheese, chips, salty biscuits, chocolate, cookies, pastries, and candy, etc. The authors argue that the "healthiness" of organic production actually reduces the pleasure experienced in the consumption of such "vice" or pleasure foods. Similar results were obtained by Rousseau (2015) in a study on organic chocolate. A study on organic cheese also found that consumers' preference for organic production was relatively low compared to the decisive role played by taste and place of origin in their purchase of cheese (Bernabéu et al., 2010).

Another finding relevant to understanding the attitude-behavior gap in relation to the purchase and consumption of specific organic food products was made in a study about biscuits by McIntyre and Schwanke (2010). This study concluded that the added value of organic production was unable to compensate consumers for what they perceived as the inherent "unhealthiness" of biscuits. Like other health attributes, organic production presented no extra value to consumers as compared to the sensory properties of this product, which were largely perceived as decisive for this "treat" product. Organic labeling alone thus seems insufficient to compete with enjoyment as the main reason for buying biscuits. Indeed, the organic attribute was even perceived as undesirable in the case of this product, in strong contrast to the effect of this quality on the consumption of organic raw products such as vegetables and meat, where the benefits of organic production are more evident to consumers (McIntyre and Schwanke, 2010). A study by Arvola et al. (2008) comparing consumers' preferences for organic apples and organic pizza similarly concluded that products associated with high levels of processing are found incongruent with consumers' ideas of organic production.

The studies cited above were published several years ago. The availability and variety of organic food has generally increased during the past 10 years in many countries. However, also recent research points to interesting differences between consumers' taste perceptions of healthy and unhealthy organic food products. Nadricka et al. (2020) found that healthy food is perceived to be tastier when it has an organic label (compared to the same food without an organic label). For unhealthy food, however, this effect was not observed. The authors were able to show that the effect of organic labels on taste evaluations is explained by perceived healthiness of the product category. It is thus interesting to re-visit the relationship between quality and enjoyment orientation and actual organic food purchases with more recent data and across different food categories.

MATERIALS AND METHODS

Dataset and Definition of Variables

The present study is based on two consumer panels of the GfK market research institute: ConsumerScan (which includes the purchase of packaged food) and ConsumerScan FreshFood (which includes unpackaged food). The dataset consisted of 8,400 households in Germany who participated in both panels throughout 2016 (The final sample comprised 8,065 households due to missing values in survey questions). The data covered total organic and conventional food purchases aggregated at household level, including specific information on the purchase of organic and conventional cheese, meat, frozen food, and sweets.

The households continuously recorded their food purchases by scanning the European Article Number (EAN) code, which provides specific information about products, including whether they are organic. The participants additionally specified the prices and quantities of each product they bought. On the basis of this information, the variable "organic budget share" (OBS) was computed as a measure for households' organic food purchases. A household's OBS is thus calculated (in euros) as the ratio of their expenditure on organic food to their total expenditure on food over the 12 months of 2016. The variable thus takes on values within an interval bounded from 0 for households that buy no organic food to 1 for households that buy exclusively organic food. In addition to overall (organic) food expenditures, we calculated the OBS for specific product categories, i.e., the ratio of expenditure (in euros) on organic cheese, meat, frozen food, and sweets to total expenditures within the respective product categories.

The data also included socio-demographic information. "Income" was calculated as the weighted monthly net income per household member, and this variable comprised five classes. "Education" was defined by the highest school qualification of the diary keeper (the person in the household responsible for the purchase diary), and a dummy variable was created with the value 1 for holding at least a university entrance diploma. "Age" referred to the age of the person responsible for the households' food purchases.

In addition to actual food purchase data and socio-demographic information, the dataset included 130 survey items on food-related values and attitudes toward organic food from an annual written and self-administered questionnaire. The level of participants' agreement with the survey items was indicated through a five-point rating scale from (1) "I do not agree at all" to (5) "I totally agree." One item on the topic of animal welfare used a six-point rating scale from (1) "That's not relevant to me" to (6) "I have done so in the past/I already do that today."

Three items were used to measure consumer attitudes to organic food (similar to those used in Janssen, 2018): "When buying food, I prefer organic food"; "I would like to see a larger assortment of organic food in grocery stores"; and "I am willing to pay higher prices for organic food." In the next step, we selected potential indicators for the value constructs we hypothesized would be linked to organic food purchases: healthiness and naturalness; environmental protection; animal welfare; local and domestic food; convenience orientation; quality and enjoyment; and price consciousness (see **Table 1**). For two of the seven constructs, the GfK survey only contained one statement per item: price-consciousness ("When buying food, I care more for prices than for brands") and animal welfare ("I prefer to buy/eat meat from animal-friendly production systems"). These constructs were included in the structural model as single-item constructs. The remaining five constructs were each assigned three or more potential indicators. With an exploratory factor analysis (Eigenvalue > 1, Varimax rotation), we analyzed whether

the constructs could be considered as distinct dimensions (= uncorrelated factors) and whether the indicators proved to be assigned to the constructs (= factors) as expected. The analysis resulted in a seven-factor solution instead of the expected five factors. The seven factors partly overlapped in terms of content. In the next step, we reduced the number of items and omitted those that formed factors difficult to interpret. The second EFA resulted in a six-factor solution. Two items we had expected to allocate to the factor "environmental protection" were found to constitute separate factors by themselves, and two of the 28 items ("I only buy fresh products instead of e.g., canned or frozen food" and "For the preparation of food I prefer fresh ingredients") had factor loadings smaller than 0.5. These four items were therefore excluded and a third factor analysis was run. The scale-reliability test showed that one item significantly reduced the reliability of the respective factor. This item was therefore removed and a fourth factor analysis was conducted. In the final solution, the factor structure and distribution of items was in accordance with prior expectations. The five factors explained 55.5 % of the total variance. This solution was used in the subsequent confirmatory factor analysis (CFA).

Structural Equation Modeling

The data were analyzed with the lavaan R software package for Structural Equation Modeling (SEM) (Rosseel, 2012). A comprehensive and flexible multivariate data analysis method that estimates relations between variables, SEM encompasses a structural model and a measurement model. The measurement model defines latent constructs, such as attitudes and other psychological constructs that are not directly observable, by several observable variables through CFA (Gana and Broc, 2019; Hair et al., 2019). The structural model applies multiple regression analysis methods and estimates a sequence of distinct but interdependent multiple regression equations simultaneously. In this model, variables can have a reciprocal role, i.e., a dependent variable in one equation can become an independent variable in other parts of the SEM (Gunzler et al., 2013). In the present study, "attitudes toward organic food" have the role of such a two-sided variable. Equation 1 investigates the effect of food-related values on attitudes, while Equation 2 specifies attitudes as the "mediator" variable between food-related values and behavior (see **Figure 1**). Both equations further controlled for the socio-demographic variables of income, education, and age.

From a theoretical perspective, a mediator variable can serve to explain why a relationship between two constructs exists (Baron and Kenny, 1986); it can be regarded as an "intervening or facilitating variable" (Hair et al., 2019, p. 745). To demonstrate mediation in our case, we needed to observe strong relations between food-related values (= the exogenous variables) and attitudes (= the mediating variable), and between attitudes and behavior (= the endogenous variable). We did not hypothesize that attitudes would fully mediate the effect of food-related values on behavior, but we expected a partial mediation so that food-related values would also have direct effects on behavior.

SEM is a covariance analysis structure technique that explains covariation among variables. The weighted least squares mean and variance adjusted (WLSMV) estimation method was chosen because the normality assumption was violated and the model included ordinal variables. The WLSMV estimation method is a robust version of Weighted Least Squares estimation methods (Gana and Broc, 2019) and substitutes the full weight matrix by a weight matrix that contains only diagonal elements, meaning only asymptotic variances and polychoric correlations are included (Moshagen and Musch, 2014).

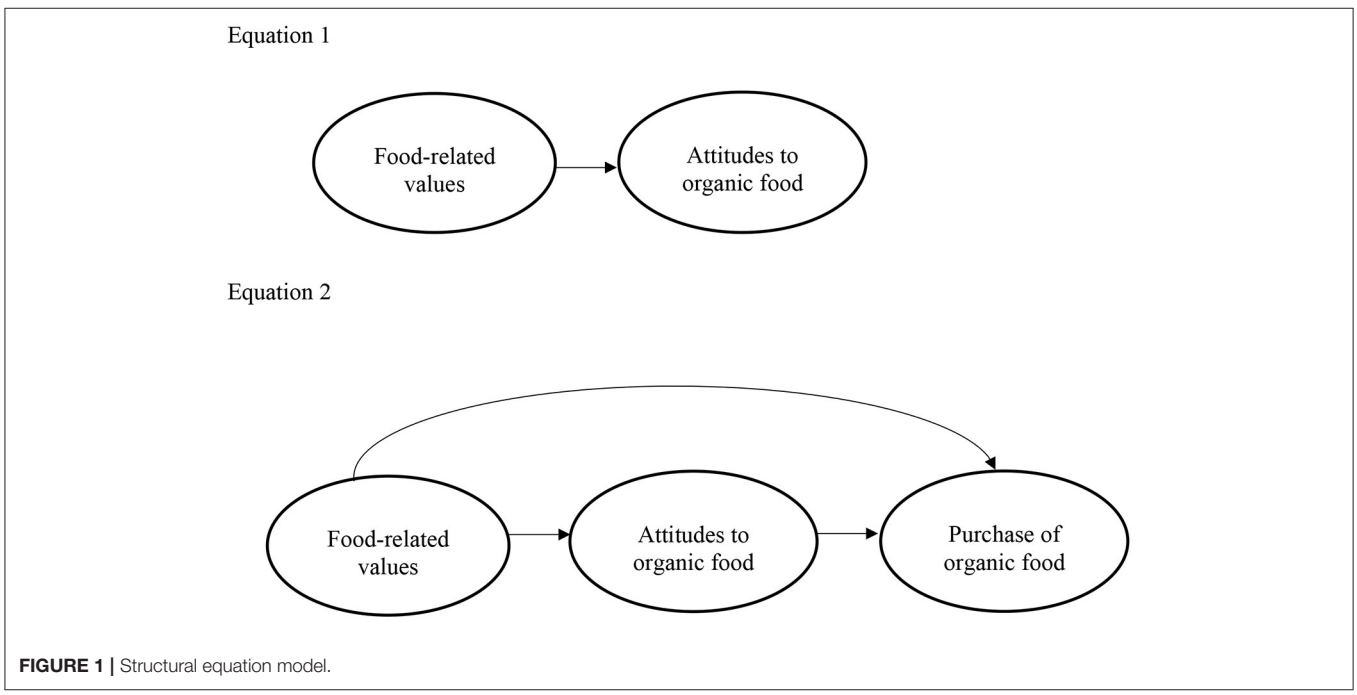

FIGURE 1 | Structural equation model.

RESULTS

Description of the Sample

The socio-demographic characteristics of the sample and the German population are presented in **Table 2**. Direct comparison is difficult because the federal statistical office applies different age and income categories. Moreover, the education categories of the household survey involve a combination of school-leaving and vocational qualifications, whereas the German federal office provides two separate statistics on these types of educational qualification.

With regard to age, young households were underrepresented in the sample, in particular the youngest age group (2% in the sample vs. 17% in the total population). In about a third of the households, the diary keeper (person responsible for the purchase diary) held a university-entrance diploma or a university degree, which is quite similar to the distribution of the highest school-leaving qualification of the German population. The data further suggests that high-income households were underrepresented in the sample.

Table 3 presents the distribution of the organic budget share (OBS) for food overall and for specific food categories among the households. With regard to food overall, almost all households (96.5%) bought at least some organic food in 2016 (i.e., only 3.5% did not buy a single organic food item). However, a large proportion of the households (40.8%) had an overall OBS below 1%, thus it is assumed that these households' purchase of organic items may have happened unintentionally. Some 37.1% of the households rarely purchased organic food (OBS 1% to <5%). While 14.7% of households once in a while purchased organic

TABLE 2 | Socio-demographic characteristics of the sample and the German population.

Socio-demographics (*N* = 8,400)	**Sample%**	**Population%**	
	Age of the head of household	**Age of German residents older than 18 years[a]**	
Up to 29 years	1.9	17.0	
30–39 years	10.1	14.2	
40–49 years	17.2	19.9	
50–59 years	24.8	50 up to under 75 years	
60–69 years	23.3	37.8	
70 years and older	22.6	75 years and older	
		11.2	
	Formal education of the diary keeper (including vocational school and university)	**School-leaving qualification of German residents[b]**	**Vocational qualification of German residents[c]**
Secondary general school	22.5	29.6	-
Intermediate secondary school	32.9	29.9	-
Qualified dual vocational training programme	-	-	47.5
Special upper secondary school (vocational school)	8.0	-	8.8
University entrance diploma	14.1	32.5	-
University	22.5	-	18.0
Others	-	8	25.7
	Household net income	**Net income of private households in Germany[d]**	
up to 749 Euro	3.5	Under 1,500	
		26%	
750–1,249 Euro	12.9		
1,250–1,749 Euro	16.2	1,500–3,200	
		43%	
1,750–2,249 Euro	18.8		
2,250–2,749 Euro	15.6		
2,750–3,249 Euro	12.8		
3,250–3,749 Euro	7.7	Over 3,200	
		31%	
3,750–4,999 Euro	9.2		
5,000 Euro and more	3.3		

[a] *German Federal Statistical Office (2020), table 12111–0004.*
[b] *German Federal Statistical Office (2019), p. 88.*
[c] *German Federal Statistical Office (2019), p. 90.*
[d] *German Federal Statistical Office (2020), table 12111-0004.*

food, these households still spent the great majority of their food budget on conventional food (OBS of >5–20%). Only 4.0% of the panel households spent a significant part of their food budget on organic food (OBS of >20%). Focusing on individual food categories, it is striking that the great majority of the households (between 73 and 82% depending on the product category) did not buy any organic cheese, meat, frozen food, or sweets in the 12-month period. Correspondingly, the proportion of households falling in the categories of occasional and frequent buyers of organic food was much lower in individual food categories compared to the distribution of the overall organic budget share. Interestingly, however, the proportion of households who spent a significant amount of their food category budget (OBS of >20%) on organic cheese, meat, and frozen food did not deviate substantially between the food categories and overall expenditures on food, with 3.9, 6.2, and 2.3% of households classifying as regular buyers of organic cheese, meat, and frozen food. However, regular buyers of organic sweets were very rare, amounting to only 1.5% of households.

Table 4 demonstrates the relationship between the OBS and overall expenditures (in euros) within the specific food categories (organic and non-organic products together). This shows that the higher a household's OBS, the more they spent on average on cheese, i.e., both organic and non-organic cheese. The expenditure share for cheese in relation to overall food expenditures increased with the OBS as well, i.e., households with a high OBS spent a relatively high share of their overall food expenditure on cheese.

With meat, frozen food, and sweets, the exact opposite relation was found. In these product categories, households with a higher organic budget shares spent significantly lower shares of their food expenditures on meat, frozen food, and sweets than households with low OBS. For instance, households who purchased no organic food in 2016 spent 6.0, 5.0, and 7.7% of their food expenditures on meat, frozen food, and sweets, respectively, while for households with a high OBS these shares amounted to 4.5, 2.7, and 4.7%.

TABLE 3 | Annual organic budget share (OBS) within each food category.

	Share of respondents in %				
Annual organic budget share	**Food overall**	**Cheese**	**Meat**	**Frozen food**	**Sweets**
0%	3.5	73.1	81.8	73.4	75.7
>0–<1%	40.8	2.3	0.7	4.2	7.2
1–<5%	37.1	12.7	5.1	13.2	11.0
5–<20%	14.7	8.0	6.2	6.9	4.6
≥20%	4.0	3.9	6.2	2.3	1.5
Total	100.0 (*N* = 8,400)	100.0 (*N* = 8,340)	100.0 (*N* = 8,140)	100.0 (*N* = 8,253)	100.0 (*N* = 8,379)

TABLE 4 | Expenditures for food categories by annual organic budget shares.

	Cheese		Meat		Frozen food		Sweets	
Annual organic budget share	**Average expenditures on cheese (in Euros)**	**Average expenditure share for cheese%***	**Average expenditures on meat (in Euros)**	**Average expenditure share %***	**Average expenditures on frozen food (in Euros)**	**Average expenditure share %***	**Average expenditures on sweets (in Euros)**	**Average expenditure share %***
0%	64.35^{a}	$3.9^{a,b}$	112.93^{a}	$6.0^{a,b}$	88.08^{a}	5.0^{a}	130.18^{a}	7.7^{a}
>0–<1%	92.97^{b}	3.7^{a}	165.53^{b}	6.1^{a}	121.43^{b}	4.6^{a}	179.53^{b}	7.1^{a}
1–< 5%	108.92^{c}	4.2^{b}	150.78^{c}	5.4^{b}	110.38^{c}	4.1^{b}	170.54^{c}	6.6^{b}
5–< 20%	121.85^{d}	4.6^{c}	137.51^{c}	4.6^{c}	93.86^{a}	3.3^{c}	151.38^{d}	5.7^{c}
≥20%	162.24^{e}	5.3^{d}	$157.18^{b,c}$	4.5^{c}	84.11^{a}	2.7^{d}	$147.54^{d,a}$	4.7^{d}
				N = 8,400				

**In relation to overall food expenditures.*

^{a,b,c,d,e}*Within each column, average expenditures, and average expenditure shares with different letters are significantly different from each other ($p < 0.05$).*

TABLE 5 | Attitude statements on organic food[a].

	I fully disagree	**I rather disagree**	**Neither nor**	**I rather agree**	**I fully agree**	**Total**
When buying food, I prefer organic food	27.8	26.6	22.8	17.0	5.7	100.0
I am willing to pay higher prices for organic food	25.2	22.1	28.5	17.4	6.8	100.0
I would like to see a larger assortment of organic food in grocery stores	27.0	21.3	23.5	21.7	6.5	100.0
						N = 8,137

[a] *The three statements form the construct "Attitudes toward organic food" (see **Tables 6**, **7**).*

Table 5 displays the answer distribution of the three attitude items on organic food. More than 20% of households partly or fully agreed with the following statements: "When buying food, I prefer organic food" (23%); "I am willing to pay higher prices for organic food" (24%); and "I would like to see a larger assortment of organic food in grocery stores" (28%). The positive stated attitudes of around one-fourth of the sample, when compared to the fact that only 4% of the households spent more than 20% of their food budget on organic food (**Table 3**), clearly shows an attitude-behavior gap applies in a considerable share of households.

Evaluation of the Measurement Model

The measurement model was evaluated by assessing discriminant validity and convergent validity, which is the common procedure in SEM (Hair et al., 2019). Discriminant validity was assessed through the Fornell-Larcker criterion (Averages variance extracted (AVE) > squared correlation with any other construct) to make sure that the factors identified in the exploratory factor analysis were truly distinct from one another. This was the case with all factors in our model.

Convergent validity specifies the extent to which the items within the same construct share a high proportion of variance in common. Convergent validity was assessed by factor loadings, construct reliability, and average variance extracted (AVE):

- The factor loadings of three items were below 0.5 and these items were therefore removed: "I pay attention to what I eat and drink because I need to take care of my health" (construct healthiness and naturalness); "The government and the industry, not ordinary citizens, should take care of protecting the environment" (construct environmental protection); "Frozen food is just as good as fresh food" (construct convenience orientation). Finally, the factor loadings of all items were above 0.5 and thus, satisfactory (see **Table 6**).
- Construct reliability—a reliability measure commonly used in SEM instead of Cronbach's alpha—was computed from the squared sum of factor loadings for each construct and the sum of the error variance terms for a construct (Hair et al., 2019). High construct reliability of >0.7 indicates that internal consistency exists. In our case, all values were higher than 0.8 (see **Table 7**) and thus, good. We also included Cronbach's alpha in **Table 7**, since some readers might be more familiar with this reliability measure.
- Finally, the AVE was examined. In SEM, the AVE is calculated as the mean variance extracted for the items loading on a construct; i.e., AVE equals the sum of all squared factor loadings divided by the number of items in the construct. This indicator should be higher than 0.5. Three constructs did not achieve this threshold (Hair et al., 2019). However, the measurement model was accepted because of good levels of construct reliability, factor loadings, and discriminant validity.

Structural Model

The goodness-of-fit indices, i.e., the "Standardized Root Mean Square Residual (SRMR)," the "Root-Mean-Square-Error of Approximation (RMSEA)," the "Comparative Fit Index (CFI)," and the "Tucker-Lewis Index (TLI)," indicate that all models fit the data well (Gana and Broc, 2019) (see **Table 8**).

The model for organic food purchases across all food categories explained 28.8% of the variance of the construct "organic purchases." For cheese (14.0%), sweets (10.8%), meat (9.6%), and frozen food (8.7%), the explained variance in organic food purchases was relatively low (see **Table 10**). The explained variance in the mediator construct "attitudes toward organic food" was comparably high at 52.6%. Thus, the independent variables better explained attitudes than real purchase behavior. Among the independent variables, socio-demographics had a low explanatory power compared to food values for both dependent

TABLE 6 | Confirmatory factor analysis.

Constructs	Indicators	Standardized factor loading
Healthiness and naturalness	I dislike products containing preservatives	0.78
	When shopping for food, I am careful to choose products without any additives	0.82
	I dislike products containing flavor enhancers (e.g., glutamate)	0.62
	I obtain information about which food is environmentally polluted and stop buying it	0.67
	In my diet, I avoid everything that is bad for my health.	0.52
Convenience orientation	Ready-made refrigerated meals are as good as self-made meals	0.74
	Nowadays, canned food tastes as good as fresh food to me	0.75
	I can hardly image cooking without convenience products (like instant gravy, frozen food, canned food).	0.65
Local and domestic food	When I have the choice, I definitely buy food from Germany	0.82
	For me, food from Germany has the best quality	0.65
	When I have the choice, I prefer local food	0.84
	I am willing to pay more for local products	0.76
Environmental protection	Nowadays, too much fuss is made about the environment	0.76
	What is currently done to protect the environment is absolutely sufficient	0.65
	In my household, I can do little to protect the environment	0.50
	I care little about the environmental impact of products	0.69
Quality and enjoyment	I like treating myself to fine food	0.59
	I treat myself to delicacies once in a while.	0.57
	I like cooking extravagant dishes	0.63
	I demand high standards when it comes to food and drinks	0.71
Attitudes toward organic food	When buying food, I prefer organic food	0.95
	I would like to see a larger assortment of organic food in grocery stores	0.94
	I am willing to pay higher prices for organic food	0.93

TABLE 7 | Construct validity and reliability.

	Average variance extracted	Construct reliability	Cronbach's alpha
Healthiness and naturalness	0.48	0.88	0.80
Convenience orientation	0.51	0.85	0.73
Local and domestic food	0.59	0.90	0.83
Environmental protection	0.43	0.84	0.72
Quality and enjoyment	0.39	0.88	0.70
Attitudes toward organic food	0.88	0.95	0.94

TABLE 8 | Goodness-of-fit indices of the structural model.

	Food overall	Cheese	Meat	Frozen food	Sweets
indicator					
RMSEA	0.063	0.084	0.085	0.084	0.084
p-value (RMSEA < 0.05)	0.000	0.000	0.000	0.000	0.000
SRMR	0.056	0.045	0.045	0.045	0.045
TLI	0.931	0.963	0.959	0.963	0.963
CFI	0.909	0.954	0.949	0.954	0.954

TABLE 9 | Effects on organic purchases and attitudes toward organic food[a].

	Organic purchases (food overall)[b]						Attitudes toward organic food	
	Direct effects		Indirect effects		Total effects		Direct effects=total effects	
Healthiness and naturalness	0.03	*	0.15	***	0.18	***	0.33	***
Convenience orientation	−0.10	***	0.00	n.s.	−0.09	***	0.00	n.s.
Local and domestic food	−0.07	***	0.08	***	0.01	n.s.	0.17	***
Environmental protection	0.07	***	0.08	***	0.15	***	0.18	***
Quality and enjoyment	−0.05	***	0.01	n.s.	−0.05	*	0.02	n.s.
Price consciousness (single indicator)	−0.07	***	−0.08	***	−0.15	***	−0.18	***
Animal welfare (single indicator)	−0.02	*	0.18	***	0.17	***	0.40	***
Attitudes toward organic food	0.46	***						
Age	−0.04	***	−0.02	***	−0.07	***	−0.05	***
Education	0.04	***	0.05	***	0.09	***	0.10	***
Income	0.05	***	0.02	***	0.07	***	0.05	***
Variance extracted			28.8%				52.6%	
N				8,065				

****Significant at p < 0.001.*
***Significant at p < 0.01.*
**Significant at p < 0.05.*
n.s., not significant.
[a]*Results of structural equation modeling on the values-attitude-behavior relation (see **Figure 1**).*
[b]*Organic purchases (food overall) refers to the ratio of expenditures for organic food (in €) to the total expenditures for food (in €) during the 1 year period 2016.*

constructs. Education and income had a positive effect on organic purchases, while age exerted a negative effect (see **Table 9**).

Here, the total effects of total organic purchases are presented first, after which the differences among the specific food categories are explained, followed by a comparison of the direct and indirect effects in the different models. The constructs "healthiness and naturalness," "animal welfare," "environmental protection," and "price-consciousness" all had a significant influence on total organic purchases, i.e., households who cared more for healthy and natural food, animal welfare, and environmental protection had a higher organic budget share. Higher price-consciousness, however, was associated with a lower organic budget share. The constructs "quality and enjoyment" and "convenience orientation" showed a weak negative influence, while no significant effect at all was found for "local and domestic food." Comparison of the determinants of attitudes and purchase behavior revealed interesting differences: for example, the construct "animal welfare" had by far the strongest effect on "attitudes toward organic food," while "healthiness and naturalness" and "animal welfare" were of equal importance for determining the actual purchase of organic food (see **Table 9**).

Interestingly, the total effects of the independent constructs on organic food purchases differed across food categories. The purchase of organic cheese was mainly determined by consumers' price consciousness (negative effect) and concern for animal welfare (positive effect). The constructs "healthiness and naturalness" and "environmental protection" were also significant, though their effect strength was slightly smaller. For organic meat, animal welfare was by far the most important determinant, while all other food-related values only had a weak impact on the purchase of organic meat. For organic frozen food, "healthiness and naturalness" was most important, followed by "convenience orientation" (negative effect), and "price consciousness." With regard to the purchase of organic sweets, "healthiness and naturalness" had by far the greatest influence on purchase behavior, followed by "environmental protection," and "price consciousness" (see **Table 10**).

Attitudes toward organic food acted as a mediator between food values and purchase behavior. However, significant direct effects reveal that this relation is not fully mediated through attitudes and that most variables also influence behavior directly. The model for total organic purchases showed significant direct effects for all independent variables, while some variables of the food category-specific models influenced behavior only indirectly through attitudes (direct and indirect effects of the different food categories can be found in the **Supplementary Material**).

For the construct "convenience orientation," no mediation effect of attitudes was found in either of the food categories. This is linked to the fact that consumers' convenience orientation did not influence their attitudes toward organic food. However, this construct did exert a negative direct and total effect on behavior.

TABLE 10 | Total effects on organic purchases for different food categories[a].

	Food overall		Cheese		Meat		Frozen food		Sweets	
Healthiness and naturalness	0.18	***	0.11	***	0.05	**	0.12	***	0.17	***
Convenience orientation	−0.09	***	−0.07	***	−0.04	*	−0.09	***	−0.03	*
Local and domestic food	0.01	n.s.	0.02	n.s.	0.01	n.s.	−0.02	n.s.	−0.02	n.s.
Environmental protection	0.15	***	0.10	***	0.06	***	0.06	***	0.12	***
Quality and enjoyment	−0.05	*	−0.03	*	−0.01	n.s.	−0.02	n.s.	−0.02	n.s.
Price consciousness (single indicator)	−0.15	***	−0.13	***	−0.09	***	−0.09	***	−0.10	***
Animal welfare (single indicator)	0.17	***	0.12	***	0.20	***	0.05	***	0.04	***
Attitudes toward organic food	0.46	***	0.29	***	0.21	***	0.24	***	0.25	***
Age	−0.07	***	−0.03	*	−0.02	n.s.	−0.03	*	−0.07	***
Education	0.09	***	0.07	***	0.05	***	0.05	***	0.06	***
Income	0.07	***	0.06	***	0.03	**	0.05	***	0.02	n.s.
Variance extracted	28.8%		14.0%		9.6%		8.7%		10.8%	
N	8.065		8.008		7.811		7.924		8.046	

****Significant at $p < 0.001$.*
*** Significant at $p < 0.01$.*
** Significant at $p < 0.05$.*
n.s., not significant.
[a]*Results of structural equation modeling on the values-attitude-behavior relation (see **Figure 1**).*

The construct "quality and enjoyment" had a significant (but small) negative effect on organic purchases overall and on the purchases of organic cheese, while no significant total effect on purchases of organic meat, frozen food, and sweets were recorded. Like "convenience orientation," this construct had no significant effect on attitudes toward organic food.

In the case of the construct "local and domestic food," quite the opposite was true, with attitudes positively influenced while purchase behavior was not affected in total. This non-significant total effect was due to positive indirect effects and negative direct effects (no significant direct effects for meat).

DISCUSSION AND CONCLUSIONS

The present study has shown that food-related values are good predictors of attitudes toward organic food; attitudes in turn play a major role in explaining organic food consumption, consistent with the findings of a recent meta-analysis that attitudes exert the strongest summary effect on behavior within the framework of the Theory of Planned Behavior (Scalco et al., 2017). This leads to the conclusion that attitudes toward organic food are important antecedents of organic food purchases and very good predictors of consequent behavior.

However, our data also revealed that approximately one in four consumers in our sample of more than eight thousand consumers held very positive attitudes toward organic food, but only a small proportion of consumers (4% of all households) directly translated these attitudes into purchase behavior. This study thus provides further evidence of the attitude-behavior gap (Yamoah and Acquaye, 2019; ElHaffar et al., 2020). The following discussion provides possible explanations for the attitude-behavior gap in the different product categories, based on our findings of how food-related values serve as drivers and barriers to organic food purchases (first research question), and how attitudes mediate the value-behavior relation (second research question).

Drivers and Barriers of Organic Food Purchases and the Attitude Behavior Gap

Interestingly, our household panel data showed that the attitude-behavior gap is much stronger for meat, frozen food, cheese, and sweets than for total organic purchases. The gap between attitudes and behavior can probably partly be attributed to the relatively high price premiums and low availability of organic food in these specific product categories in conventional supermarkets (Vermeir and Verbeke, 2006; Aschemann-Witzel and Niebuhr Aagaard, 2014; Yamoah and Acquaye, 2019). Price-conscious consumers buy less organic food because of the organic premium price (Aschemann-Witzel and Zielke, 2017), and our study shows that for cheese and meat, high price premiums in particular deter consumers from purchasing organic alternatives. High convenience orientation is also connected to low organic budget shares according to our data. Interestingly, convenience orientation had no significant effects on attitudes toward organic food in either of the food categories but it was significantly linked to purchase behavior. This result suggests the attitude-behavior gap can (partly) be explained by the fact that convenience-oriented consumers may not be willing to invest high search costs, and therefore, the low availability of organic food in conventional supermarkets may play a crucial role as a purchase barrier (Gottschalk and Leistner, 2013). However, this proposition requires further investigation since we did not analyze where the households purchase organic food (e.g., in conventional supermarkets or specialized organic food stores).

Confirming the results of previous studies (Dangi et al., 2020; Tandon et al., 2020b), the present study also suggests that organic products are purchased in particular by health-conscious and environmentally conscious consumers. This rather small target group might represent a challenge for making organic food attractive to a broader audience (Van Doorn and Verhoef, 2015), specifically because in product categories like frozen food, sweets, and fresh meat, organic food is not widely available in conventional grocery stores (Rana and Paul, 2017). Interestingly, the present study shows that the motives driving consumers to buy organic food are very similar across the different food categories analyzed, although the relative importance of the drivers differs. Concern for animal welfare is of high importance for the purchase of organic meat and cheese, while concern for healthiness and naturalness is crucial for the purchase of organic frozen food and sweets. However, a challenge for expanding the organic market based on the current core target group of regular organic buyers arises from the fact that these consumers generally have low consumption levels of meat, sweets, and processed foods.

Organic food producers should therefore develop product-category-specific marketing actions. Organic sweets may have a potential for health-concerned consumers, though only if such products do actually have healthier dietary properties than their conventional counterparts, since organic labeling alone seems insufficient to contend with enjoyment as the main motive for buying sweets (McIntyre and Schwanke, 2010). Given that healthy lifestyles typically involve low levels of sweet consumption, the market for organic sweets will probably rather remain a niche market.

This study has confirmed the findings of a previous household panel study by Van Doorn and Verhoef (2015) in showing that the values of quality and enjoyment are not positively related to the purchase of organic food overall. Our results imply that the large segment of quality-conscious consumers is currently not committed to buying organic food. This could partly be due to consumers perceiving the "healthiness" of organic production as reducing the pleasure of consuming these products (McIntyre and Schwanke, 2010; Van Doorn and Verhoef, 2011). We argue that this target group represents an untapped opportunity for organic food producers, since quality-conscious consumers are generally less price-conscious. In order to gain this segment as new organic consumers, organic producers should focus on the high quality of organic products in their marketing communications so as to convince this target group that organic products are of the same or better quality than conventional counterparts.

Another problem with reaching the quality-oriented consumers might be the limited organic product assortment. Our data suggests that consumers who place high importance upon quality and enjoyment tend to prefer conventional cheese. Cheese is a somewhat special product category in that specialty foods play an important role and the selection of organic cheese is often limited. In this case, the solution to reaching the target group of quality-conscious consumers would lie in increasing the organic product assortment to better meet the taste preferences of these consumers. According to Van Doorn and Verhoef (2011), this proposition applies to all hedonic product categories where pleasure and enjoyment plays the decisive role.

The Mediating Role of Attitudes Within the Value-Behavior Relation

A closer look at the mediating role of attitudes toward organic food within the value-behavior relation in our data provides interesting insights. While we found that food-related values are good predictors of attitudes, certain values also inserted significant direct effects on behavior, suggesting that cognitively formed attitudes do not fully mediate the effect of values on behavior. Interestingly, we found that values related to convenience, quality and enjoyment affected behavior directly (with negative effects on organic purchases), while these values did not influence cognitively formed attitudes toward organic food. This means that even if consumers have developed positive attitudes toward organic products, they tend to behave habitually and perhaps impulsively when it comes to the actual purchase decisions. The desire for convenience and enjoyment is thus a possible explanation for why consumers do not act in accordance with their positive attitudes toward organic food. For example, purchase behavior could be driven by an immediate desire for enjoyment that overwhelms the intention to purchase organic food, especially in the case of certain products like sweets (Hauser et al., 2013) and cheese (Bernabéu et al., 2010).

Values related to local and domestic production were not associated with the purchase of organic food, though they were found to positively influence attitudes toward organic food. This implies that consumers who place value on local food also prefer organic food, though they do not necessarily opt for organic products when it comes to real purchase decisions. One reason for this could be the relatively low availability of local organic products in supermarkets in Germany, while local conventional food is more commonly found in supermarkets.

The findings also show that convenience-oriented consumers do not necessarily have negative attitudes toward organic food. This is an interesting finding in view of the fact that household panel data from 2008 proved a negative relation between convenience orientation and attitudes toward organic food (Janssen, 2018). However, we also found that convenience-oriented consumers buy significantly less organic food than people without convenience orientation, which is also consistent with the findings of Janssen's study (Janssen, 2018). This result suggests that an attitude-behavior gap may exist for some convenience-oriented consumers.

Overall, the present study shows that organic food purchases and attitudes are not completely driven by the same values, and their relative importance differs. Therefore, the results of studies on the effects of food values on attitudes and intentions cannot simply be generalized to real purchase behavior.

Limitations

To the best of our knowledge, this research study is the first to have analyzed consumer behavior for different organic food categories using household panel data, and therefore, the study extends knowledge on consumer behavior regarding organic food (Van Doorn and Verhoef, 2015; Moser, 2016; Janssen, 2018). Even though the comparison of the models for the different food categories is a valuable contribution to the existing literature, the applied method does not allow checking for statistically significant differences between the models. A further limitation of the research study is that the sample is not directly comparable to the German population according to age and income, and therefore, descriptive data need to be treated with caution. However, since the study's primary aim is to analyze relations between values, attitudes, and behavior, a representative sample is not a decisive aspect in the first place.

Moreover, it was not possible to examine the effects of all influential factors on the complex process of purchase behavior, including factors such as geographical origin, store type, packaging and promotion, and trust in different types of retailers, which might account for parts of the unexplained variance. Moreover, attitudes toward organic food were measured with regard to food consumption in general and not explicitly for the specific food categories. This is important because consumers

may have positive attitudes toward organic vegetables and milk but not toward organic sweets or cheese. The attitude-behavior gap within the specific product categories would possibly have been lower if product-specific attitudes had been measured.

The analyzed data covers consumers' actual purchase behavior and therefore offers a high degree of validity as compared to surveys and purchase experiments. However, a recent review study (ElHaffar et al., 2020) on the attitude-behavior-gap in the area of sustainable consumption put forward that more qualitative studies, studies based on experiments as well as consumer segmentation approaches are needed in order to find solutions to close the gap in the future. Moreover, barriers that prohibit the transformation of attitudes into behavior need to be analyzed more deeply in order to extend the market for sustainable products (Yamoah and Acquaye, 2019).

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because we got the household panel data from the research institute GfK and are not permitted to share the data.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

IS: carried out data preparation, aggregation and anaylsis, and wrote the manuscript. MJ: had the idea for the research project and added substantially to the development of the research question and gave comprehensive feedback to the manuscript and provided knowledge on the method of data analysis, the interpretation of the results, and the discussion and conclusions parts. Both authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

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Italian Food? Sounds Good! Made in Italy and Italian Sounding Effects on Food Products' Assessment by Consumers

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Italian Sounding—i. e., the Italian appearance of a product or service brand irrespective of its country of origin—represents a global market phenomenon affecting a wide range of economic sectors, particularly the agro-food sector. Although its economic impact has been repeatedly stressed from different points of view (policy, economy, culture, etc.), systematic scientific knowledge regarding its social–psychological bases is lacking. Three studies carried out in three different countries (Italy, China, and USA) address this literature gap. Different consumer groups (both native and/or non-native) are targeted regarding major product categories pre-selected categories, which are the major Italian food goods within the specific country according to piloting (oil and/or pasta). In each study, the main independent variable (product version) has been manipulated by presenting real product images (previously pre-selected within the tested food category in each country market), whose "Italianness" degree is effectively manipulated by the main study variable (product version) across three or four levels (Protected Designation of Origin Made in Italy, Made in Italy, Italian Sounding, and Generic Foreign). Main hypotheses are tested via a survey with the specific product images administered to samples in Italy (N = 204, 148 Italians and 56 non-Italians), China (N = 191, 100 Chinese and 91 non-Italian expatriates in China), and the USA (N = 237 US citizens). Across the three studies, results show that Made in Italy products, compared to the other ones, are advantaged in terms of the main dependent variables: reputation profile, general reputation, attitude, and willingness to pay (WTP). Moreover, Italian Sounding products are endowed with corresponding significant advantages when compared to the Generic Foreign by non-Italian samples (although to a different degree according to the different sub-samples). Results reveal the specific social–psychological profile of Italian Sounding products in terms of either weaknesses or strengths when compared to both Made in Italy products and Generic Foreign ones, differently in the eyes of Italian and non-Italian

consumers across different countries. Finally, consistently across the three studies, the extent to which a food product is perceived to be Italian increases consumers' WTP for that product, and this effect is consistently mediated by the product's reputation.

Keywords: food, Italian sounding, made in Italy, reputation, willingness to pay (WTP)

INTRODUCTION

The food industry is the second most important sector of Italian economy, making Italy the 10th exporter of this sector in the world [ISMEA (Istituto di Servizi per il Mercato Agricolo Alimentare), 2017]. Agro-food "Made in Italy" products—with features evoking an "Italian" concept in the world, including history, culture, and tradition (Napolitano et al., 2015; Temperini et al., 2016)—are typical goods of the Mediterranean diet [Antimiani and Henke, 2007; ISMEA (Istituto di Servizi per il Mercato Agricolo Alimentare) and Fondazione Qualivita, 2018], and they currently spearhead Italian exports in terms of technologies, procedures, and intrinsic transformation of raw materials (Carbone and Henke, 2012; Caiazza and Volpe, 2014; Coldiretti, 2015). The European Commission has adopted several regulations on the application of EU quality schemes for the agro-food sector (Barjolle and Sylvander, 2000; European Commission, 2016), in order to protect typical products and to provide quality guarantee (Van der Meulen, 2015). The compulsory affixing of PDO, Protected Designation of Origin; PGI, Protected Geographical Indication; TSG, Traditional Specialty Guaranteed labels to products ensures consumers' safety with certification of working methods, reputation of places of production, traceability, and risk management of food (World Trade Organization, 1994). Italian agro-food distinctive products constitute about 80% of domestic exports in the food sector, with a recent growing appreciation especially in China (Huliyeti et al., 2008; Snaiderbaur, 2009; Vianelli et al., 2012a).

The Italian Sounding Phenomenon

Because of its worldwide known high-quality standards, the Italian agro-food market is currently facing various food counterfeiting (or similar) phenomena (Nicoletti et al., 2007; Iaricci et al., 2010; Montanari et al., 2016), especially the increasingly widespread phenomenon of the so-called "Italian Sounding" (IS), which consists in proposing to consumers products whose name, image, shape, and place of production are associated with "typically Italian" features. In IS, either the product name may recall the "original" one, as the American "Parmesan" cheese, or the brand may be invented, although "sounding" Italian as the "Da Vinci" or "Gattuso" tomato sauces. Colors evoking the Italian flag and images of famous Italian landscapes or monuments—e.g., the gulf of Naples, the tower of Pisa—reproduced on the label and packaging are other frequently used strategies [OECD (Organization for Economic Cooperation Development), 2008; Canali, 2012; Carreño and Vergano, 2016; Federalimentare, 2016].

This contemporary phenomenon can be partly framed within the very well-known Country of Origin (COO) effect, namely, the process by which "country of origin has a considerable influence on the quality perceptions of a product" (Bilkey and Ness, 1982, p. 89; see also Mainolfi, 2010; Marino and Mainolfi, 2013). IS is however different, as it is based on exploiting an alleged COO, on the basis of an ambiguity of the product's origin. Quite often, the IS product officially declares its "real" country of origin (i.e., via a correct labeling "made in"), while at the same time presenting an Italian "allure" endowed by means of some of its peripheral cues (e.g., stereotypical colors or images, as well as a name which "sounds" Italian, etc.). This communication and marketing compromise solution is therefore not counterfeiting its "true" country of origin, but at the same time it mimics some features of another "different" country of origin (specifically, Italy) or of its most classical and typical food products or culinary recipes. The informational cues that are crucial to convey an alleged COO (parallel to the "made in" one) can be of different kinds, and they are used as a basis to evaluate the product, by different kinds of stakeholders including consumers from different geographical areas too (e.g., Bilkey and Ness, 1982). Though this is mostly a social-cognitive process, it is framed within broader social systems, ending up in social–psychological implications for consumers' social inferences and attributions, as well as consumption decision-making processes, up to less or more stable consumer habits (fads or trends), and situated social identities in terms of a consumer's practices and communities (e.g., Busacca et al., 2006; Boatto et al., 2016).

More specifically, IS is based on the Country Sound Branding (CSB) construct, i.e., the construction of a brand recalling a non-real Country of Origin Image (COI), a variable often affecting consumers' attitude toward products (Erickson et al., 1984; Roth and Romeo, 1992; Phau and Prendergast, 2000; Rosenbloom and Haefner, 2009; Samiee, 2010; Bertoli and Resciniti, 2012; Aichner, 2013). Companies may use a strongly positive COI in order to increase their products' attractiveness (Usunier, 2006, 2011; Bursi et al., 2012; Vianelli et al., 2012b), also taking advantage of the fact that information on the product's origin may not be immediately accessible for many brands (Zhou et al., 2010).

Consumers' Cultural Differences

As already mentioned above (Bilkey and Ness, 1982), since its beginning, the COO literature has been aware of the fact that the COO effect depends on the stakeholders' point of view, first of all regarding consumers' different geographical and cultural areas. The subtlety of the interplay among the official declaration of the true country of origin (a non-Italian country "made in"), on one side, and of the alleged country of origin suggested or evoked by some packaging peripheral features (Italian-like colors or images or wording), on the other side, is not perceived, and/or cognitively or affectively treated in the same way from each consumer. Of course, a consumer's specific knowledge and past experience of the specific country

and with its products can come into play here, as well as other factors related either to a consumer's attention process and/or to her/his personal, social, and place identity, regarding cultural dimensions too. These factors can either facilitate or hinder psychological dynamics, and particularly social-cognitive ones, at the basis of the IS phenomenon. In fact, the CSB uses the favorable misclassification strategy, so that the brand is perceived as coming from a country with a more positive image or reputation, at least in that very specific sector, than that of the real COO (Balabanis and Diamantopoulos, 2011), in the eye of that consumer. Weaker and not well-known brands especially benefit from this strategy (Ahmed and D'Astous, 1996; Ahmed et al., 2002). Recently, the ability of an accurate perception of the brand's COI by customers has been questioned (Liefeld, 2004; Magnusson et al., 2011; Checchinato et al., 2013), a detail being generally communicated by the seller rather than required by consumers. However, consumers do associate the brand to a specific country, thus affecting the overall final image, or reputation, and attitude toward the brand itself (Liefeld, 2004; Balabanis and Diamantopoulos, 2008, 2011). This intentional ambiguity of the brand name, being printed on the product label, is very widespread as it is much more visible than the label of origin (the official "made in"), thus requiring a lower learning effort from the consumer (Thakor, 1996; Thakor and Lavack, 2003). IS products thus contribute to uncertainty and confusion, generating doubts, or false certainties, in consumers on the actual origin of Italian products. Possible negative consequences of the growing phenomenon of IS are delocalization of production, choice of non-local raw materials, and loss of quality, possibly causing the complete disappearance of authentic "Made in Italy" products (EURISPES, 2013). Such a complex scenario—where product information regarding its (real and/or alleged) country of origin interplay with the consumer's cultural background within a certain national market interconnected with the global one—thus requires deepening the investigation of psychological and social-cognitive dynamics connected to the IS phenomenon within a given national market according to different sub-samples existing in such a context. Studies did not address this issue systematically, and this is why, in two of the three studies presented here, two different sub-samples are considered and their results contrasted in order to test how the IS effect depends not only on the interplay among a specific market and the perceived Italianness of the food product but also on the specific perspective of the local stakeholder: a certain consumer group vs. another one within the same geographical and cultural area, considering both the West and the East, although all located within one only scenario: the contemporary global market.

Food Reputation

Over the last decades, the advent of the Internet, new media, social networks, and online communities have gradually assimilated the world to a "global village," where the mediation of experiences via multiple social actors is causing a major return of the construct of reputation (Bonaiuto et al., 2012), especially in large electronic markets, such as eBay and Amazon (Ulgado, 2002; Kuwabara, 2005; Chang et al., 2006; Utz et al., 2012), where the lack of physical interaction with sellers and goods calls for a greater need for trust, compared to traditional markets.

Based on perception (Zajonc, 1980; Isen, 1984; Lerner and Keltner, 2000; Winkielman and Cacioppo, 2001; Herzog and Stark, 2004; Graziano, 2010) and influenced by advertising (Babiloni et al., 2007; Graziano, 2010), the construct of reputation (Emler, 1990; Conte and Paolucci, 2002; Marmo, 2007; Mutti, 2007) can be defined as believed effects that any social agent (ranging from a person to a company up to a country) can have (Emler, 1990; Bromley, 1993, 2001; Palmonari et al., 2002; Bonaiuto et al., 2012).

In an organizational context, a company's reputation affects the relationship between quality and price (Klein and Leffler, 1981; Shapiro, 1983; Allen, 1984; Gorton, 1996; Winfree and McCluskey, 2005; van Riel and Fombrun, 2007). At the time of purchase, consumers generally observe intrinsic (e.g., freshness, flavor) and extrinsic (e.g., price, label) quality signals more than quality attributes (Steenkamp, 1990). A study on the evaluation of Bordeaux wine shows that the premium price associated with better individual and collective (or group) reputation far exceeds that associated with improvements in current quality (Landon and Smith, 1998).

In this context, food reputation is becoming a particularly stimulating research field, as foods and drinks affect the life of an individual on a physical, psychological, and social level, and are involved in many other social problems, such as globalization (e.g., the so-called "McDonaldization" phenomenon; Ritzer, 1996) or the exploitation of natural resources (Kuisel, 1991; Zimmet, 2000; Leatherman and Goodman, 2005; U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2011). Foods and drinks, and the whole systems involving them and revolving around them, are the core of a renewed appreciation of the quality issue, e.g., according to three fundamental features within the Slow Food paradigm: good, clean, and fair (Petrini, 2005, 2010). Therefore, within such a contemporary complex global scenario, COO became particularly relevant within the agro-food sector, where it contributes to a certain food item assessment in terms of interest toward its origin, which promotes its positive image evaluation and consequently its consumption (Yeh et al., 2010): moreover, COO can interplay with other food features, but not many studies have addressed the interplay among COO, on the one hand, and other food features, on the other hand (e.g., Loureiro and Umberger, 2007). Finally, geographical and cultural differences across consumers' sub-samples can become relevant here too.

Within the social–psychological literature, food features have been traditionally investigated according to some relevant dimensions affecting consumers' choices (Magnusson et al., 2003) and via measuring scales such as the *Reasons for Eating Scale* (Harmatz and Kerr, 1981), the *Food Choice Questionnaire* (Steptoe et al., 1995), and broader conceptual frames on food features (Conner and Armitage, 2002; Olivero and Russo, 2008). The *Food Reputation Map* (FRM) is probably the first validated set of scales which specifically and explicitly targets the reputation of food products by encompassing the wider array of their features: in fact, FRM includes six main areas of food reputation,

articulated into 23 dimensions determining food attractiveness, based on past experiences and future expectations; moreover, such a paradigm has also been already deployed in terms of geographical and cultural differences, by testing it with consumers from both a Western and an Eastern area (Bonaiuto et al., 2012, 2017; De Dominicis et al., 2020). It is therefore the most updated and complete paradigm to tackle the issue of a food product's features, and it can easily be adopted to study and test issues related to the COO effect paradigm, such as the IS phenomenon seems (partly, at least) to be, considering different consumer cultural sub-samples within the same geographical area. A product's geographical and cultural origin perception and the consequent food feature assessment being dependent on the COO effect would of course affect the consumer's attitude toward it as well as her/his final decision-making in terms of food product purchasing, thus affecting that consumer's willingness to pay (WTP) a certain amount of money for that food item.

Willingness to Pay

Consumers' food choices concern physical characteristics of the products themselves and psychological factors (Rozin et al., 1986), including the perception of the risk to food safety (Yeung and Morris, 2001; De Jonge et al., 2004). On top of that, in the last decades, the agro-food market has recorded an increased demand for organic, natural, and local products (Thompson, 1998; Dimitri and Greene, 2002), often motivated by a growing concern for health (Huang, 1996; Makatouni, 2002; Honkanen et al., 2006) and by the perception of these products being more environmentally friendly and more favorable for small-scale agriculture and for local rural communities (Underhill and Figueroa, 1996; Williams and Hammit, 2000, 2001): as a consequence, WTP the premium prices generally required for high-quality products increases (Suryanta, 2000; Loureiro and Hine, 2002; Wang and Sun, 2003; Batte et al., 2007). For example, consumers were found willing to pay a premium price for fresh national meat products with a PGI label in Spain (Loureiro and McCluskey, 2000) and supported compulsory labeling policies (Schupp and Gillespie, 2001), often with the WTP a high premium (Loureiro and Umberger, 2007). However, in other cases, a reduction in the price of the product with uncontrolled origin was sufficient for the consumer to be indifferent between the two (Unterschultz et al., 1997).

The WTP premium prices for quality products has been found higher among families with children (Thompson and Kidwell, 1998) or with few members (Loureiro and Hine, 2002), families with high income (Wang and Sun, 2003), and women (Loureiro and Umberger, 2007). WTP has been measured mainly via the *Contingent Valuation* (CV) method (Hanemann, 1984).

Studies on reputation and WTP applied to agro-food products are still limited. It is particularly needed to understand how the "made in" (here specifically, "Made in Italy") products are perceived and how much people are willing to pay for them, in order to contrast the IS (as a case of CSB) phenomenon, increasingly spreading in many countries, which has a negative impact on the Italian market (Canali, 2012; Carreño and Vergano, 2016; Federalimentare, 2016). Moreover, while such a literature often advocated that the IS phenomenon has a negative economic impact on the global Made in Italy agro-food sector, with its financial impact considered at a macro-economic level—recent estimates from Italian institutional bodies or economic specialized press placed it in the range of €50–90 billion per year and, in some cases, near to almost €100 billion per year—there are not many evidences of how the IS phenomenon affects the single individual's micro-economic decision (e.g., in terms of WTP for purchasing a single specific agro-food item by the single consumer). IS spreading is most prevalent in China and the USA: according to some sources, most counterfeit products on the European market come from China (Cheung and Prendergast, 2006; Lin, 2011; Zimmerman, 2013), and the US market is the one with the largest amount of false Italian food (IPR Desk NY, 2010, 2011; Federalimentare, 2016), although both countries register an increasing level of appreciation for Italian products (Girardelli, 2004; Huliyeti et al., 2008; Vianelli and Pegan, 2014). As for the USA, IS is particularly frequent in metropolitan areas, with large Italian-American communities and above-average incomes, and it results from the need for US companies—often created by Italian-Americans and subsequently absorbed by multinationals—to respond to the increasing demand for Italian food (Vianelli and Marzano, 2013).

Given the paucity of studies addressing this set of phenomena, and particularly the lack of studies on the social–psychological processes regulating IS consumers' choices, the present research is developed with the aim of investigating the IS effects on consumers' assessment of agro-food products associated to Italy, and their consumption choices for such targets. The central question of the research is to determine whether, for a food product, the COO label, in terms of IS, can influence first of all its "Italianness," then its general reputation and related specific reputation features, and, consequently, consumers' attitude toward that product, up to her/his WTP for that food item, by comparing different forms of products associated to Italy (*Made in Italy*; *IS*; *Generic Foreign*), within different cultural contexts and consumers sub-samples.

Three studies were designed to test this general aim. The first was conducted to compare the perception of two products typically associated with Italy (oil and pasta) by Italian and non-Italian subjects within the EU and to measure the effects of the product label on perception, attitude, reputation, and WTP for that product (typically associated to Italy), by using four different product forms (*PDO Made in Italy*, *Made in Italy*, *IS*, and *Generic Foreign*).

The second study was performed to measure the effects of the product label on perception, attitude, reputation, and WTP for a product (typically associated to Italy), by using three or four different product forms (*PDO Made in Italy*, *Made in Italy*, *IS*, and *Generic Foreign*) and by assessing more detailed reputational profiles by means of a standard tool (Bonaiuto et al., 2017; De Dominicis et al., 2020) in China considering two different sub-samples (Chinese and non-Chinese), which are relevant for their different cultural background in that national market (Huliyeti et al., 2008; Vianelli and Pegan, 2014). The third study was performed to measure the effects of the product label on perception, attitude, reputation, and WTP for a product (typically associated to Italy), by using three different product forms (*Made*

in Italy, *IS*, and *Generic Foreign*) and by assessing detailed reputational profiles by means of a standard tool (Bonaiuto et al., 2017; De Dominicis et al., 2020) in the USA (Cembalo et al., 2008).

STUDY 1

Aim and Hypotheses

The main aim of Study 1 is to investigate how two sub-samples (Italian vs. non-Italian within the EU) in an Italian and EU context (respectively) perceive (in terms of reputation and attitude) and are willing to pay for two agro-food products typically associated to Italy (oil and pasta), presented in four forms, differentiated by label: *PDO Made in Italy*, *Made in Italy*, *Italian Sounding*, and *Generic Foreign*.

It is thus expected that[1]:

H1: The product form or label has an effect on reputation. The reputation is more positive for the Italian products (particularly PDO) compared to the *Italian Sounding* products, and this one compared to the *Generic Foreign*; further significant differences can emerge between Italian and non-Italian EU sub-samples.

H2: The product has an effect on attitude. In particular, the attitude is more positive for the Italian products (particularly PDO) compared to *Italian Sounding* products, and this one compared to the *Generic Foreign*; further significant differences can emerge between Italian and non-Italian EU sub-samples.

H3: The product has an effect on WTP. The WTP is higher for the Italian products (particularly PDO) compared to *Italian Sounding* products, and this one compared to the *Generic Foreign*; further significant differences can emerge between Italian and non-Italian EU sub-samples.

Method

Participants, Procedure, and Materials

The survey reached a total of 204 subjects ($M = 97$; $F = 107$). A total of 148 were Italians living in Italy, 52% women, average age 33.3 ($SD = 13.6$); 56 were non-Italian, European Union citizens (23.2% UK, 16.1% Germany, 16.1% Spain, 7.1% Croatia, 7.1% France, and 30.4% other EU country), 53.6% women, average age 26.5 years ($SD = 8.7$). Electronic data collection was performed in January 2014 via an online survey in two versions (Italian and English), using various social media platforms (e.g., Facebook, Twitter). Each subject randomly received the questionnaire (Italian/English), concerning only one of the two selected food products (olive oil or pasta), and was asked to fill in the questionnaire observing the images of the four different products reported in it, presented in the following order: *PDO Made in Italy*, *Made in Italy*, *Italian Sounding*, and *Generic Foreign*.

In order to identify the products to be investigated, a pre-test was conducted, asking subjects to indicate some of the best known and most consumed Italian foods, and measuring the subjects' perception of different products' "Italianness" and origin. Pre-test subjects were firstly asked to list six food products that came to their mind when thinking of Italian food and subsequently to list six Italian food products they consumed most. On the basis of pre-test results, pasta and olive oil were selected. The different actual products were then selected on the basis of those actually on sale in Italian supermarkets at the time (avoiding most renowned brands in order to escape from potential strong familiarity effects).

The four selected olive oil products were as follows: "Garum olio extravergine di oliva D.O.P. Colline salernitane" as *PDO Made in Italy*, "Olio del Fraticello olio extravergine di oliva" as *Made in Italy*, "Fígaro extra virgin olive oil" as *Italian Sounding*, and "Natives olivenöl extra" as *Generic Foreign* (see **Appendix A**).

The four selected pasta products were as follows: "Spaghetti Gentile Pasta di Gragnano I.G.P." as *PDO Made in Italy*, "Spaghetti Pasta Zara" as *Made in Italy*, "Spaghetti Milaneza" as *Italian Sounding*, and "Spaghetti Riesa Hartweizennudeln" as *Generic Foreign* (see **Appendix A**).

Measures

The questionnaire was produced in two similar versions, differentiated by product type (pasta or olive oil), and administered in the research with a 2 × 4 design: 2 different samples (Italian vs. EU non-Italian) × 4 product forms (*PDO Made in Italy*, *Made in Italy*, *Italian Sounding*, and *Generic Foreign*). The questionnaire includes several scales, repeated for each of the four product forms (*PDO Made in Italy*, *Made in Italy*, *Italian Sounding*, and *Generic Foreign*), and a final section concerning socio-demographic data (gender, age, country of origin, and country of residence). The whole survey is available in the **Supplementary Material** of this article.

Three types of manipulation checks were run to measure the subjects' perception of the product's "Italianness" and origin. In the first ("Italianness intensity"), subjects were asked how Italian they thought the product was, on an 11-point Likert-type scale (from 0 "in no way" to 10 "completely"): "Secondo lei quanto è Italiano il prodotto di riferimento?" or "In your opinion, how much Italian is the product?" In the second ("Italianness probability"), they were asked how likely it was that the product was produced in Italy, on a five-point Likert-type scale, ranging from 0% (= "definitely produced abroad") to 100% (= "definitely produced in Italy"), with +25% cumulative increasing steps: "Secondo lei quanto è probabile che il prodotto di riferimento sia prodotto in Italia?" or "In your opinion, how much is it likely that the product is produced in Italy?" In the third ("Italianness origin"), subjects were asked where they thought the product came from, and to answer either 0 "Abroad" or 1 "Italy": "Secondo lei da dove proviene il prodotto?" or "In your opinion, where does the product come from?"

Ten seven-point evaluative semantic differential scales were used to measure the subjects' attitude toward the product: "Cattivo" vs. "Buono"; "Contraffatto" vs. "Autentico"; "Naturale" vs. "Artificiale"; "Genuino" vs. "Manipolato"; "Vero" vs. "Falso"; "Indesiderabile" vs. "Desiderabile"; "Senza certificato" vs. "Con certificato"; "Alta qualità" vs. "Bassa qualità"; "Alta fascia" vs. "Bassa fascia"; "Economico" vs. "Costoso" (in their English

[1]H1–H3 in Study 1, H5–H7 in Study 2, and H9–H11 in Study 3 have been tested also considering gender and age as covariates. The covariates were non-significant and therefore are not considered in the present final version.

version as well, "Bad" vs. "Good"; "Counterfeit" vs. "Authentic"; "Natural" vs. "Artificial"; "Genuine" vs. "Manipulated"; "True" vs. "False"; "Undesirable" vs. "Desirable"; "Without certificate" vs. "With certificate"; "High quality" vs. "Low quality"; "High range" vs. "Low range"; "Economic" vs. "Expensive"). The rating scale was a Likert-type scale ranging from 1 (= "totally") to 7 (= "totally"), with 4 (= "neither/nor") being intermediate.

To measure the product's general reputation, one item was used, asking subjects to indicate the product's reputation on a seven-point Likert-type scale (from "completely negative" to "completely positive"): "Questa Pasta/Olio ha una reputazione" or "This Pasta/Oil reputation is."

To measure WTP (Gil et al., 2000), subjects were asked how much they would be willing to pay for that product considering its average price, expressed in euros. Responses were given on an 11-point Likert-type scale, adapted from Hanemann (1984). WTP ranged from €2.50 to €7.50 for olive oil (with one step increase in the Likert scale corresponding to an increase of €0.50) and from €0.00 to €4.00 for pasta (with one step increase in the Likert scale corresponding to an increase of €0.40). The scale's middle point and range in euro was close to a possible national average price for the product in that period (€5.00 for oil, €2.00 for pasta). For the Italian sample, the "oil" item was: "Considerando che il costo medio al litro dell'olio extravergine di oliva è pari a circa €5.00, quanto sarebbe disposta/o a pagare se volesse acquistare un litro di PRODUCT NAME." For the Italian sample, the "pasta" item was: "Considerando che il costo medio 500 g di pasta è pari a circa €2.00, quanto sarebbe disposta/o a pagare se volesse acquistare 500 g di PRODUCT NAME." For the non-Italian EU sample, the "oil" item was: "Considering that the average price of a liter of extra virgin olive oil is about €5.00, how much would you be willing to pay if you would buy a liter of PRODUCT NAME." For the non-Italian EU sample, the "pasta" item was: "Considering that the average price of 500 g of pasta is about €2.00, how much would you be willing to pay if you would buy 500 g of PRODUCT NAME."

All statistical analyses were released using the SPSS version 27 software.

Manipulation Check

A manipulation check was performed to test whether the manipulation of the products, being PDO Made in Italy, Made in Italy, Italian Sounding, or Generic Foreign products, was effective in changing the perception of Italianness (intensity, probability, and origin) in our participants.

Two repeated-measures analyses of variance (ANOVAs) were performed to test the effects of product label on the dependent variable "Italianness intensity" (score 0–10) and "Italianness probability" (score 0–100%). The manipulation checks indicated an effect of the product label on Italianness intensity [$F_{(2.45,\ 496.25)} = 657.4$, $p < 0.001$, $\eta p^2 = 0.76$] and on Italianness probability [$F_{(2.39,\ 464.9)} = 579.43$, $p < 0.001$, $\eta p^2 = 0.75$], such that both dependent variables significantly decreased from PDO Made in Italy to Made in Italy to Italian Sounding to Generic Foreign products. Estimated marginal means comparisons showed significant differences across all four means (see values in **Table 1**) in each of the two dependent variables.

TABLE 1 | Mean scores and *SD* of product label related to Italianness intensity, probability, and origin (Study 1).

Product label	Italianness intensity	Italianness probability	Italianness origin
	M (SD) (*N* = 203)	M (SD) *N* = 195)	Italian%/foreign% (*N*)
PDO made in Italy	8.54 (1.79)	4.33 (0.80)	97/3 (199)
Made in Italy	5.86 (2.38)	3.24 (0.99)	74.5/25.5 (192)
Italian sounding	1.62 (2.16)	1.64 (0.91)	10.3/89.7 (194)
Generic foreign	0.94 (1.73)	1.33 (0.68)	4.7/95.3 (193)

Furthermore, four binary logistic regressions were conducted to understand whether Italian origin (yes/no) was predicted by each product label. All four models were statistically significant (all $p < 0.001$) and predicted Italian (or non-Italian) origin as expected: the PDO Made in Italy and Made in Italy products were considered Italian products in 97 and 74% of cases, respectively, while the Italian Sounding and Generic Foreign products were considered foreign products in 89.7 and 95.3% of cases, respectively.

Therefore, it is possible to conclude that the manipulation was effective: the PDO Made in Italy product was perceived as more Italian than the Made in Italy product, which, in turn, was perceived as more Italian than the Italian Sounding product, which was finally perceived more Italian than the Generic Foreign product.

Finally, given its relevance for the present manuscript, we wanted to further corroborate the effect of the manipulation specifically for the Italian Sounding product. Therefore, we run an independent samples *t*-test comparing the perceived Italianness of the Italian Sounding product between the Italian and non-Italian samples. We expected that the Italian Sounding product should be perceived to be lower in Italianness by the Italian sample compared to the non-Italian sample. Results confirmed this expectation, showing that the Italian sample reported both lower Italianness intensity [$M = 1.11$, $SD = 1.89$, $t_{(201)} = -6.02$, $p < 0.001$] and Italianness probability [$M = 1.44$, $SD = 0.74$; $t_{(199)} = -5.07$; $p < 0.001$] than the non-Italian sample ($M = 3.04$; $SD = 2.27$; $M = 2.21$; $SD = 1.07$, respectively).

Results

Cronbach's α was calculated to test the reliability of the attitude scale. Analyses show that the scale is reliable at all levels of measurement within the subjects (*PDO Made in Italy*, $\alpha = 0.90$; *Made in Italy*, $\alpha = 0.88$; *Italian Sounding*, $\alpha = 0.89$; *Generic Foreign*, $\alpha = 0.92$). In order to test H1, H2 and H3, a series of 2 (between-subjects factor: Italian vs. non-Italian) × 4 (within-subject factors: *PDO Made in Italy* vs. *Made in Italy* vs. *Italian Sounding* vs. *Generic Foreign*) mixed-model ANOVAs were run to verify the effect of the independent variables (nationality and product label) on the dependent variables (reputation, attitude, and WTP), for the two food products aggregated (preliminary analyses showed a general lack of significant differences on the main dependent variables among them). A series of protected *t*-test pairwise comparisons were also conducted in order to define

TABLE 2 | Mean scores and *SD* of product label related to attitude, reputation, and WTP (€) in each national sample (Italian vs. Non-Italian).

Product label	Reputation (0–10)		Attitude (1–7)		WTP (€)	
	Italian M (SD) (*N* = 148)	Non-Italian M (SD) (*N* = 53)	Italian M (SD) (*N* = 138)	Non Italian M (SD) (*N* = 44)	Italian M (SD) (*N* = 147)	Non-Italian M (SD) (*N* = 53)
PDO made in Italy	5.29 (1.06)	5.32 (0.85)	5.48 (1.13)	5.41 (0.90)	7.14 (2.30)	7.51 (1.73)
Made in Italy	3.87 (0.93)	4.30 (1.03)	3.73 (0.96)	4.44 (0.87)	4.13 (1.99)	5.30 (1.60)
Italian sounding	2.81 (1.17)	3.43 (1.17)	2.59 (1.04)	3.29 (0.96)	2.59 (1.65)	3.74 (2.10)
Generic foreign	3.17 (1.27)	3.92 (1.16)	3.08 (1.23)	3.97 (1.31)	2.96 (1.87)	5.09 (2.32)

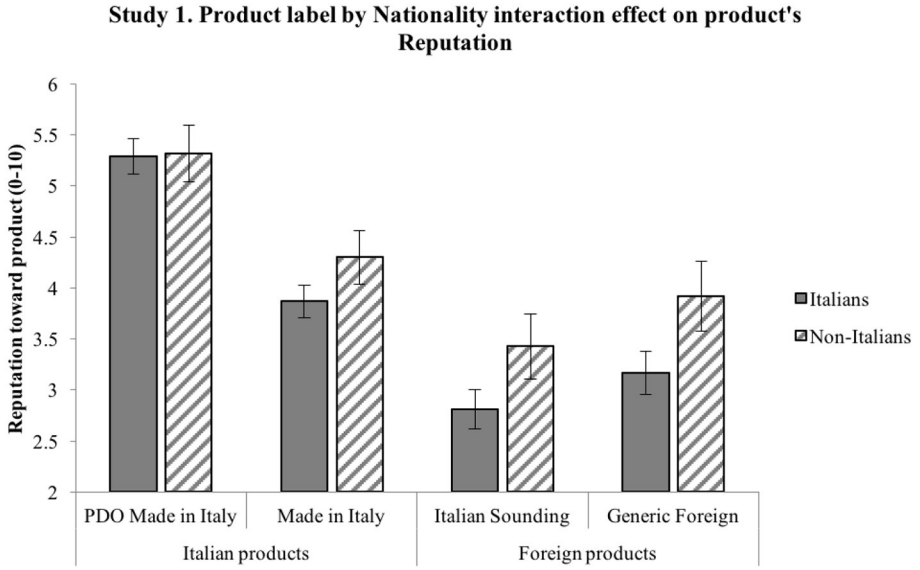

FIGURE 1 | Interaction effect of product label and nationality on product's reputation. Reputation toward product is measured on a scale from 1 (negative reputation) to 10 (positive reputation). Error bars represent 95% confidence interval of the mean. All significant differences have a $p < 0.001$.

significant differences between the individual levels of the two independent variables on the three dependent variables. Data analyses report the following results for the hypotheses, while all descriptive statistics are synthetized in **Table 2**.

H1. ANOVA shows a significant effect of product label on reputation [$F_{(3, 597)} = 130.57$, $p < 0.001$] and a significant effect of nationality on reputation [$F_{(1, 199)} = 19.97$, $p = 0.001$]. Importantly, an interaction effect also emerges between the two independent variables on reputation [$F_{(3, 597)} = 3.64$, $p = 0.013$, $\eta p^2 = 0.018$]. Results emerging from the pairwise comparisons are synthetized in **Figure 1**: significant differences are shown by the 95% intervals of the mean values. Overall, results confirm H1: product label has an effect on reputation such that it is more positive for the Italian products (particularly PDO) compared to both the Italian Sounding and the Generic Foreign products; moreover, PDO Made in Italy's positive reputation is stronger than that of Made in Italy. Non-Italians attribute a more positive reputation than Italians to IS products, as well as to Made in Italy and Foreign products, while the two sub-samples do not differ in their reputational assessment of the PDO Made in Italy products.

H2. ANOVA shows a significant effect of product label on attitude [$F_{(3, 540)} = 146.77$, $p < 0.001$] and a significant effect of nationality on attitude [$F_{(1, 180)} = 27.02$, $p < 0.001$]. An interaction effect emerges between the two independent variables on attitude [$F_{(3, 540)} = 5.75$, $p = 0.001$, $\eta p^2 = 0.031$]. Results emerging from the pairwise comparisons are synthetized in **Figure 2**: significant differences are shown by the 95% intervals of the mean values. Overall, results confirm H2: product label has an effect on attitude such that it is more positive for the Italian products (particularly PDO) compared to both the Italian Sounding and the Generic Foreign products; moreover, PDO Made in Italy's positive attitude is stronger than that of Made in Italy. Non-Italians express a more positive attitude than Italians to IS products, as well as to Made in Italy and Foreign products, while the two sub-samples do not differ in their attitudinal assessment of the PDO Made in Italy products.

H3. First, a three-way repeated-measures ANOVA (product label × nationality × product type) was run to account for a possible interaction effect due to the price difference in the two selected types of products (olive oil and pasta), which indeed was not significant [*Wilks' Lambda* (3, 194) = 0.98, $p = 0.40$)]. Therefore, the scheduled analysis was

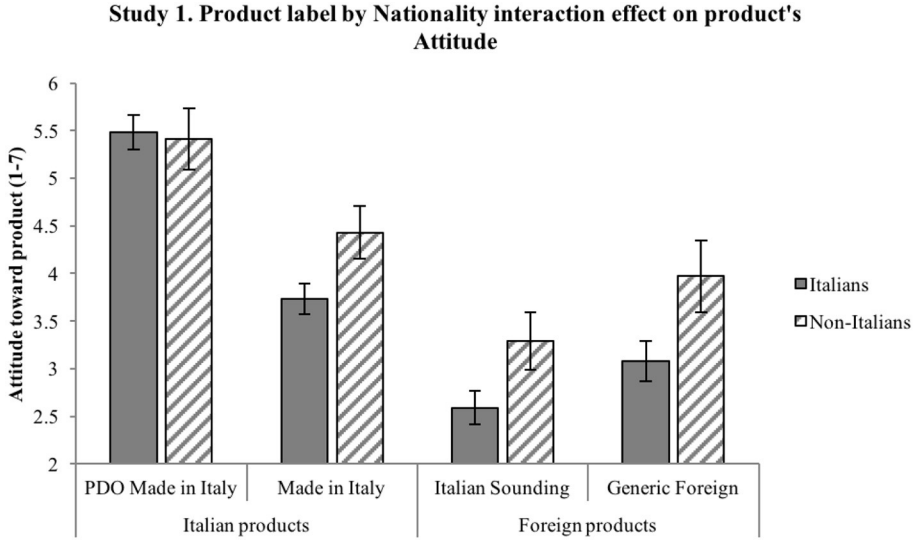

FIGURE 2 | Interaction effect of product label and nationality on attitude toward product. Attitude toward product is measured on a scale from 1 (negative attitude) to 7 (positive attitude). Error bars represent 95% confidence interval of the mean. All significant differences have a $p < 0.001$.

FIGURE 3 | Interaction effect of product label and nationality on WTP. WTP for the product is measured from 1 (WTP a lower price) to 11 (WTP a higher price). WTP ranged from €2.50 to €7.50 for olive oil (with one step increase in the Likert scale corresponding to an increase of €0.50) and from €0.00 to €4.00 for pasta (with one step increase in the Likert scale corresponding to an increase of €0.40). Error bars represent 95% confidence interval of the mean. All significant differences have a $p < 0.001$.

conducted. The mixed-model ANOVA shows a significant effect of product label on WTP [$F_{(3, 594)} = 175.71$, $p < 0.001$] and a significant effect of nationality on WTP [$F_{(1, 198)} = 7.32$, $p < 0.001$]. An interaction effect also emerges between the two independent variables on WTP [$F_{(3, 594)} = 7.13$, $p = 0.001$, $\eta p^2 = 0.035$]. Results emerging from the pairwise comparisons are synthetized in **Figure 3**: significant differences are shown by the 95% intervals of the mean values. Overall, results confirm H3: product label has an effect on WTP such that it is higher for the Italian products (particularly PDO) compared to both the Italian Sounding and the Generic Foreign products; moreover, PDO Made in Italy's WTP is higher than that of Made in Italy. Non-Italians declare a greater WTP than Italians for IS products, as well as for Made in Italy and Foreign products, while the two sub-samples do not differ in their WTP for the PDO Made in Italy products.

TABLE 3 | Summary of mediation analyses predicting Willingness to Pay in the whole sample in Study 1 (Italian and non-Italian in the EU).

Product label (*N*)	Effect of X on M	Effect of M on Y	Total effect of X on Y	Direct effect of X on Y	Indirect effect of X on Y
	a	*b*	*c*	*c'*	*ab* [95% CI]
PDO made in Italy (202)	0.39***	0.68***	0.49***	0.22	0.27*** [0.14, 0.43]
Made in Italy (201)	0.31***	1.05***	0.43***	0.1	0.32*** [0.21, 0.45]
Italian sounding (200)	0.36***	0.66***	0.46***	0.22**	0.24*** [0.15, 0.34]
Generic foreign (196)	0.39***	0.95***	0.70***	0.33**	0.38*** [0.24, 0.51]

$^{***}p < 0.001$. a: effect of X on M; b: effect of M on Y; c: total effect of X on Y; c': direct effect of X on Y; ab: indirect effect of X on Y.

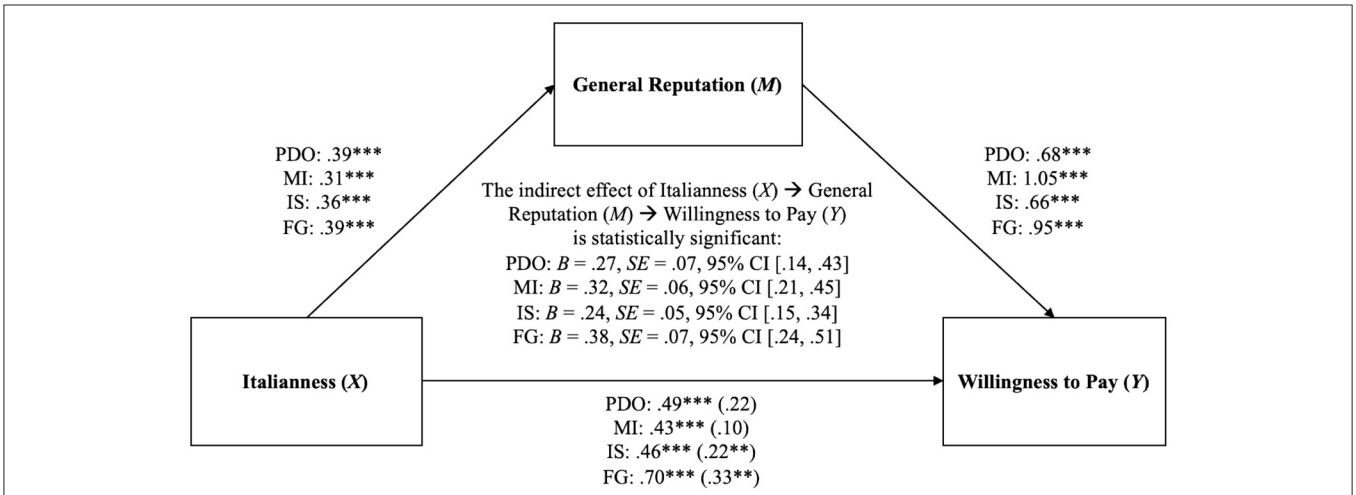

FIGURE 4 | Indirect effects of Italianness (X) on WTP (Y) through General Reputation (M) using bias-correcting bootstrapping (resampled 5,000 times) for each of the four product labels, in Study 1 (Italian and non-Italian in Italy). Values represent standardized estimates. When modeling the relationship between Italianness (X) and WTP (Y), total effects are shown outside parentheses and direct effects are displayed inside parentheses. PDO, PDO Made in Italy; MI, Made in Italy; IS, Italian Sounding; GF, Generic Foreign. $^{**}p < 0.01$; $^{***}p < 0.001$.

Auxiliary Analysis

Given the significant label effect for WTP, a series of four exploratory mediation analyses were conducted. Although differences in Italianness were initially examined as a manipulation check, the follow-up analyses were implemented to test the indirect effect of Italianness on WTP, mediated by reputation. The Italianness score was computed by averaging the Italianness intensity and Italianness probability scores for each product label. The PROCESS Macro for SPSS (Model 4) was used in these analyses (Hayes, 2012). Results (**Table 3**; **Figure 4**) support the mediation interpretation: Italianness increased reputation, which was associated with an increase in WTP. The indirect effect of Italianness on WTP via reputation was significant for all the different product labels. Overall, these results suggest that the more any food product (oil or pasta) is perceived to be Italian, the more its reputation will increase, which, in turn, will increase consumers' WTP for that product.

Discussion

The three hypotheses were generally confirmed by the results. Reputation, attitude, and WTP differ significantly for the four product labels, with further differences in the three dependent variables when comparing the Italian and non-Italian sub-samples. H1, H2, and H3 have been largely confirmed, as different reputation, attitude, and WTP emerged for the four different product labels: the highest reputation, attitude, and WTP were found for the PDO Made in Italy product, followed by the Made in Italy product, then by the Generic Foreign product, and finally by the Italian Sounding product. To better understand the magnitude of the effect confirming H3, it is worth reverting the Likert values of the WTP scale in euro: critically, for the *DPO Made in Italy* product, subjects have been found willing to pay 10% more than the average price (€5.50 for oil, €2.00 for pasta) of one product item (around €0.50 more for olive oil and €0.40 more for pasta); for the *Made in Italy* product, they would pay 11% less than the average price (around €0.50 less for olive oil and €0.40 less for pasta); for the *IS* product, they would pay 20% less than the average price (around €1.00 less for olive oil and €0.80 less for pasta); for the *Generic Foreign* product, they would pay 16% less than the average price (around €0.75 less for olive oil and €0.60 less for pasta). Overall, results are thus consistent with expectations, as they show a significant effect of perception, in terms of reputation and attitude, on consumers' WTP (Landon and Smith, 1998; Loureiro and McCluskey, 2000; Loureiro and Umberger, 2007).

Also, differences within the two sub-samples were in line with expectations. Confirming H1, H2 and H3, different reputation, attitude, and WTP emerged for three different product labels (Made in Italy, IS, and Generic Foreign), with non-Italian participants reporting significantly higher reputation, attitude,

and WTP. Importantly, there was no significant differences in reputation, attitude, and WTP toward the PDO Made in Italy product label between the non-Italian sub-sample and the Italian sub-sample, suggesting that the PDO Made in Italy product is perceived to be the best one by Italians and Europeans alike. Interestingly, Italian Sounding items (oil and pasta) turn out to be the worst ones among the four product labels, contrary to the expectation of their capability to endorse a competitive advantage when compared to the Generic Foreign corresponding ones: such a lack of IS effect can be interpreted within the specific samples and contexts, namely, Italians living in Italy and non-Italians living in the EU (i.e., a close-by target with respect to the country of origin on which the IS phenomenon is based).

Finally, the auxiliary analysis provided critical insights into the psychological process by which a given product, when perceived to be Italian, might gain a financial competitive advantage over other products. Basically, the more a food product is perceived to be Italian, the more positive its reputation is. The higher the reputation, the more its consumers are willing to pay for that given product. The Italianness economic effect of a product is thus critically mediated by its reputational advantage, in both Italian and EU consumers.

Overall, although some caution in the interpretation of results should be used given the different sample sizes of the two considered sub-samples, the main pattern of results suggests that Made in Italy products (especially being PDO Made in Italy, partly being simply Made in Italy) are perceived to be better products than foreign products (being Italian Sounding or Generic Foreign), a crucial insight for Italian products market potential in Italy and abroad. Furthermore, the auxiliary results shed light on the reason why the competitive advantage of Italian products might occur: our results show that it is not Italianness *per se* that directly translates into market value; instead, the reputation gain associated with it is the crucial driver. The next step would be to understand whether this process specifically holds true for Italian Sounding products: in fact, those products that sound Italian but in fact are not (that is, Italian Sounding products) might hold the competitive advantage over other foreign products by "stealing" the reputation of Italian products. This effect, underpinning the Italian Sounding phenomenon, could be even more likely to occur in markets where finding Italian products is not as easy as it is in Italy and in Europe. Indeed, the perception and the WTP for products associated with Italy should be investigated not only in an Italian and EU context, as it was in Study 1. Therefore, research in other continents should be carried out to clarify this issue. Furthermore, the methodology of Study 1 has not included a standard tool to assess more in detail the food reputation profile of the investigated products (over and above a measure of general reputation). This possibility should be included too in the next steps of the research, in order to clarify which peculiar aspects of food reputation are key to explain the Italian Sounding phenomenon. Accordingly, these steps will be addressed by Study 2 first, and then by Study 3. The next two studies will also deepen the interplay among the expected Italian Sounding phenomenon with regard to different contexts and samples: rather than assessing its effects within Italy with Italian and EU samples (as in Study 1), they will move such a test to both China (Study 2) and the USA (Study 3), by thus expecting a much more salient scenario to test the effects hypothesized by the Italian Sounding phenomenon. In Study 2, this issue will be tested more thoroughly by adding a comparison across different non-Italian cultural groups within the same country (i.e., a Chinese vs. a non-Chinese sample).

STUDY 2

Aim and Hypotheses

The main aim of Study 2 is to confirm and enlarge the findings that emerged in Study 1, that is, to investigate how non-Italian subjects perceive, in terms of reputation and attitude, and are willing to pay for an agro-food product associated to Italy (pasta) presented in three forms, differentiated by label (*Made in Italy*, *Italian Sounding*, and *Generic Foreign*), in a different linguistic and cultural context. In order to shed light on the process by which Made in Italy and Italian Sounding products can gain a competitive advantage on foreign products and to deepen the knowledge of Italian Sounding effects within one of the main global markets, the study has been conducted on a first sample of Chinese citizens (Huliyeti et al., 2008; Vianelli et al., 2012a), as well as on a second sample of non-Italian expatriates in China (to check for the hypothesized effects in the same cultural place but on a different cultural group). In general, the first sample (Chinese citizens in China) is expected to be vulnerable to the Italian Sounding effects (i.e., Italian Sounding product perceived and treated similarly to the Made in Italy one), while the second sample (non-Italian expatriates in China) is expected to be less vulnerable to the Italian Sounding effects (i.e., Italian Sounding product perceived and treated at a lower lever compared to the Made in Italy ones). The PDO product was not included for the first sample, as PDO, being an EU labeling system, is estimated to be meaningful in the EU rather than in Asia (therefore for the second sample only in Study 2); the PDO product is however included in the second sample as expatriates may have a better knowledge of the difference among PDO and non-PDO products that belong from the same country of origin (and also to further test the specific result previously obtained in Study 1, now with a non-Italian sample abroad). Study 2 also deepens the general knowledge acquired with Study 1's findings by measuring more detailed reputation profiles of the products via a list of items reproducing the main 23 features emerged in the *Food Reputation Map* (FRM, Bonaiuto et al., 2017; De Dominicis et al., 2020).

It is thus expected that:

H4: The product form or label has an effect on reputation profiles measured via FRM, which are more positive for *Made in Italy* and *Italian Sounding* products compared to the *Generic Foreign Chinese* product in the first sample (Chinese in China), while in the second sample (Expatriates in China), the *PDO Made in Italy* product is the highest, the *Made in Italy* product is the second highest, and the other two products are the lowest.

H5: The product has an effect on general reputation: In particular, reputation is more positive for *Made in Italy* and

Italian Sounding products compared to the *Generic Foreign Chinese* product in the first sample (Chinese in China), while in the second sample (Expatriates in China), the *PDO Made in Italy* product is the highest, the *Made in Italy* product is the second highest, and the other two products are the lowest ones.

H6: The product has an effect on the attitude: In particular, the attitude is more positive for *Made in Italy* and *Italian Sounding* products compared to the *Generic Foreign* product in the first sample (Chinese in China), while in the second sample (Expatriates in China), the *PDO Made in Italy* product is the highest, the *Made in Italy* product is the second highest, and the other two products are the lowest ones.

H7: The product has an effect on the WTP: In particular, WTP is higher for *Made in Italy* and *Italian Sounding* products compared to the *Generic Foreign Chinese* product in the first sample (Chinese in China), while in the second sample (Expatriates in China), the *PDO Made in Italy* product is the highest, the *Made in Italy* product is the second highest, and the other two products are the lowest ones.

Method

Participants, Procedure, and Materials

Data were collected on two samples. The first sample is composed of 100 subjects of Chinese nationality: 56% were women, 48% were 18–25 years old, 35% were 26–34 years old, 13% were 35–44 years old, and 4% were 45–54 years old. The second sample is composed of 91 non-Italian expatriates in China (living in China and not an Italian or Chinese nationality): 42% were women; 49.5% were 18–25 years old, 39.6% were 26–34 years old, 8.8% were 35–44 years old, 2.2% were 45–54 years old; nationality: 22% USA, 15.4% Germany, 12.1% Malaysia, 8.8% Singapore, 6.6% North Korea, 4.4% Iran, 4.4% Switzerland, and 26.3% other countries. The questionnaire for the two samples was administered electronically in May 2015 via the major Chinese social network (WeChat) and via networks such as "CrackingChina" and "ExpatMix." In order to identify which products could be investigated in a context that is culturally different from the Italian one, a similar pre-test as in Study 1 was conducted on 20 subjects selected at Zhejiang University in Hangzhou (asking a preliminary sample to indicate two information: the most known and the most consumed Italian food product). The pre-test results and calculated count of the subjects' responses show that the best known and most consumed Italian product in China is pasta. For the first sample, the questionnaire was translated from English to Mandarin Chinese with the collaboration of a group of master's and PhD students from Zhejiang University, and a back-translation was carried out. As in Study 1, for the first sample, each subject was asked to fill in a questionnaire, observing the images of the three different products reported in it, presented in the following order: *Made in Italy*, *Italian Sounding*, and *Generic Foreign Chinese*; for the second sample, each subject was asked to fill in a questionnaire, observing the images of the four different products reported in it, presented in the following order: *PDO Made in Italy*, *Made in Italy*, *Italian Sounding*, and *Generic Foreign Chinese*.

The three selected products were as follows (again, as in Study 1, avoiding major brands): "Spaghetti Capellini Agnesi" as *Made in Italy*, "Spaghetti San Remo" as *Italian Sounding*, and one Chinese spaghetti, as *Generic Foreign Chinese* (**Appendix B**); for the second sample only, the fourth product was a *PDO Made in Italy* ("Spaghetti Gentile Pasta di Gragnano").

Measures

The questionnaire is similar to the one used in Study 1, although only one version was produced, as only one type of product (pasta) was explored, indicated as the most representative of the Italian cuisine by the pre-test. The questionnaire, investigating three product forms (*Made in Italy*, *Italian Sounding*, and *Generic Foreign Chinese*), was administered in Mandarin Chinese to Chinese citizens in China for the first sample; moreover, the questionnaire, investigating four product forms (*PDO Made in Italy*, *Made in Italy*, *Italian Sounding*, and *Generic Foreign Chinese*) was administered in English to non-Italian expatriates in China for the second sample. The whole survey is available in the **Supplementary Material** of this manuscript.

The same three types of manipulation checks as Study 1 were used to measure Italianness intensity, probability, and origin.

To measure the product's general reputation, the same one-item seven-point Likert-type scale as Study 1 was used. Reputation profiles of each product were investigated via a new 23-item set on a seven-point Likert-type scale (from "strongly disagree" to "strongly agree"), created *ad hoc* by adapting the 23 indicators of the FRM (Bonaiuto et al., 2017; De Dominicis et al., 2020). Four items measured *Essence*; four items measured *Cultural Effects*; three items measured *Economic Effects*; four items measured *Environmental Effects*; three items measured *Physiological Effects*; five items measured *Psychological Effects* (see **Appendix C**).

The same 10 seven-point evaluative semantic differential scales as Study 1 were used to investigate attitude by means of the same bi-polar couples of adjectives.

To measure WTP, the same one-item 11-point Likert-type scale (adapted from Hanemann, 1984) as Study 1 was used, expressing prices in yuan, ranging from "¥0" to "¥40" for the first sample (¥4 cumulative increase in each step) and in US dollars (from $0 to $3) for the second sample ($0.30 cumulative increase in each step), where the scale's middle point was close to a possible national average price (¥20 or $1.50) for the product in that period.

For the non-Italian expatriates in China sample, the "pasta" item was: "Considering that the average price of a 500 g of pasta is about $1.50, how much would you be willing to pay if you would buy 500 g of PRODUCT NAME"; for the Chinese sample, the item was the same one written in Chinese Mandarin language.

As for Study 1, all statistical analyses were released using the SPSS version 27 software.

Manipulation Check

Similarly to Study 1, a series of manipulation checks was performed to test whether the manipulation of the products' form or label, being PDO Made in Italy, Made in Italy, Italian Sounding, or Generic Foreign products, was effective in changing

TABLE 4 | Mean scores and *SD* of product label related to Italianness intensity, probability, and origin, for the first sample of Chinese respondents in China (Study 2).

Product label	Italianness intensity	Italianness probability	Italianness origin
	M (SD) (N = 100)	M (SD) (N = 100)	Italian%/foreign % (N), sig.
Made in Italy	6.28 (2.13)	3.32 (1.31)	59/41 (100), $p = 0.073$
Italian sounding	6.68 (2.25)	3.11 (1.27)	54/45 (99), *ns*
Generic foreign	2.36 (2.36)	1.48 (0.91)	4/96 (100), $p < 0.001$

TABLE 5 | Mean scores and *SD* of product label related to Italianness intensity, probability, and origin, for the second sample of non-Italian expats respondents in China (Study 2).

Product label	Italianness intensity	Italianness probability	Italianness origin
	M (SD) (*N* = 91)	M (SD) (*N* = 91)	Italian%/foreign% (*N*), sig.
PDO made in Italy	7.82 (1.66)	3.93 (0.96)	83.5/16.5 (91), $p < 0.001$
Made in Italy	6.70 (1.79)	3.52 (1.24)	76.9/23.1 (91), $p < 0.001$
Italian sounding	5.18 (2.44)	3.12 (1.21)	59.3/40.7 (91), $p = 0.076$
Generic foreign	4.60 (2.66)	2.24 (1.20)	20.9/79.1 (91), $p < 0.001$

the perception of Italianness (intensity, probability, and origin) in both samples of participants.

On the first sample (Chinese respondents in China), two repeated-measures ANOVAs were performed to test the product label effects on the dependent variable "Italianness intensity" (score 0–10) and "Italianness probability" (0–100%). The manipulation checks indicated an effect of the product label both on Italianness intensity [$F_{(2,\ 198)} = 127.86$, $p < 0.001$, $\eta p^2 = 0.56$] and on Italianness probability [$F_{(2,\ 198)} = 86.16$, $p < 0.001$, $\eta p^2 = 0.46$], such that, as expected, Made in Italy and Italian Sounding products, while not differing from each other, were significantly higher in both dependent variables than the Generic Foreign products (**Table 4**). Furthermore, three binary logistic regressions were conducted to understand whether Italian origin (yes/no) was predicted by each product label. The Made in Italy and the Italian Sounding products were perceived Italian by the slight majority (59 and 54% of cases, respectively), while Generic Foreign product was considered foreign in 96% of cases (**Table 4**). Therefore, it is possible to conclude that the manipulation was effective on the Chinese sample, according to the sample-specific expectations: the Made in Italy product and the Italian Sounding product were both perceived as more Italian than the Generic Foreign product.

On the second sample (non-Italian expats respondents in China), two repeated-measures ANOVAs were performed to test the effects of product label on the dependent variable "Italianness intensity" (score 0–10) and "Italianness probability" (0–100%). The manipulation checks indicated an effect of the product label both on Italianness intensity [$F_{(2.43,\ 218.91)} = 51.76$, $p < 0.001$, $\eta p^2 = 0.36$] and on Italianness probability [$F_{(3,\ 270)} = 37.42$, $p < 0.001$, $\eta p^2 = 0.29$], such that, as expected, both dependent variables significantly decreased from PDO Made in Italy to Made in Italy to Italian Sounding to Generic Foreign products. Estimated marginal means comparisons showed significant differences across all four means (see values in **Table 5**) in each of the two dependent variables. Furthermore, three binary logistic regressions were conducted to understand whether Italian origin (yes/no) was predicted by each product label. All four models were statistically significant (all $p < 0.001$) and predicted Italian (or non-Italian) origin as expected: the PDO Made in Italy and Made in Italy products were considered Italian products in 97 and 74% of cases, respectively, while the Italian Sounding and Generic Foreign products were considered foreign products in 89.7 and 95.3% of cases, respectively. Therefore, it is possible to conclude that the manipulation was effective, again according to the sample-specific expectations: the PDO Made in Italy product was perceived as more Italian than the Made in Italy product, which, in turn, was perceived as more Italian than the Italian Sounding product, which finally was perceived more Italian than the Generic Foreign product.

Results

Comparison of Indicators of Food Reputation Across Products (H4)

Results are separately reported for the first and the second sample. Regarding the first sample, to test H4, a series of repeated-measures ANOVA was conducted on each of the 23 specific indicators of the FRM, comparing each indicator across the products. The results of the repeated-measures ANOVAs, *post hoc* comparisons, and descriptive statistics are presented in **Table 6** by grouping them into the six areas identified by the synthetic indicators of FRM: *Essence*, *Cultural Effects*, *Economic Effects*, *Environmental Effects*, *Physiological Effects*, and *Psychological Effects*.

As for the *Essence* scores, the products do not significantly differ (except for *Made in Italy* enjoying a tendency to a higher *Recognition* than *Generic Foreign Chinese*).

As for *Cultural Effects*, all dimensions contribute to defining the products' distinctive reputation profile, except for *Familiarity*. In particular, both *Territorial identity* and *Tradition* mark a positive difference of the *Made in Italy* product compared to the *Generic Foreign Chinese* product. *Innovativeness* is common to *Made in Italy* and *Italian Sounding* products and positively differentiates them from the *Generic Foreign Chinese* product.

As for *Economic Effects*, both *Context* and *Preparation* differentiate the profile of the *Generic Foreign Chinese* product from both the *Made in Italy* and the *Italian Sounding* ones, which do not differ from each other: while on the first variable they are more positive, on the second variable, they are less positive than the *Generic Foreign Chinese*. Moreover, the *Generic Foreign Chinese* product enjoys a more positive *Price* ratio than the Made in Italy product.

As for *Environmental Effects*, results show that *Traceability* positively differentiates both *Made in Italy* and *Italian Sounding* products from the *Generic Foreign Chinese* product; while

TABLE 6 | Mean (*M*) and Standard Deviation (*SD*) scores for 23 reputation features related to the three product labels and the relevant *p*-value indicating the statistical significance of each difference (ANOVA), for the first sample (Chinese citizens in China).

	Omnibus effect	M (SD)			Significance (*p*-value)		
	F(df) **ηp^2**	**Made in Italy (MI)**	**Italian sounding (IS)**	**Generic Foreign Chinese (GFC)**	**MI-IS**	**MI-GFC**	**IS-GFC**
ESSENCE							
Composition	0.83 (2, 198) 0.43	4.43 (1.11)	4.31 (1.14)	4.26 (1.04)	1.000	0.569	1.000
Genuineness	0.32 (1.63, 161.19) 0.00	4.16 (1.27)	4.25 (1.27)	4.11 (1.70)	1.000	1.000	1.000
Life time	1.97 (2, 198) 0.02	5.05 (1.17)	4.81 (1.28)	5.10 (1.24)	0.250	1.000	0.248
Recognition	**3.42 (2, 198)* 0.03**	4.73 (1.12)	4.53 (1.24)	4.30 (1.53)	0.524	**0.054^**	0.514
CULTURAL EFFECTS							
Territorial identity	**4.31 (2, 198)* 0.04**	4.87 (1.20)	4.61 (1.37)	4.33 (1.62)	0.390	**0.012***	0.478
Tradition	**5.61 (2, 198)** 0.05**	4.80 (1.18)	4.61 (1.21)	4.28 (1.51)	0.590	**0.006****	0.129
Familiarity	1.10 (2, 198) 0.01	4.67 (1.36)	4.54 (1.21)	4.40 (1.51)	1.000	0.420	1.000
Innovativeness	**27.37 (1.82, 179.87)*** 0.22**	4.45 (1.27)	4.22 (1.23)	3.23 (1.61)	0.352	**0.000*****	**0.000*****
ECONOMIC EFFECTS							
Context	**14.97 (2, 198)*** 0.13**	4.49 (1.32)	4.53 (1.16)	3.67 (1.42)	1.000	**0.000*****	**0.000*****
Price	**3.04 (2, 198)*0.03**	4.38 (1.18)	4.46 (1.23)	4.75 (1.36)	1.000	**0.080^**	0.260
Preparation	**6.57 (2, 198)** 0.06**	4.94 (1.07)	4.83 (0.93)	5.31 (1.38)	1.000	**0.032***	**0.005****
ENVIRONMENTAL EFFECTS							
Social and environmental responsibility	0.94 (2, 198) 0.01	4.65 (1.21)	4.83 (1.16)	4.63 (1.33)	0.770	1.000	0.660
Traceability	**7.39 (1.79, 177.3)** 0.07**	4.61 (1.24)	4.50 (1.01)	4.02 (1.54)	1.000	**0.004****	**0.022***
Proximity	0.98 (2, 198)0.01	4.41 (1.40)	4.62 (1.12)	4.42 (1.53)	0.626	1.000	0.681
Safety	**2.98 (2, 198)^ 0.03**	4.82 (1.23)	4.59 (1.20)	4.43 (1.39)	0.410	**0.051^**	1.000
PHYSIOLOGICAL EFFECTS							
Ability to Satisfy	**9.80 (2, 198)*** 0.09**	5.27 (1.41)	4.95 (1.34)	5.64 (1.48)	0.115	**0.062^**	**0.000*****
Digestibility	0.99 (2, 198) 0.01	4.75 (1.39)	4.90 (1.37)	4.99 (1.56)	0.997	0.526	1.000
Lightness	**6.72 (1.86, 184.33)** 0.06**	3.95 (1.34)	4.37 (1.23)	3.80 (1.47)	**0.009****	1.000	**0.003****
PSYCHOLOGICAL EFFECTS							
Organoleptic perception	**9.79 (2, 198)*** 0.09**	4.40 (1.38)	4.30 (1.21)	3.74 (1.43)	1.000	**0.000*****	**0.004****
Personal memories	0.76 (2, 198) 0.01	3.83 (1.54)	4.03 (1.42)	4.05 (1.76)	0.882	0.880	1.000
Psycho-physical well-being	1.38 (2, 198) 0.01	4.06 (1.46)	4.07 (1.24)	3.83 (1.44)	1.000	0.589	0.471
Conviviality	**21.61 (2, 198)*** 0.18**	4.17 (1.42)	4.18 (1.45)	3.22 (1.53)	1.000	**0.000*****	**0.000*****
Group belongingness	2.13 (2, 198) 0.02	4.00 (1.50)	4.00 (1.53)	3.67 (1.66)	1.000	0.250	0.260

*Bold values represents significant or marginally significant effects. ^$p < 0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.*

Safety positively differentiates only the Made in Italy one from the *Generic Foreign Chinese* one, *Proximity* does not show significant differences.

As for *Physiological Effects*, the averages obtained from the different products in *Digestibility* are not significantly different, while significant differences emerge with respect to *Ability to*

Satisfy—a dimension in which the reputation score of the *Generic Foreign Chinese* product is higher than both the *Italian Sounding* and the *Made in Italy* products, as well as with respect to *Lightness*—for which the reputation of the *Italian Sounding* product is significantly higher than both the *Made in Italy* and the *Generic Foreign Chinese* ones.

As for *Psychological Effects*, results show both *Organoleptic perception* and *Conviviality* positively differentiating the reputation profiles of both *Made in Italy* and *Italian Sounding* products from that of the *Generic Foreign Chinese* product, while neither *Personal memories*, nor *Psycho-physical well-being*, nor *Group belongingness* differentiates among the three products' reputation.

Regarding the second sample, to test H4, a series of repeated-measures ANOVA was then conducted on each of the 23 specific indicators of the FRM, comparing each indicator with the four product forms. The results of the repeated-measures ANOVAs, *post hoc* comparisons, and descriptive statistics are presented in **Table 7** by grouping them into the six areas identified by the synthetic indicators of FRM: *Essence*, *Cultural Effects*, *Economic Effects*, *Environmental Effects*, *Physiological Effects*, and *Psychological Effects*.

As for the *Essence* scores, there are several statistically significant differences among the products. *Italian Sounding* and *General Foreign Chinese* do not differ in these features, while they are both always less reputable when compared to the *PDO Made in Italy*. *Composition* appears to be the one best discriminating among those products, while regarding *Genuineness*, only *PDO Made in Italy* has a significantly higher score compared to all other products. Regarding *Recognition* and *Life time*, the two *Made in Italy* products both enjoy higher scores than the couple represented by the *Italian Sounding* and *General Foreign Chinese* products. Thus, the general pattern is that *PDO Made in Italy*, and often *Made in Italy* too, is better than both *Italian Sounding* and *Generic Foreign Chinese*.

As for *Cultural Effects*, all dimensions contribute to defining the products' distinctive reputation profile. It can be highlighted how the most discriminating feature is the one about *Territorial identity*: the *PDO Made in Italy* product has the best reputation compared to the other three; moreover, the *Made in Italy* product has a better reputation than the *Italian Sounding* and the *Generic Foreign Chinese* one. The *Italian Sounding* product and the *Generic Foreign Chinese* one never differ in any dimension within this area (*Tradition* and *Familiarity*), except the *Innovativeness* feature, where the *Italian Sounding* product reports the lowest score compared to both *PDO Made in Italy* and the *Generic Foreign Chinese* one. Moreover, the *PDO Made in Italy* and the Made in Italy products do not differ in *Tradition*, *Familiarity*, and *Innovativeness*. Thus, the general pattern for *Cultural Effects* is that both *PDO Made in Italy* and *Made in Italy* are very often better than both *Italian Sounding* and *Generic Foreign Chinese*.

As for *Economic Effects*, the *PDO Made in Italy* product receives higher scores compared to all other products for *Context* and for *Price*; the *Made in Italy* product partly enjoys a more positive reputation than the *Italian Sounding* (for *Context*) and the *Generic Foreign Chinese* ones (*Price*). Moreover, similarly to the first sample, the feature *Preparation* is more positive in the *Generic Foreign Chinese*, in this case compared to both *Made in Italy* and (tendency) *PDO Made in Italy*. Thus, the pattern for *Economic Effects* is articulated: *PDO Made in Italy* is better than both *Italian Sounding* and *Generic Foreign Chinese* only for Context, while *Italian Sounding* equals *Made in Italy* in Price and *Generic Foreign Chinese* equals *Made in Italy* in Context, and it overrides both *Made in Italy* products in *Preparation*.

As for *Environmental Effects*, the *PDO Made in Italy* product reports significantly higher scores compared to all three other products both for *Traceability* and for *Safety*, as well as for *Social and environmental responsibility* (though with only a tendency for *Made in Italy*); moreover, *PDO Made in Italy* enjoys a more positive reputation for *Proximity* as compared to both *Made in Italy* and *Italian Sounding*. The *Made in Italy* product here enjoys a more positive reputation only compared to the *Italian Sounding* and only on *Social and environmental responsibility*. Thus, the general pattern for *Environmental Effects* is that *PDO Made in Italy* is very often better than both *Italian Sounding* and *Generic Foreign Chinese*.

As for *Physiological Effects*, it is on the *Lightness* that the *PDO Made in Italy* has the best reputation compared to all other three products. Moreover, for *Digestibility*, the *PDO Made in Italy* has a more positive reputation compared to both *Italian Sounding* and *Generic Foreign Chinese* ones, but not compared to the *Made in Italy* one, which, however, has a more positive reputation than those two in terms of *Ability to satisfy*. Thus, the general pattern for *Physiological Effects* is that either *PDO Made in Italy* or *Made in Italy*—although with different peculiarities (*Lightness* and *Digestibility* for *PDO Made in Italy*, *Ability to satisfy* for *Made in Italy*)—is better than both *Italian Sounding* and *Generic Foreign Chinese*.

As for *Psychological Effects*, *PDO Made in Italy* consistently reports the highest reputation score, compared to all three other products, in each feature, namely, *Organoleptic perception*, *Personal memories*, *Psycho-physical well-being*, *Conviviality*, and *Group belongingness*.

Thus, the general pattern for *Psychological Effects* is that the *PDO Made in Italy* product enjoys the best reputation in all features (*Organoleptic perception*, *Personal memories*, *Psycho-physical well-being*, *Conviviality*, and *Group belongingness*) as compared to any other product, namely, both *Made in Italy* and *Italian Sounding* and *Generic Foreign Chinese*.

Comparison of General Reputation, Attitude, and WTP Across Products (H5–H6–H7)

Results are separately reported for the first (Chinese) and the second (non-Chinese expatriates) sample. Regarding the first sample (Chinese), to test H5, a repeated-measures ANOVA of products on the general reputation scores was conducted, showing a significant omnibus effect, $F_{(2,\ 198)} = 2.98$, $p = 0.05$, $\eta p^2 = 0.03$. The subsequent *post hoc* comparisons show that the reputation mean scores of *Made in Italy* ($M = 4.66$, $SD = 1.10$) and *Italian Sounding* ($M = 4.7$, $SD = 1.08$) were respectively marginally ($p = 0.06$) and significantly ($p = 0.03$) higher than

TABLE 7 | Mean (*M*) and Standard Deviation (*SD*) scores for 23 reputation features related to the three product labels and the relevant *p*-value indicating the statistical significance of each difference (ANOVA), for the second sample (non-Italian expatriates in China).

	Omnibus effect	M (SD)				Significance (*p* value)					
	F(df) **ηp^2**	**PDO Made in Italy (PMI)**	**Made in Italy (MI)**	**Italian Sounding (IS)**	**Generic Foreign Chinese (GFC)**	**PMI-MI**	**PMI-IS**	**PMI-GFC**	**MI-IS**	**MI-GFC**	**IS-GFC**
ESSENCE											
Composition	**19.22 (3, 270)*** 0.18**	4.82 (1.23)	4.27 (1.18)	3.69 (1.50)	3.78 (1.29)	**0.009****	**0.000*****	**0.000*****	**0.008****	**0.041***	1.000
Genuineness	**19.21 (3, 270)*** 0.18**	4.97 (1.23)	4.11 (1.27)	3.74 (1.53)	3.77 (1.46)	**0.000*****	**0.000*****	**0.000*****	0.304	0.460	1.000
Life time	**11.64 (2.33, 209.64)*** 0.11**	5.19 (1.21)	5.04 (1.29)	4.19 (1.72)	4.44 (1.44)	1.000	**0.000*****	**0.000*****	**0.002****	**0.005****	1.000
Recognition	**13.76 (3, 270)*** 0.13**	4.88 (1.25)	4.68 (1.27)	4.03 (1.49)	4.11 (1.40)	0.951	**0.000*****	**0.000*****	**0.001****	**0.006****	0.951
CULTURAL EFFECTS											
Territorial identity	**26.30 (3, 270)*** 0.23**	5.11 (1.18)	4.56 (1.31)	3.59 (1.57)	3.84 (1.33)	**0.018***	**0.000*****	**0.000*****	**0.000*****	**0.001****	1.000
Tradition	**10.34 (3, 270)*** 0.10**	4.63 (1.39)	4.30 (1.35)	3.77 (1.46)	3.69 (1.46)	0.575	**0.001****	**0.000*****	**0.055^**	**0.011***	1.000
Familiarity	**14.97 (3, 270)*** 0.14**	4.82 (1.34)	4.59 (1.41)	3.68 (1.40)	4.11 (1.57)	1.000	**0.000*****	**0.001****	**0.000*****	**0.088^**	0.145
Innovativeness	**6.94 (2.68, 240.91)*** 0.07**	4.35 (1.66)	4.09 (1.66)	3.57 (1.50)	4.31 (1.10)	0.924	**0.005****	1.000	0.114	1.000	**0.000*****
ECONOMIC EFFECTS											
Context	**26.26 (3, 270)*** 0.23**	4.99 (1.16)	4.20 (1.42)	3.47 (1.41)	3.78 (1.55)	**0.000*****	**0.000*****	**0.000*****	**0.000*****	0.312	0.595
Price	**22.33 (2.38, 214.62)*** 0.20**	5.15 (1.14)	4.41 (1.27)	4.05 (1.68)	3.68 (1.31)	**0.000*****	**0.000*****	**0.000*****	0.756	**0.001****	0.308
Preparation	**2.59 (2.48, 223.57)^0.03**	5.11 (1.49)	5.08 (1.27)	5.32 (1.39)	5.53 (0.89)	1.000	1.000	**0.080^**	1.000	**0.026***	1.000
ENVIRONMENTAL EFFECTS											
Social and environmental responsibility	**11.01 (3, 270)*** 0.11**	4.92 (1.19)	4.49 (1.17)	4.07 (1.36)	4.14 (1.22)	**0.069^**	**0.000*****	**0.000*****	**0.078^**	0.239	1.000
Traceability	**11.36 (3, 270)*** 0.11**	5.07 (1.32)	4.58 (1.26)	4.14 (1.30)	4.15 (1.44)	**0.024***	**0.000*****	**0.000*****	0.150	0.137	1.000
Proximity	**4.15 (2.63, 236.92)** 0.04**	4.57 (1.43)	3.95 (1.46)	4.00 (1.44)	4.18 (1.24)	**0.008****	**0.050^**	0.214	1.000	1.000	1.000
Safety	**13.87 (2.75, 247.12)*** 0.13**	5.14 (1.26)	4.53 (1.24)	4.12 (1.35)	4.21 (1.35)	**0.002****	**0.000*****	**0.000*****	0.149	0.582	1.000

(Continued)

TABLE 7 | Continued

	Omnibus effect	M (SD)				Significance (*p* value)					
	F(df) ηp^2	**PDO Made in Italy (PMI)**	**Made in Italy (MI)**	**Italian Sounding (IS)**	**Generic Foreign Chinese (GFC)**	**PMI-MI**	**PMI-IS**	**PMI-GFC**	**MI-IS**	**MI-GFC**	**IS-GFC**
PHYSIOLOGICAL EFFECTS											
Ability to satisfy	**5.22 (2.70, 243.31)**** **0.05**	4.84 (1.40)	5.03 (1.33)	4.44 (1.40)	4.45 (1.16)	1.000	0.290	**0.066^**	**0.021***	**0.024***	1.000
Digestibility	**7.28 (2.74, 246.84)***** **0.07**	4.68 (1.37)	4.44 (1.42)	4.08 (1.38)	4.07 (1.28)	0.527	**0.002****	**0.000*****	0.197	0.227	1.000
Lightness	**6.67 (3, 270)***** **0.07**	4.37 (1.45)	3.69 (1.52)	3.68 (1.48)	3.93 (1.40)	**0.000*****	**0.002****	**0.046***	1.000	1.000	0.953
PSYCHOLOGICAL EFFECTS											
Organoleptic perception	**5.96 (3, 270) **** **0.06**	4.97 (1.39)	4.36 (1.39)	4.26 (1.36)	4.36 (1.38)	**0.003****	**0.004****	**0.009****	1.000	1.000	1.000
Personal memories	**6.33 (2.73, 245.74)**** **0.07**	4.40 (1.42)	3.85 (1.53)	3.67 (1.54)	3.71 (1.47)	**0.028***	**0.001*****	**0.000*****	1.000	1.000	1.000
Psycho-physical well-being	**6.64 (2.79, 251.03)***** **0.07**	4.27 (1.40)	3.62 (1.43)	3.62 (1.59)	3.70 (1.57)	**0.000******	**0.005***	**0.002****	1.000	1.000	1.000
Conviviality	**7.49 (2.44, 219.32)***** **0.08**	4.87 (1.18)	4.35 (1.51)	4.04 (1.50)	4.29 (1.16)	**0.014***	**0.001****	**0.000*****	0.951	1.000	1.000
Group belongingness	**18.10 (2.33, 209.61)***** **0.17**	4.90 (1.17)	3.99 (1.62)	3.67 (1.61)	3.88 (1.33)	**0.000*****	**0.000*****	**0.000*****	0.982	1.000	0.982

*Bold values represents significant or marginally significant effects. ^p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001.*

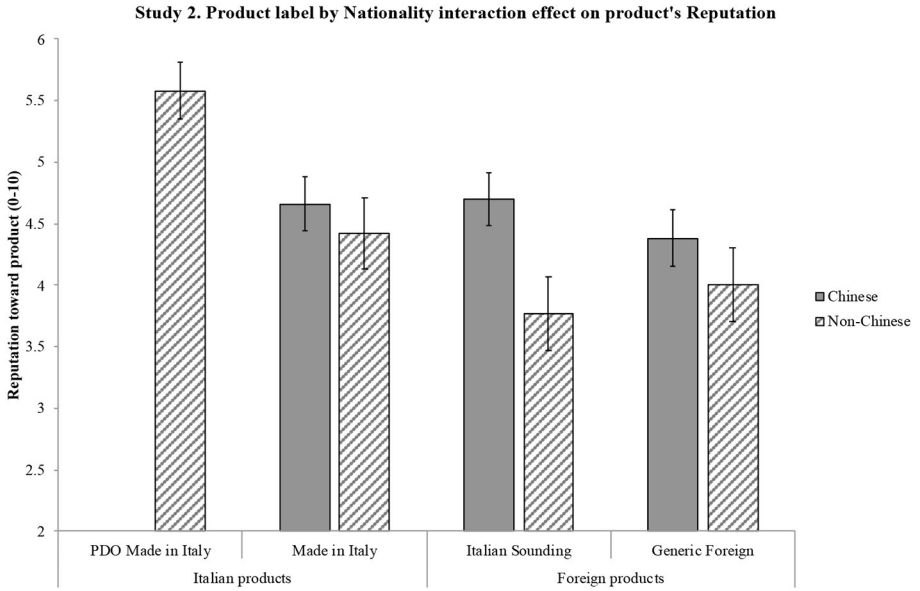

FIGURE 5 | Interaction effect of product label and nationality on product's reputation. Reputation toward product is measured on a scale from 1 (negative reputation) to 10 (positive reputation). Error bars represent 95% confidence interval of the mean. All significant differences have a $p < 0.001$. For visualization purposes, all means from the two sub-samples are plotted together; yet, pairwise comparisons are made across products within the same sample.

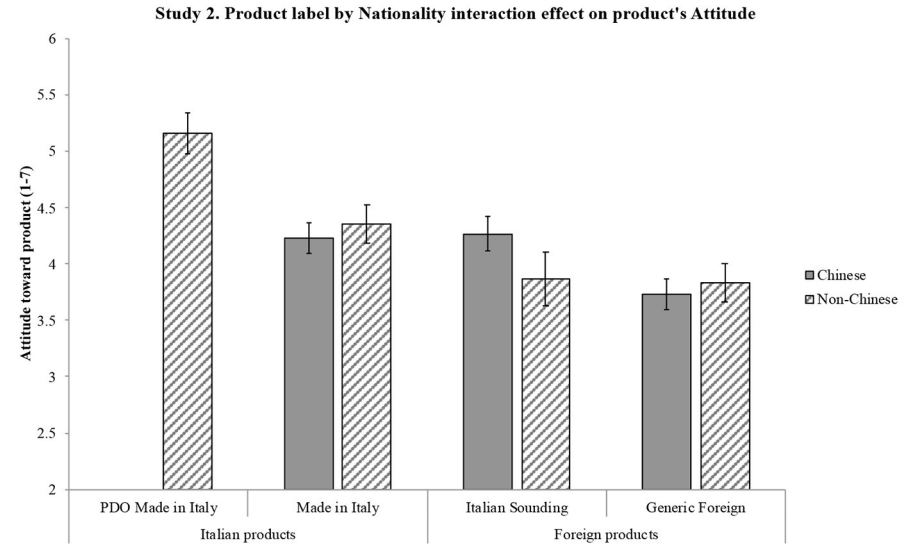

FIGURE 6 | Interaction effect of product label and nationality on attitude toward product. Attitude toward product is measured on a scale from 1 (negative attitude) to 7 (positive attitude). Error bars represent 95% confidence interval of the mean. All significant differences have a $p < 0.001$. For visualization purposes, all means from the two sub-samples are plotted together; yet, pairwise comparisons are made across products within the same sample.

the reputation of the *Generic Foreign Chinese* product ($M = 4.37$, $SD = 1.15$). Thus, H5 is confirmed (**Figure 5**).

To test H6, the reliability of the attitude scale was sufficient or good for all levels of measurement within the subjects (*Made in Italy*, $\alpha = 0.66$; *Italian Sounding*, $\alpha = 0.75$; *Generic Foreign Chinese*, $\alpha = 0.65$). A repeated-measures ANOVA on attitude was run, showing a significant omnibus effect of product on attitude, $F_{(2, 198)} = 21.82$, $p < 0.001$, $\eta p^2 = 0.18$. The subsequent *post hoc* comparisons show that both *Made in Italy* ($M = 4.23$, $SD = 0.71$) and *Italian Sounding* ($M = 4.27$, $SD = 0.75$) products get similar scores on the attitude scale, which are both significantly higher (both $p < 0.001$) than the *Generic Foreign Chinese* product score ($M = 3.73$, $SD = 0.71$). Thus, H6 is confirmed (**Figure 6**).

To test H7, a repeated-measures ANOVA of product on WTP (price expressed in yuan) was conducted, showing a significant omnibus effect, $F_{(2, 198)} = 101.56$, $p < 0.001$, $\eta p^2 = 0.51$. The subsequent *post hoc* comparisons show that the average price payable for *Made in Italy* ($M = 18.84$; $SD = 7.82$) and *Italian*

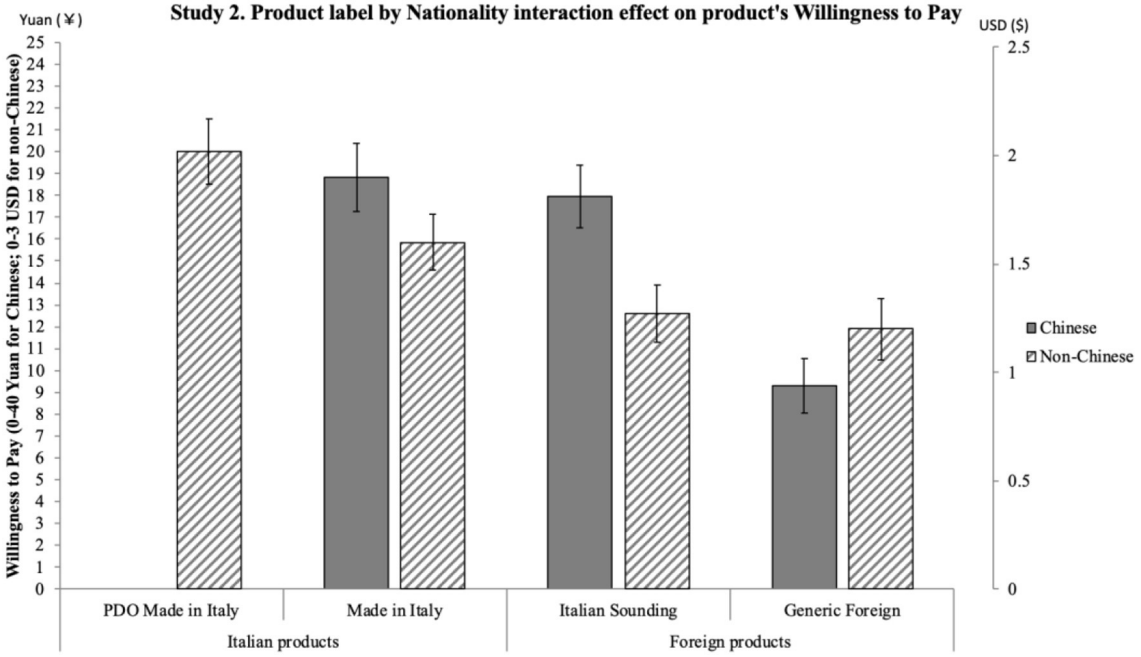

FIGURE 7 | Interaction effect of product label and nationality on WTP. WTP for the product is measured from ¥0 to ¥40 for the Chinese sample (left *Y* axis) and from \$0 to \$3 for the non-Chinese sample (right *Y* axis). Error bars represent 95% confidence interval of the mean. All significant differences have a $p < 0.001$. For visualization purposes, all means from the two sub-samples are plotted together; yet, pairwise comparisons are made across products within the same sample.

Sounding ($M = 17.96$; $SD = 7.18$) products are similar and they are both significantly higher (both $p < 0.001$) than the *Generic Foreign Chinese* product price ($M = 9.30$; $SD = 6.38$). Thus, H7 is confirmed (**Figure 7**).

Regarding the second sample (non-Chinese expatriates), to test H5, a repeated-measures ANOVA confirms the hypothesis of different general reputation scores across the four products $F_{(3, 270)} = 43.33$, $p < 0.001$, $\eta p^2 = 0.32$, showing that the *PDO Made in Italy* product receives a significantly higher reputation score ($M = 5.58$, $SD = 1.11$) than the *Made in Italy* one ($M = 4.42$, $SD = 1.39$, $p < 0.001$), which, in turn, received a significantly higher score than both the *Italian Sounding* ($M = 3.77$, $SD = 1.43$, $p = 0.001$) and the *Generic Foreign Chinese* ($M = 4.00$, $SD = 1.45$, $p = 0.02$). The *Italian Sounding* and the *Generic Foreign Chinese* products do not differ among them ($p = 0.18$). Thus, H5 is confirmed (**Figure 5**).

To test H6, the reliability of the attitude scale was good reliability for all levels of measurement within the subjects (*PDO Made in Italy*, $\alpha = 0.76$; *Made in Italy*, $\alpha = 0.80$; *Italian Sounding*, $\alpha = 0.89$; *Generic Foreign Chinese*, $\alpha = 0.68$). A repeated-measures ANOVA of products on attitude show a significant omnibus effect, $F_{(2.44, 220.06)} = 45.70$, $p < 0.001$, $\eta p^2 = 0.34$. The subsequent *post hoc* comparisons show that the *PDO Made in Italy* product ($M = 5.16$, $SD = 0.83$) gets a significantly higher attitude score than the *Made in Italy* one ($M = 4.36$, $SD = 0.85$, $p < 0.001$), which, in turn, received a significantly higher attitude score than both the *Italian Sounding* product ($M = 3.87$, $SD = 1.13$, $p = 0.001$) and the *Generic Foreign Chinese* product ($M = 3.73$, $SD = 0.76$, $p < 0.001$). The *Italian Sounding* and the *Generic Foreign Chinese* products do not differ among them ($p = 0.18$). Thus, H6 is confirmed (**Figure 6**).

To test H7, a repeated-measures ANOVA of products on WTP (expressed in USD) was conducted, showing a significant omnibus effect, $F_{(2.62, 235.84)} = 41.78$, $p < 0.001$, $\eta p^2 = 0.32$. The subsequent *post hoc* comparisons show that the average price payable for the *PDO Made in Italy* product ($M = 2.02$, $SD = 0.69$) is significantly higher than the price for *Made in Italy* product ($M = 1.60$; $SD = 0.62$, $p < 0.001$), which, in turn, was higher than the prices both for *Italian Sounding* product ($M = 1.27$; $SD = 0.64$; $p < 0.001$) and for *Generic Foreign Chinese* product ($M = 1.20$; $SD = 0.63$, $p < 0.001$). The *Italian Sounding* and the *Generic Foreign Chinese* products do not differ among them ($p = 0.30$). Thus, H7 is confirmed (**Figure 7**).

Auxiliary Analysis

Given the significant product form or label effect for WTP, an exploratory mediation analysis was conducted to corroborate Study 1's findings, by testing the indirect effect of Italianness on WTP, mediated by general reputation, only for the *Italian Sounding* product in the whole sample. The total Italianness score was computed by averaging the Italianness intensity and Italianness probability scores. The PROCESS Macro for SPSS (Model 4) was used in these analyses (Hayes, 2012). Results (**Figure 8**) show that the overall model was statistically significant [$R^2 = 0.37$, $F_{(2, 188)} = 14.61$, $p < 0.001$], supporting the mediation interpretation: total Italianness increased general reputation ($b = 0.43$, 95% CI: 0.34, 0.53, $p < 0.001$), which was associated with an increase in WTP ($b = 1.99$, 95% CI: 0.82, 3.16, $p < 0.001$). The

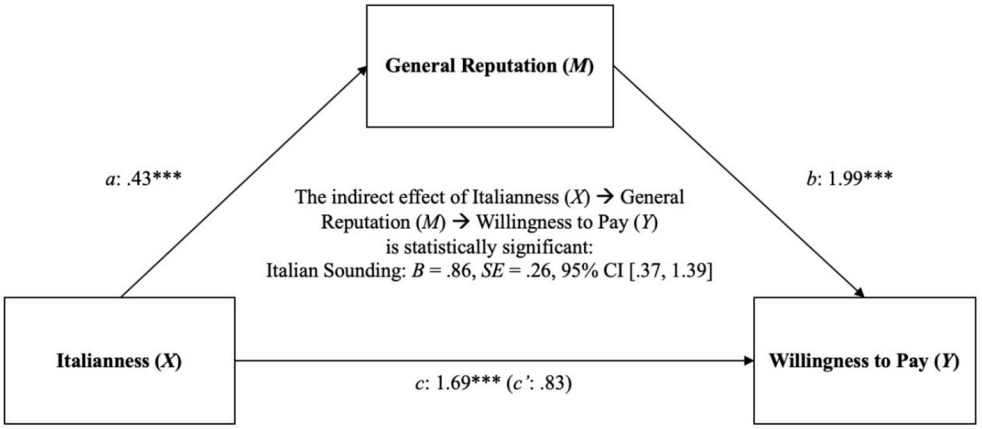

FIGURE 8 | Indirect effects in Study 2 (Chinese and non-Italian expatriate residents in China) of total Italianness (X) on WTP (Y) through General Reputation (M) using bias-correcting bootstrapping (resampled 10,000 times) for each of the Italian Sounding product. When modeling the relationship between Italianness (X) and WTP (Y), total effects are shown outside parentheses and direct effects are displayed inside parentheses. ***$p < 0.001$.

indirect effect of total Italianness on WTP via general reputation was significant ($b = 0.87$, 95% CI: 0.37, 1.39). These results suggest that the more an Italian Sounding product is perceived to be Italian, the more its reputation will increase, which, in turn, will increase consumers' WTP for that product (in ¥ for the Chinese sample, in $ for the expatriates in China sample).

Discussion

The main aim of Study 2 is to generalize Study 1's findings by investigating how non-Italian subjects perceive, in terms first of reputation and then of attitude, and how they finally are willing to pay for a food product associated to Italy (pasta) as presented in three different forms differentiated by labeling (*Made in Italy*, *Italian Sounding*, and *Generic Foreign Chinese*), in China. The same hypotheses are tested, within the same Country (China) for the same product type, via two samples: first on a Chinese sample and second on a non-Italian expatriate sample (with the presence of a fourth product, *PDO Made in Italy*).

The first sample's results, consistent with expectations, basically confirm all hypotheses (H4, H5, H6, and H7), indicating that Chinese consumers do not distinguish between authentic *Made in Italy* and *Italian Sounding* products: as shown by the analyses, the scores of these two product forms almost never differ. First of all, the general reputation significantly (for the *Italian Sounding*) or with a strong tendency (for the *Made in Italy*) differs from the *Generic Foreign Chinese* product (H5); moreover, when studying the details of the specific reputation profile resulting from the 23 FRM features, this does indeed show significant differences among those three products in the detailed profile (H4). Significant differences did not emerge for *Essence*, which has to do with the more basic features of a food item. However, differences emerge for more symbolic food features such as specifically for *Cultural, Economic, Environmental*, and *Psychological Effects*, indicating that, though they did not show an advantage on the general reputation measure (compared to the *Generic Foreign Chinese* product), the *Made in Italy* product and the *Italian Sounding* product possess a very specific significantly higher reputation in certain features, which therefore allow one to understand what "Italianness" is made of, and to what extent the *Italian Sounding* can be assimilated to the *Made in Italy* in the eyes of the Chinese food consumer. As far as *Innovativeness* (*Cultural Effects*), *Context* (*Economic Effects*), *Traceability* (*Environmental Effects*), and both *Organoleptic perception* and *Conviviality* (*Psychological Effects*) are concerned, the *Made in Italy* and the *Italian Sounding* are more positively reputed than the *Generic Foreign Chinese* product. Moreover, the *Made in Italy* only (but not the *Italian Sounding*) product is more reputed than the *Generic Foreign Chinese* both for *Territorial identity* and for *Tradition* (*Cultural Effects*), while the *Italian Sounding* is more reputed than the other two products for *Lightness* and less reputed than the *Generic Foreign Chinese* for *Ability to satisfy* (both *Physical Effects*). Consequentially and coherently with the reputation profile endowing several advantages to the *Made in Italy* product, and to a slightly lesser or different extent to the *Italian Sounding* product too, subjects show an equally more favorable attitude toward both the *Made in Italy* and the *Italian Sounding* pasta products compared to the *Generic Foreign Chinese* one (H6). Finally, as expected, subjects are then willing to pay a higher price both for the *Made in Italy* (¥18.84) and for the *Italian Sounding* (¥17.96) pasta products, than for the *Generic Foreign Chinese* pasta product (¥9.30), thus confirming H7 (Huliyeti et al., 2008; Vianelli et al., 2012a). While both the Made in Italy and the Italian Sounding pack of pasta are aligned to the average price for the product, the Generic Foreign Chinese pasta pack is paid about −50% than the average product price.

The second sample's results, consistent with expectations, entirely confirm the hypotheses (H4, H5, H6, and H7), indicating that non-Italian expatriate consumers in China distinguish between authentic *PDO Made in Italy* and *Made in Italy*, and even more they distinguish among those first two compared to the *Italian Sounding* and *Generic Foreign Chinese* products. First of

all, confirming the expectations, the general reputation is highest for the *PDO Made in Italy*, followed by the *Made in Italy*, while the *Italian Sounding* and *Generic Foreign Chinese* products do not differ among themselves by both having a comparatively lower general reputation (H5 confirmed). When studying more in detail the specific reputation profile resulting from the 23 FRM features, this does indeed differ among those four products (H4 confirmed). The pattern of results is pretty constant in depicting a reputation profile at the top for the *PDO Made in Italy* product, followed by the *Made in Italy* in an intermediate position, with the lowest rank occupied by both the *Italian Sounding* and the *Generic Foreign Chinese* products. Such a pattern appears across all the six areas of the reputation profile, namely, *Essence*, *Cultural Effects*, *Economic Effects*, *Environmental Effects*, *Physiological Effects*, and *Psychological Effects* (Bonaiuto et al., 2017; De Dominicis et al., 2020; as measured via the 23 features of the FRM model). There are some features, however, where the *PDO Made in Italy* and the *Made in Italy* are not significantly differentiated, as they both enjoy the same higher score of reputation for *Life time* and *Recognition* (in *Essence*); *Tradition*, *Familiarity*, and *Innovativeness* (in *Cultural Effects*); *Preparation* (*Economic Effects*); and *Ability to satisfy* and *Digestibility* (in *Physiological Effects*). In all other features, the *PDO Made in Italy* reputation is higher than the *Made in Italy* one, namely, *Composition* and *Genuineness* (in *Essence*); *Territorial identity* (in *Cultural Effects*); *Context* and *Price* (in *Economic Effects*); *Traceability and Safety*; as well as *Social and environmental responsibility* although with a tendency (in *Environmental Effects*); *Lightness* (in *Physiological Effects*); and *Organoleptic perception*, *Personal memories*, *Psycho-physical well-being*, *Conviviality*, and *Group belongingness* (in *Psychological Effects*). As for *Preparation* (in *Economic Effects*), it is the only reputation feature where the *Generic Foreign Chinese* product results with a higher score compared to both *Made in Italy* products.

Consequentially and coherently with the reputation profile endowing several advantages to the *PDO Made in Italy* product, and partly to the *Made in Italy* product, subjects show an equally more favorable attitude toward both the *PDO Made in Italy* pasta product above all, and secondly toward the *Made in Italy* one, when compared to both the *Italian Sounding* pasta product and the *Generic Foreign Chinese* one, which do differ among them (H6 confirmed). Finally, as expected, subjects are then willing to pay a higher price for the *PDO Made in Italy* pasta product ($2.02) and then for a *Made in Italy* one ($1.60), compared to both the *Italian Sounding* ($1.27) pasta product and the *Generic Foreign Chinese* pasta product ($1.20), thus confirming H7 (Huliyeti et al., 2008; Vianelli et al., 2012a). Therefore, on average, the non-Chinese expat consumer is keen to pay less than the given average price, at that time in China, for a pack of Generic Foreign Chinese pasta (about −15%) and for a pack of Italian Sounding pasta (about −20%), while affording an extra of about +7% for a Made in Italy pack of pasta and an extra of about +33% for a PDO Made in Italy pack of pasta.

Finally, the auxiliary analysis provided critical insights into the process by which a given product, when it is perceived to be Italian, might gain a financial competitive advantage over other products in China by both local citizens and expatriates: again, the more a food product is perceived to be Italian, the more positive its reputation is; in turn, the higher its reputation, the more its consumers are willing to pay for that given product. Study 3 has been subsequently planned to generalize Study 2's results to a different, equally important area of the global market.

STUDY 3

Aim and Hypotheses

As in Study 2, the main aim of Study 3 is to investigate how non-Italian subjects perceive, in terms of reputation and attitude, and are willing to pay for a food product associated to Italy (pasta) presented in three different forms (*Made in Italy*, *Italian Sounding*, and *Generic Foreign US*), by testing the same already confirmed hypotheses from Studies 1 and 2 on a sample of US citizens (Cembalo et al., 2008; Vianelli and Marzano, 2013).

The same hypotheses of Study 1 and Study 2 were here targeted again. It is thus expected that:

H8: The product form or label has an effect on the reputation profile: In particular, reputation profiles measured via the FRM are positively different for *Made in Italy* and *Italian Sounding* products compared to *Generic Foreign* products.

H9: The product has an effect on general reputation: In particular, general reputation is more positive for *Made in Italy* and *Italian Sounding* products compared to *Generic Foreign* products.

H10: The product has an effect on attitude: In particular, the attitude is more positive for the *Made in Italy* and *Italian Sounding* products compared to *Generic Foreign* products.

H11: The product has an effect on WTP: In particular, WTP is higher for the *Made in Italy* and *Italian Sounding* products compared to *Generic Foreign* products.

Method

Participants, Procedure, and Materials

Data were collected on a sample of 237 subjects ($M = 134$; $F = 103$) having both US nationality and residence, whose age ranged from 19 to 69. The questionnaire was administered electronically in October–November 2016 in the United States via *M-Turk*, a well-known online sorting program.

In order to select the three different products, the same pre-test as Study 1 and Study 2 was used (asking a preliminary sample of about 20 persons at Claremont Graduate University to indicate two pieces of information: the most known and the most consumed Italian food product), showing that the best known and most consumed Italian product in the USA is pasta, as in China. The three selected products were (again, avoiding major brands among those actually on sell in the market at that moment): "Spaghetti Divella" as *Made in Italy*, "Spaghetti Ronzoni" as *Italian Sounding*, and "Spaghetti Anthonys" as *Generic Foreign US* (**Appendix D**).

Measures

The questionnaire, similar to the one used in Study 2, investigated three product forms (*Made in Italy*, *Italian Sounding*, and *Generic Foreign US*), and it was administered in American English. The

whole survey is available in the **Supplementary Material** of this manuscript.

Similarly to Studies 1 and 2, Italianness intensity and probability were used to measure Italianness perception. To measure the product's general reputation, the same seven-point Likert-type scale item as Studies 1 and 2 was used. Food reputation profiles of the three products were measured via the same 23 items on a seven-point Likert-type scale (from "strongly disagree" to "strongly agree"), derived from FRM (Bonaiuto et al., 2017; De Dominicis et al., 2020), as those used in Study 2.

The same 10 seven-point evaluative semantic differential scales as Studies 1 and 2 were used to investigate attitude. To measure WTP, the same one-item 11-point Likert-type scale (adapted from Hanemann, 1984) as Studies 1 and 2 was used, expressing prices in US dollars (from "$0" to "$3"), where the scale's middle point ("$1.50") was close to a possible national average price for the product in that period (USD 0.30 cumulative increase in each step). The item was: "Considering that the average price of a 16 oz (1 lb) package pasta is about $1.50, how much would you be willing to pay if you would buy 16 oz (1 lb) of PRODUCT NAME."

As in Studies 1 and 2, all statistical analyses were released using the SPSS version 27 software.

Manipulation Check

To verify that the products were perceived differently as for their level of Italianness, a manipulation check was carried out on the Italianness intensity and probability to compare the three products.

Two repeated-measures ANOVAs were performed to test the effects of product label on the dependent variable "Italianness intensity" (score 0–10) and "Italianness probability" (0–100%). The manipulation checks indicated an effect of the product label both on Italianness intensity [$F_{(1.76,\ 351.58)} = 222.92$, $p < 0.001$, $\eta p^2 = 0.53$] and on Italianness probability [$F_{(1.56,\ 305.22)} = 307.69$, $p < 0.001$, $\eta p^2 = 0.61$], such that Made in Italy gets significantly higher scores in both Italianness intensity ($p < 0.001$) and probability ($p < 0.001$) than the Italian Sounding product, which, in turn, gets significantly higher scores in both Italianness intensity ($p < 0.001$) and probability ($p < 0.001$) than the Generic Foreign product (**Table 8**).

TABLE 8 | Mean scores and SD of product label related to Italianness intensity and probability in US citizens (Study 3).

Product label	Italianness intensity	Italianness probability
	M (SD) ($N = 201$)	M (SD) ($N = 196$)
Made in Italy	7.83 (1.84)	4.00 (0.98)
Italian sounding	4.47 (2.63)	2.14 (1.09)
Generic foreign	3.62 (2.56)	1.70 (0.99)

Results

Comparison of Indicators of Food Reputation Across Products (H8)

As in Study 2, the results of the different repeated-measures ANOVAs were grouped in the six areas identified by the synthetic indicators of FRM (see **Table 9**).

As for the Essence scores, results show that all dimensions contribute to defining the distinctive reputation profiles of the products. In particular, for Composition, Life time, and Recognition, the results of the Made in Italy and Italian Sounding products do not significantly differ among them, although both scored higher reputation levels compared to the Generic Foreign US product. As regards Genuineness, the Made in Italy product significantly differs from both other product forms; however, the Italian Sounding product has still higher scores compared to the Generic Foreign US product.

As regards *Cultural Effects*, results for *Territorial identity*, *Familiarity*, and *Innovativeness* show a similar trend: namely, the *Generic Foreign US* and the *Italian Sounding* products do not significantly differ, while the *Made in Italy* product records higher scores in all dimensions. Only for *Tradition* does the *Italian Sounding* product have a more positive reputation than the *Generic Foreign US* product, and the *Made in Italy* confirms its excellence here too.

As regards Economic Effects, the Made in Italy product significantly (or by a strong tendency) excels with respect to the other two products, both for Context and for Preparation. However, the Italian Sounding product succeeds in marking a positive reputation significantly different with respect to the Generic Foreign US product for Price, equalling the Made in Italy product.

As regards *Environmental Effects*, apart from Proximity, which does not differentiate the three products, the three dimensions *Social and environmental responsibility*, *Traceability*, and *Safety* all show the significant (or strong tendency) reputation advantage of both *Made in Italy* and *Italian Sounding* products compared to the *Generic Foreign US* product, while the *Made in Italy* product positively differentiates itself from the *Italian Sounding* one only in the first two features, not in the last one above.

As for *Physiological Effects*, again both *Made in Italy* and *Italian Sounding* products get an equally positive reputation profile, which is significantly (or with a strong tendency) higher than the *Generic Foreign US* product in both *Ability to satisfy* and *Digestibility* dimensions, while in the *Lightness* dimension, the *Italian Sounding* product enjoys the best reputation among all products.

As for *Psychological Effects*, the mean score of the *Made in Italy* product is always significantly higher than the *Generic Foreign US* one, and the Italian Sounding product follows the same pattern of results (whether with significance or a strong tendency), for all features except *Conviviality*, namely, *Organoleptic perception*, *Personal memories*, *Psycho-Physical Well-being*, and *Group belongingness*. *Organoleptic perception* and *Conviviality* are the only two features where the *Made in Italy* product manages to significantly differentiate its reputation profile from the *Italian Sounding* product.

TABLE 9 | Mean (*M*) and Standard Deviation (*SD*) scores for 23 reputation features related to the three product labels and the relevant *p*-value indicating the statistical significance of each difference (ANOVA), for the US citizens in USA.

	Omnibus effect	M (SD)			Significance (*p*-value)		
	F(df) ηp^2	**Made in Italy (MI)**	**Italian sounding (IS)**	**Generic Foreign USA (GFUS)**	**MI-IS**	**MI-GFUS**	**IS-GFUS**
ESSENCE							
Composition	**19.08 (2, 400)*** 0.09**	4.82 (1.15)	4.75 (1.32)	4.33 (1.32)	1.000	**0.000*** **	**0.000*** **
Genuineness	**48.78 (1.93, 386.71)*** 0.20**	5.23 (1.18)	4.78 (1.34)	4.22 (1.37)	**0.000*** **	**0.000*** **	**0.000*** **
Life time	**8.33 (2, 400)*** 0.04**	5.39 (1.27)	5.38 (1.25)	5.09 (1.35)	1.000	**0.001** **	**0.002** **
Recognition	**17.61 (2, 400)*** 0.08**	5.36 (1.23)	5.13 (1.24)	4.83 (1.33)	0.061	**0.000*** **	**0.001** **
CULTURAL EFFECTS							
Territorial identity	**34.47 (1.89, 377.55)*** 0.16**	5.09 (1.28)	4.30 (1.47)	4.10 (1.48)	**0.000*** **	**0.000*** **	0.186
Tradition	**42.50 (1.89, 377.36)*** 0.15**	5.24 (1.22)	4.63 (1.36)	4.34 (1.34)	**0.000*** **	**0.000*** **	**0.009** **
Familiarity	**18.37 (2, 400)*** 0.08**	5.24 (1.21)	4.83 (1.31)	4.65 (1.31)	**0.001** **	**0.000*** **	0.173
Innovativeness	**12.96 (1.94, 387.49)*** 0.06**	4.39 (1.52)	4.00 (1.54)	3.87 (1.47)	**0.001** **	**0.000*** **	0.491
ECONOMIC EFFECTS							
Context	**16.63 (1.87, 374.30)*** 0.08**	5.17 (1.13)	4.83 (1.33)	4.65 (1.53)	**0.003** **	**0.000*** **	0.173
Price	**8.53 (1.86, 372.04)*** 0.04**	5.25 (1.03)	5.16 (1.13)	4.91 (1.23)	0.794	**0.001** **	**0.004** **
Preparation	**7.67 (2, 400)** 0.04**	5.76 (1.02)	5.28 (1.13)	5.48 (1.27)	**0.034***	**0.001** **	0.440
ENVIRONMENTAL EFFECTS							
Social and environmental responsibility	**24.01 (2, 400)*** 0.11**	4.84 (1.09)	4.53 (1.13)	4.27 (1.09)	**0.000*** **	**0.000*** **	**0.008** **
Traceability	**31.81 (1.94, 388.13)*** 0.14**	5.06 (1.20)	4.46 (1.31)	4.22 (1.37)	**0.000*** **	**0.000*** **	**0.055^**
Proximity	0.623 (1.69, 337.45) 0.00	4.34 (1.50)	4.34 (1.34)	4.23 (1.34)	1.000	1.000	0.676
Safety	**10.92 (1.94, 387.91)***	5.06 (1.11)	5.00 (1.14)	4.67 (1.30)	1.000	**0.000*** **	**0.001** **
PHYSIOLOGICAL EFFECTS							
Ability to satisfy	**6.59 (1.94, 387.54)** 0.03**	5.76 (1.12)	5.67 (1.09)	5.50 (1.20)	0.781	**0.000*** **	**0.070^**
Digestibility	**10.75 (2, 400)*** 0.05**	4.99 (1.26)	4.87 (1.42)	4.62 (1.37)	0.473	**0.000*** **	**0.009** **
Lightness	**9.67 (1.94, 388.26)*** 0.05**	3.95 (1.48)	4.17 (1.52)	3.78 (1.37)	**0.062^**	0.112	**0.000*** **
PSYCHOLOGICAL EFFECTS							
Organoleptic perception	**22.22 (2, 400)*** 0.10**	5.62 (1.10)	5.38 (1.25)	5.04 (1.28)	**0.022***	**0.000*** **	**0.000*** **
Personal memories	**15.47 (1.80, 360.59)*** 0.07**	5.10 (1.41)	4.93 (1.48)	4.59 (1.42)	0.299	**0.000*** **	**0.001** **
Psycho-physical well-being	**9.93 (1.92, 385.09)*** 0.05**	4.24 (1.39)	4.16 (1.47)	3.89 (1.40)	1.000	**0.000*** **	**0.002** **
Conviviality	**10.36 (2, 400)*** 0.05**	5.47 (1.18)	5.24 (1.28)	5.09 (1.32)	**0.025***	**0.000*** **	0.231
Group belongingness	**12.91 (2, 400)*** 0.06**	4.95 (1.12)	4.84 (1.33)	4.49 (1.37)	0.753	**0.000*** **	**0.001** **

*Bold values represents significant or marginally significant effects. ^$p < 0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.*

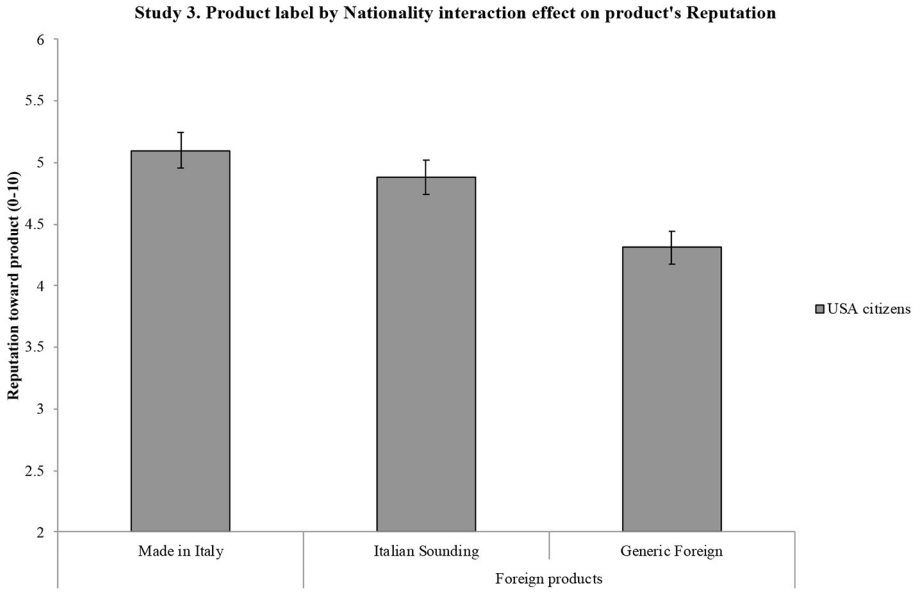

FIGURE 9 | Interaction effect of product label and nationality on product's reputation. Reputation toward product is measured on a scale from 1 (negative reputation) to 10 (positive reputation). Error bars represent 95% confidence interval of the mean. All significant differences have a $p < 0.001$.

Comparison of General Reputation, Attitude, and WTP Across Products (H9–H10–H11)

To test H9, a repeated-measures ANOVA of products on the general reputation scores was conducted, showing a significant omnibus effect, $F_{(2, 400)} = 45.72$, $p < 0.001$, $\eta p^2 = 0.19$. The subsequent *post hoc* comparisons show that the reputation mean scores of *Made in Italy* product ($M = 5.10$, $SD = 1.00$) were significantly higher than the reputation score of the *Italian Sounding* product ($M = 4.88$, $SD = 1.00$, $p < 0.001$), which, in turn, was significantly higher than the reputation score of the *Generic Foreign US* product ($M = 4.31$, $SD = 0.93$, $p < 0.001$) (H9 confirmed; **Figure 9**).

To test H10, the reliability of the attitude scale was excellent for all levels of measurement within the subjects (*Made in Italy*, $\alpha = 0.87$; *Italian Sounding*, $\alpha = 0.89$; *Generic Foreign US*, $\alpha = 0.89$). A repeated-measures ANOVA on attitude was run, showing a significant omnibus effect of product on attitude, $F_{(1.92, 383.79)} = 81.93$, $p < 0.001$, $\eta p^2 = 0.29$. The subsequent *post hoc* comparisons show that attitude toward *Made in Italy* product ($M = 5.07$, $SD = 0.91$) was significantly higher than the attitude toward the *Italian Sounding* product ($M = 4.43$, $SD = 0.98$), which, in turn, was significantly higher than the attitude toward the *Generic Foreign US* product ($M = 4.03$, $SD = 1.00$) (H10 confirmed; **Figure 10**).

To test H11, a repeated-measures ANOVA of product on WTP (price expressed in USD) was conducted, showing a significant omnibus effect, $F_{(1.74, 348.99)} = 92.05$, $p < 0.001$, $\eta p^2 = 0.31$. The subsequent *post hoc* comparisons show that the average price payable for *Made in Italy* ($M = 6.88$; $SD = 1.49$) was significantly higher than the price for the *Italian Sounding* product ($M = 5.88$; $SD = 1.10$), which, in turn, was significantly higher than the price for the *Generic Foreign US* product ($M = 5.47$; $SD = 1.22$) (H11 confirmed; **Figure 11**).

Auxiliary Analysis

Given the significant label effect for WTP, an exploratory mediation analysis was conducted to corroborate the findings of Studies 1 and 2, by testing the indirect effect of Italianness on WTP, mediated by reputation, for the Italian Sounding product in the USA. The Italianness score was computed by averaging the Italianness intensity and Italianness probability scores. The PROCESS Macro for SPSS (Model 4) was used in these analyses (Hayes, 2012). Results (**Figure 12**) show that the overall model was statistically significant [$R^2 = 0.19$, $F_{(2, 194)} = 22.65$, $p < 0.001$], supporting the mediation interpretation: Italianness increased reputation ($b = 0.21$, 95% CI: 0.13, 0.28, $p < 0.001$), which was associated with an increase in WTP ($b = 0.30$, 95% CI: 0.15, 0.45, $p < 0.001$). The indirect effect of Italianness on WTP via reputation was significant ($b = 0.06$, 95% CI: 0.03, 0.10). These results suggest that the more an Italian Sounding product is perceived to be Italian, the more its reputation will increase, which, in turn, will increase consumers' WTP for that product (in $ for this US sample).

Discussion

As expected, results fully confirm all hypotheses H8, H9, H10, and H11. US residents evaluate more positively the *Italian Sounding* product compared to the *Generic Foreign US* product. However, the most positively evaluated product is the *Made in Italy* one (Vianelli and Marzano, 2013; Pegan et al., 2014). Specifically, results show that the Italianness of the product influences the overall evaluation of the product: although the *Made in Italy* product is considered the best as for the investigated features, it is immediately followed by the *Italian Sounding* one in all analyses (H8). Specifically, the *Made in Italy* product best represents the Italian product reputation profile by becoming the leader in basically all the FRM 23

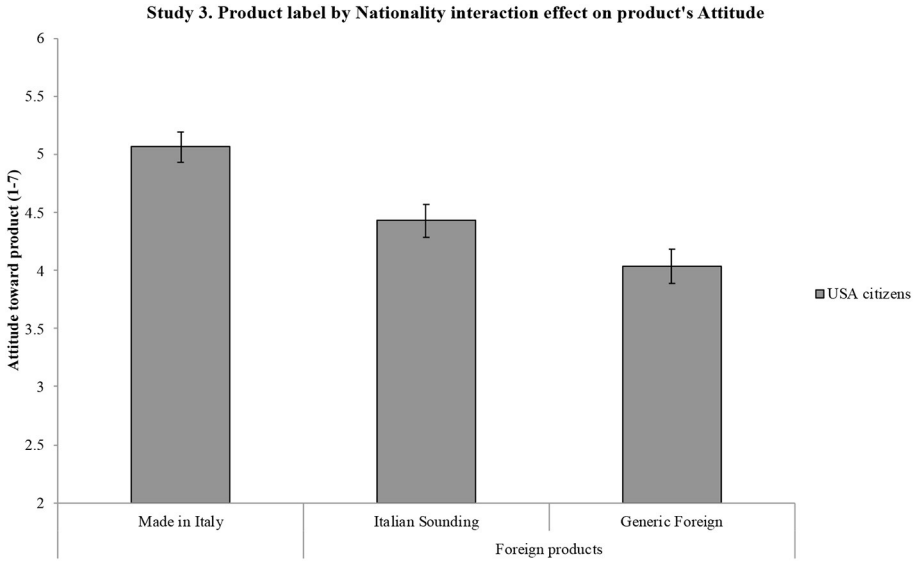

FIGURE 10 | Interaction effect of product label and nationality on attitude toward product. Attitude toward product is measured on a scale from 1 (negative attitude) to 7 (positive attitude). Error bars represent 95% confidence interval of the mean. All significant differences have a $p < 0.001$.

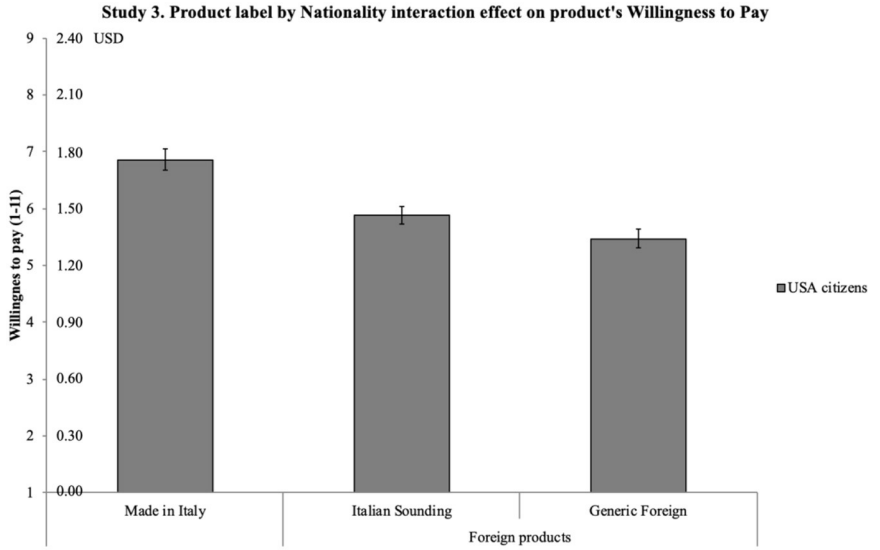

FIGURE 11 | Interaction effect of product label and nationality on WTP. WTP for the product is measured from 1 (WTP a lower price) to 11 (WTP a higher price). WTP ranged from \$0.00 to \$3.00 (with one step increase in the Likert scale corresponding to an increase of \$0.30). Error bars represent 95% confidence interval of the mean. All significant differences have a $p < 0.001$.

areas (in most cases with statistical significance, in a few cases with strong tendencies), except in *Lightness* where the *Italian Sounding* significantly overrides it. On the whole, the *Italian Sounding* product manages to significantly (or with a strong tendency) emulate the reputation profile of the Italian product, especially by marking a positive difference compared to the *Generic Foreign US* under many respects: *Composition*, *Genuineness*, *Life time*, and *Recognition* (i.e., all the *Essence* area features); *Tradition* only in the *Cultural effects* area; *Price* only in the *Economic Effects* area; *Social and environmental responsibility*, *Traceability*, and *Safety* (i.e., all the *Environmental Effects* area except one, *Proximity*); *Ability to satisfy*, *Digestibility*, and *Lightness* (i.e., all the *Physiological Effects* area features); and basically all the *Psychological Effects* area features in terms of significance (*Organoleptic perception, Personal memories*, *Psycho-physical Well-being*, and *Group belongingness*). Coherently (H9), the general reputation average score is significantly higher for the *Made in Italy* product than for the other two products, but here

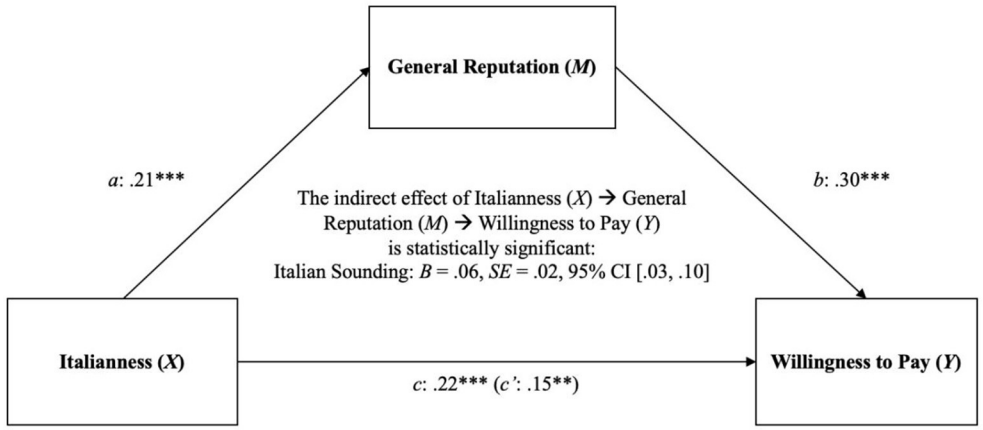

FIGURE 12 | Indirect effects in Study 3 (US citizens and residents in the USA) of Italianness (X) on WTP (Y) through General Reputation (M) using bias-correcting bootstrapping (resampled 10,000 times) for each of the Italian Sounding product. When modeling the relationship between Italianness (X) and WTP (Y), total effects are shown outside parentheses and direct effects are displayed inside parentheses. ***$p < 0.001$.

again the *Italian Sounding* product marks a general reputation advantage with regard to the *Generic Foreign US*. Consequently (H10), the consumer's average attitude becomes most positive toward the *Made in Italy* product, but the *Italian Sounding* product receives a more positive attitude than the *Generic Foreign US*. Finally (H11), on average, the US consumer is keen to pay just the given average price, at that time in California, for a pack of *Generic Foreign US* pasta (about $1.50), while affording about an extra +10% for an *Italian Sounding* pack of pasta (about $1.65), and an extra +30% for a *Made in Italy* pack of pasta (about $2.00).

Finally, the auxiliary analysis provided critical insights into the process by which a given product, when it is perceived to be Italian, might gain a financial competitive advantage over other products, by US citizens too: here, again, the more a food product is perceived to be Italian, the more positive its reputation is; in turn, the higher its reputation, the more its US consumers are willing to pay for that given product.

GENERAL DISCUSSION

This research was designed to evaluate and compare the perception of products associated with Italy and to test the effects of the product label on attitude, reputation, and WTP for different product forms, with a particular focus on IS products, compared to Made in Italy and Generic Foreign ones. Results of the three empirical studies, consistent with expectations and literature (Thakor and Lavack, 2003; Nicoletti et al., 2007; Balabanis and Diamantopoulos, 2008, 2011; Bursi et al., 2012), suggest that different cultural contexts (Italy, China, and the USA) show a different attitude and reputation toward the products differentiated by the "Italianness" of their label, as well as an impact of such product reputation on WTP (Landon and Smith, 1998; Loureiro and McCluskey, 2000; Loureiro and Hine, 2002).

We found that, in Italian and EU consumers (Study 1), the Italian Sounding product did not gain reputation, attitude toward it, or WTP for it, compared to the other products. However, in China and in the USA (Studies 2 and 3), made in Italy products had a higher reputation compared to Italian Sounding products, which, in turn, were perceived more positively by consumers and had a higher reputation compared to Generic Foreign ones. This confirms how the Italian Sounding product label, by recalling an alleged Italian identity of the product and thus increasing its attractiveness, brings benefits to producers, exploiting the high popularity of Made in Italy specialty products and their high reputation around the world, by achieving an overall better reputational judgment from consumers, who therefore develop a positive attitude toward it. This can be explained by references to Italianness on the label itself (via brand name or iconic features), encouraging customers to mistakenly associate the product with features typical of Made in Italy products (Liefeld, 2004; Balabanis and Diamantopoulos, 2008, 2011). Thus, consumers' perception of the product's reputation, their attitudes toward the product, and their WTP are all positively affected by an Italian Sounding label. Furthermore, to ascertain the process by which these effects might occur, we run a series of auxiliary mediation analyses. Our results, consistently across Studies 1, 2, and 3, suggest that the perceived "Italianness" of a product increases its perceived reputation together with endowing a premium price: thus, the more a product is perceived to be "Italian," the more this perception increases the believed quality features applied to the product, which gains an added cost.

We further investigated this effect by decomposing the reputational profile of the tested products in different samples (Study 2 and 3), according to the Food Reputation Map model's 23 dimensions (Bonaiuto et al., 2017; De Dominicis et al., 2020). Therefore, the present contribution shows for the first time in a systematic and cross-cultural way that this reputational boost—above and beyond a general reputation halo—endows the product with a specific positive reputational profile. This result shows in detail the reputation features that are specifically boosted in the considered agro-food product (pasta) thanks to the

Italian Sounding phenomena (by also showing that other specific features in the same reputational profile do not enjoy such a positive halo effect). Specifically, results show that the values transposed on the Italian Sounding product—justifying a greater expense compared to the purchase of a foreign product—are not fuzzy or undefined, or generic ones: rather, they specifically pertain mainly to psychological and physiological well-being, as well as production responsibility, ensuring safe and reliable purchase choices. Such a result highlights the specific added value of "Italianness" within the agro-food consumption sector. It should be noted that the reputational features profile—which aims to positively differentiate the Italian Sounding product from the generic foreign one (the Chinese one in China and the American one in the USA)—mimics those features that positively differentiate both the Made in Italy one and the PDO Made in Italy one from the generic foreign product. It is thus clear that the Italian Sounding label is not simply advantaging in general the product's reputation, attitude, and WTP; rather, the Italian Sounding is doing so by granting the product a higher perceived Italianness that is associated with a cluster of reputational features assimilating it to the same reputational profile of the Made in Italy products (the standard one and especially the PDO one). Within such a scenario, results also show that only very few features remain to differentiate, if any, the Made in Italy products from the Italian Sounding ones. Our results, though limited, show that they still exist: such a residual reputational capital could be considered in terms of practical implications; i.e., features of the Italian Sounding in the future could be mimicked and those of the Made in Italy could thus be defended. The few features still differentiating Made in Italy products from Italian Sounding ones could therefore be considered as leverages for the next strategies aiming to maintain a distinction between merely Italian Sounding products and truly Made in Italy ones. This effort should however be coupled with prospective plans for recovering what today seems a lost distinction over those many features presently not enjoyed by Made in Italy anymore as differentiating assets from the Italian Sounding products.

These psychological processes in turn increase consumers' WTP for that product, in terms of average yuan the Chinese consumer is willing to pay for a pack of pasta in China, and in terms of dollars the US consumer is willing to pay for a pack of pasta in the USA. By considering the average amounts resulting from the samples of Study 2 (Chinese) and Study 3 (Americans), the US consumer in the USA is ready to pay an added cost of about 7–8% for an Italian Sounding pack of pasta (compared to a corresponding American product) in the USA, while his/her Chinese counterpart, in China, is ready to pay an extra 93% more for an Italian Sounding pack of pasta (compared to a corresponding Chinese product) in China. Moreover, average WTP data also show that the average amount of yuan the Chinese consumer is willing to pay for an Italian Sounding pack of pasta is aligned to the same amount s/he is willing to pay for a real Made in Italy one.

Finally, such a pattern of Italian Sounding results appears within specific samples only: i.e., Chinese consumers in China and US consumers in the USA. On the contrary, Italian consumers and EU consumers in Italy and the EU (Study 1), as well as expatriates, that is, non-Chinese consumers in China, are immune to Italian Sounding effects. This is in line with literature stressing that the COO effect should also be considered in the light of the specific characteristics of the consumer samples (such as socio-demographics and personality, Bilkey and Ness, 1982). Our results seem to indicate that cultural and/or geographical distance may matter here. However, as the samples contrasted within a country (e.g., Chinese vs. non-Chinese expatriates in China), with differences according to several variables, it is difficult to detect which is the crucial variable, i.e., which exact variable is discriminating between people vulnerable to the Italian Sounding effects and people who are immune to the Italian Sounding phenomenon, within a given context and market. One possibility is that an Eastern vs. Western dimension plays a role here, in the sense that people from an Eastern culture and country are sensitive to the Italian Sounding effects, while people from a Western culture and country are not. This interpretation, however, does not agree with the non-Chinese expatriates in the Chinese sample's composition and results. In fact, such a sub-sample comprises both members from Western and Eastern cultures: i.e., about 42% from USA, Germany, and Switzerland; about 32% from Malaysia, Singapore, North Korea, and Iran; and a quarter of the sample from other countries. By comparing Italian Sounding effects in the various samples considered across the three studies, it is evident that Italians showed basically no vulnerability to Italian Sounding effects; EU people showed a similar pattern, with only a small, residual vulnerability to Italian Sounding effects in the sense of a higher perception of its Italianness and reputation, attitude, and WTP compared to the Italian sample; non-Chinese expatriates in China showed a similar residual vulnerability to Italian Sounding effects, in the sense of equalling its assessment to the generic foreign Chinese product available in the same domestic market; Americans showed a limited but already significant vulnerability to Italian Sounding effects (at reputational, attitudinal, and WTP levels); Chinese people showed a conspicuous vulnerability to Italian Sounding effects (at all those levels, by also reporting, among all considered samples, the greatest magnitude in terms of consumption implication outcome). The crucial differences between Chinese people and non-Chinese expatriates in China should be carefully considered in order to appreciate this issue. Thus, future research efforts could try to better focus on which variables of a sample are capable of moderating the Italian Sounding effects at perceptual, reputational, attitudinal, and decision-making levels. On the basis of our three-study results pattern, several potential candidate variables could be short-listed for such a test: geographical distance from the country of origin allegedly referred to by the IS (the greater the geographical distance from Italy, the greater the vulnerability to the IS effects); sample familiarity and knowledge familiarity with, and knowledge of the context of the target product, i.e., of the country of origin allegedly referred to by the IS (the less the experience with Italian products, the greater the vulnerability to the IS effects); and psychological distance from language or other group markers compared to an attractive target group, i.e., from the country of origin allegedly referred to by the IS (the greater the social–psychological distance from a high reputation target group, the greater the vulnerability to the IS effect). Of course, a proper test would need to measure or

manipulate such moderating variables in order to statistically check their inhibiting or magnifying impacts on the effect that Italian Sounding, and its related Italianness perception, has on food reputation and, via it, on agro-food consumption attitudes and decision-making.

However, despite the clear potential of these insights in terms of their social–psychological, market, and policy-making applicability, this research presents some limitations. The methodology did not consider the priming effect in the presentation of the different product labels, so that the order of presentation might have influenced the subjects' responses. It could be possible that the non-randomization of the stimuli somehow influenced the results. However, results from auxiliary analyses (six mediation models) confirmed the hypothesis that the Italianness of a product influences consumers' WTP via an increase in its reputation. These results support the idea that the gain in reputation associated with Italian Sounding products, rather than presentation order, drives consumer assessments of that product. Of course, to exclude all possible confounding effects, a replication of our experiments where conditions will be presented in a random order should be conducted. Within the present data set, it can be stressed that—even if in principle order and sequence confounding effect cannot be excluded—such bias does not impede the emergence of the described Italian Sounding effect at reputational, attitudinal, and purchasing payment intention levels, in the different cultural, linguistic, and national samples considered. It seems relatively implausible, from a theoretical point of view, that such a methodological artifact would play a greater or exclusive role for some cultural sub-samples in interaction with some of the products only, by magnifying the resulted effects precisely in the direction of the hypothesis only (also considering the fact that most hypotheses regarded complex interaction effects).

Another methodological limit is that the WTP measure has been implemented in slightly different ways in some cases: in the Italian and EU samples, the origin value in the measurement scale of the two products is not homogeneous, as for one product it starts from zero, while for the other product, it starts from a price value that is above zero; in all subsequent studies, price origins start from zero. Therefore, future attempts should keep the WTP operationalization always constant to afford proper comparisons. At the same time, the present results' consistency, in spite of such slight methodological differences, corroborates the generalization of the WTP effect described in the present contribution.

A third methodological limitation is the use of scales translated from Italian into English and then into Chinese, rather than previously validated tools for those cultural contexts (although the 23 profile reputation dimensions have been recently cross-culturally validated by De Dominicis et al., 2020).

To conclude, hopefully the results of this research will encourage further investigations on the Italian Sounding phenomenon, with the goal of hindering its negative effects on Italian economy [OECD (Organization for Economic Cooperation Development), 2008; Canali, 2012; EURISPES, 2013; Federalimentare, 2016].

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. However, written informed consent was implied via completion of the questionnaire.

AUTHOR CONTRIBUTIONS

FB, SD, and MB designed the research questions and the study. SD, MB, WC, and JM supervised data collection. FB and UG contributed to data collection. FB, SD, UG, and MB drafted the manuscript. WC, JM, and MB provided feedback on the manuscript. SD performed the statistical analyses. All authors provided feedback on the final version of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.581492/full#supplementary-material

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A Cognitive-Emotional Model to Explain Message Framing Effects: Reducing Meat Consumption

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We tested the plausibility of a cognitive-emotional model to understand the effects of messages framed in terms of gain, non-loss, non-gain, and loss, and related to the health consequences of red/processed meat consumption. A total of 544 Italian participants reported their attitude toward reduced red/processed meat consumption and intention to eat red/processed meat (time 1 questionnaire). One week later, participants were randomly assigned to four different message conditions: (a) gain messages focused on the positive health outcomes associated with low meat consumption; (b) non-loss messages focused on the avoided negative health outcomes associated with low meat consumption; (c) non-gain messages focused on the missed positive health outcomes associated with high meat consumption; (d) loss messages focused on the negative health outcomes associated with high meat consumption (message sending). After reading the messages, participants answered a series of questions regarding their emotional and cognitive reactions to the messages, their evaluation of the messages, and again their attitude and intention toward red/processed meat consumption (time 2 questionnaire). Comparing different multivariate linear models under the Bayesian approach, we selected the model with the highest plausibility conditioned to observed data. In this model, message-induced fear influenced systematic processing, which in turn positively influenced message evaluation and attitude, leading to reduced intention to consume red/processed meat. Vice versa, message-induced anger reduced systematic processing, which in turn negatively influenced message evaluation, and led to no effect on attitude and intention. The comparison among message conditions showed that gain and non-loss messages activated integrated emotional and cognitive processing of the health recommendation, while loss and non-gain messages mainly activated emotional shortcuts toward attitude and intention. Overall, these results advance our comprehension of the effects of message framing on receivers' attitudes and intentions.

Keywords: framing, message, meat consumption, message elaboration, emotion, message framing

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HIGHLIGHTS

- Gain, non-loss, non-gain, and loss messages have differential effects on attitudes and intentions.
- Message-induced fear enhances systematic processing and positive evaluation of the message.
- Message-induced anger reduces systematic processing and positive evaluation of the message.
- Gain and non-loss messages trigger integrated emotional and cognitive processing of the message.

- Gain and non-loss messages have a positive impact on future attitude and intention.
- Loss and non-gain messages activate emotional shortcuts toward attitude and intention.

INTRODUCTION

High consumption of red/processed meat has been recognized as connected to the risk of developing various diseases, such as cancer and type 2 diabetes (Misra et al., 2018; Bianchi et al., 2019). For this reason, health authorities have recommended eating a maximum of three servings per week (e.g., Bach-Faig et al., 2011). However, many individuals still eat too much red/processed meat (e.g., Farchi et al., 2017), due to the presence of several individual barriers, such as habits or the lack of knowledge about the nutritional value of plant-based diets (Stoll-Kleemann and Schmidt, 2017).

In the domain of communication research, many scholars have investigated how to overcome the aforementioned psychological barriers, with message interventions focused on health, environmental, and ethical issues connected to high red/processed meat consumption (from now on RPMC) (e.g., Bertolotti et al., 2016; Carfora et al., 2019a,b; Stea and Pickering, 2019; Harguess et al., 2020). Only limited research has been devoted to the effects on attitude and intentions of messages framed in terms of the valence of the expected outcomes (i.e., in terms of gain, non-loss, non-gain, or loss; Di Massimo et al., 2019; Carfora et al., 2020a). In addition, so far, no scholars have considered the cognitive and emotional processing underlying the effects of such message framing (Rothman and Baldwin, 2012). Providing more evidence on how to frame messages to reduce RPMC and analyzing the factors through which message framing influences people's responses is therefore a substantial research challenge.

Starting from the above, in the present study we investigated the effects of message framing on attitudes and intentions regarding RPMC relying on two main theoretical frameworks. The first theoretical framework is the self-regulatory framework (Higgins, 1997; Cesario et al., 2013), which makes assumptions regarding the effectiveness of emphasizing positive or negative outcomes in a persuasive message. The second theoretical framework is the revised Elaboration Likelihood Model, according to which the persuasive effect of a message is useful to deepen people's cognitive and emotional responses when receiving a message (Petty and Briñol, 2015). The integration of these theoretical frameworks helped in the understanding of how to formulate messages on reduced RPMC and why they are effective (or not) in changing attitude and intention.

Message Framing

Across an array of research traditions, past studies have demonstrated that persuasive messages induce attitude change, which in turn lead to intention and behavior change (e.g., Ajzen, 1991; Eagly and Chaiken, 1993; Wood, 2000; Petty and Cacioppo, 2012; Petty and Briñol, 2015). Focusing on the content or the construction of the message, researchers have also shown that the persuasive effect of communication depends on how message recommendations are framed (Davis, 1995; Chong and Druckman, 2007; Spence and Pidgeon, 2010). Message framing refers to the evidence that decision-makers respond differently to different but objectively equivalent descriptions of the same issue (Kühberger, 1998, p. 150), that is messages stressing the positive or negative consequences of a behavior (e.g., Rothman et al., 2006). A positively framed message presents behavioral consequences with a positive valence. Conversely, a negatively framed message presents behavioral consequences with a negative valence. Framing the expected outcomes, however, is not limited to the basic positive vs. negative valence distinction. According to the self-regulatory framework proposed by Cesario et al. (2013), both positively and negatively framed messages can also be formulated by describing the presence or absence of pleasure or pain. This level of framing refers to the so-called *outcome sensitivities level* of message framing. According to this distinction, positively framed messages can be further diversified in messages focused on *gain*, when they describe the *presence of positive outcomes* (e.g., If you eat well, you will improve your health), or on *non-loss* when they focus on the *absence of negative outcomes* (e.g., If you eat well, you will avoid damaging your health). Likewise, negatively framed messages can be further diversified in messages focused on *loss*, when they emphasize the presence of negative outcomes (e.g., If you eat badly, you will damage your health) or *non-gain*, when they inform about the *absence of positive outcomes* (e.g., If you eat badly, you will miss the opportunity to improve your health).

Regarding the effectiveness of message framing, past studies have shown that presenting the avoidance of negative consequences can be more effective than presenting the otherwise-equivalent gain, due to the "robust psychological phenomenon" of negativity bias (Cacioppo and Gardner, 1999, p. 206), that is, the heightened impact of and sensitivity to information on negative consequences. In other words, non-loss-framed messages may tend to be more effective than gain-framed messages (for a review, see Kühberger et al., 1999). The negativity bias has been related to one of the main tenets of bib47's prospect theory (1979), i.e., loss aversion, according to which people prefer avoiding losses to acquiring equivalent gains. In consideration of the negativity bias and loss aversion, we should also expect an advantage for loss messages as compared to positively framed messages. In a meta-analysis about the relationship between message framing and message processing, O'Keefe and Jensen (2008) found that gain-framed messages (i.e., messages phrased in terms of desirable states) were more involving than loss-framed messages (i.e., messages phrased in terms of undesirable states). However, the available cases did not provide evidence concerning the distinction among loss and non-loss messages. Consistent with this prior evidence, in the case of messages focused on reducing RPMC, recent studies (Di Massimo et al., 2019; Carfora et al., 2020b) showed that loss-framed messages were the least persuasive, while non-loss-framed messages, focused on the possibility of avoiding the negative consequences related to high RPMC, were the most persuasive messages, able to involve and persuade the majority of receivers independent of their prior beliefs. One possible explanation of the lower persuasiveness of loss messages as

compared to non-loss messages is that the former might be more likely to trigger strong negative emotions and, in turn, reactance (Brehm and Brehm, 1981).

Even though message framing effects have been studied extensively in communication advocating different types of health behavior (e.g., Gallagher and Updegraff, 2012; Rothman et al., 2020), most research on reducing RPMC has so far ignored the distinction among gain, non-loss, non-gain, and loss messages. Recently, Di Massimo et al. (2019) and Carfora et al. (2020b) indeed tested the effects of these four types of messages, showing not only that they differentially influence attitude and intention toward RPMC, but also that their influence varies according to receivers' baseline attitude, intention, perceived efficacy, and subjective norm. To move further into the comprehension of the factors that may underlie the different effectiveness of the four types of messages, in the present study we explored the reactions receivers have when they are exposed to these messages, in terms of systematic and heuristic processing of the messages, positive or negative emotional reactions triggered by the messages, and message evaluation. We aimed to assess the cognitive and emotional mechanisms underlying message influence on attitude and intention toward reduced RPMC, as well as possible differences in the role played by these mechanisms according to message type. Below, the expected cognitive and emotional mechanisms are discussed in detail.

Cognitive Processes Involved in Message Evaluation

The higher or lower effectiveness of different ways of framing messages depends on how these messages are processed (e.g., Meyers-Levy and Maheswaran, 2004), and message processing can be usefully investigated referring to two classic dual-process models of persuasion: the elaboration likelihood model (Petty and Cacioppo, 1986) and the heuristic systematic model (Eagly and Chaiken, 1993). The basic premise of these models is that attitude and intention changes depend upon the likelihood that an issue or argument will be positively evaluated by the receiver. Message evaluation has a direct effect on receivers' attitude and intention toward the recommended behavior (e.g., Cauberghe et al., 2009), and this effect has also been demonstrated when the recommended behavior is the reduction of RPMC (Bertolotti et al., 2020a,b). Message evaluation can therefore be considered an important proximal determinant of the framing effect on attitude and behavior change.

Message evaluation is strongly affected by systematic or heuristic processing (Chaiken, 1980), that is, by differences in the amount of cognitive effort an individual devotes to processing and thinking about a message. Systematic processing implies cognitive effort in considering the content of a message and its relevance to a given attitude object, such as a behavior. Heuristic processing is a type of shortcut that individuals use when they are less motivated to or able to think carefully about the message. When this is the case, individuals simply rely on some non-message aspects of communication to decide whether they agree or not with the message content. In the present study, we considered receivers' self-reported systematic message processing as an important precursor of message evaluation. In doing so we referred to the work of Smerecnik et al. (2012), who developed a scale to quickly gauge whether people systematically or heuristically process message information.

Emotional Processes Involved in Message Evaluation

Although the classic dual-process models have produced decades of convincing results, they have also been criticized for undervaluing the role of emotions during message processing and evaluation (Kitchen et al., 2014). Research focusing on framing effects has also generally focused on theories mainly designed to capture the "rational" processes of decision making, overlooking the possibility that other discrete emotions, such as fear or anger, might influence framing effects. However, several scholars have shown a clear role of affective responses while processing and evaluating a message (e.g., Gross and D'ambrosio, 2004; Dillard and Nabi, 2006; Peters et al., 2006; Kühne et al., 2015).

One of the emotions that is more likely to influence the processing and thus the evaluation of a message is fear. A long history of research has led to the general conclusion that messages inducing fear are more effective than those that do not (for a meta-analysis, see De Hoog et al., 2007), also in relation to attitude and intention change toward a variety of health-related behaviors (for a meta-analysis, see Tannenbaum et al., 2015). However, messages inducing fear have also been shown to be counterproductive, and it is still not clear under which conditions this is more likely to be the case (Popova, 2014). On the one hand, fear can attract attention to the message and directly influence information processing (Loewenstein et al., 2001). Messages evoking fear lead people to rely on systematic processing, which in turn stimulates many issue-relevant thoughts, and thus a positive message evaluation (e.g., Meijnders et al., 2001; Slater et al., 2002; Meyers-Levy and Maheswaran, 2004). On the other hand, fear can induce people to enact defensive strategies to reduce the potential emotional distress associated with the message. For example, not focusing attention on the message, or reinterpreting or disregarding its content (Witte, 1992; Ruiter et al., 2001). However, so far, no research has considered how the reactions to message-induced fear may be influenced by message framing based on the self-regulatory framework.

Another emotion that is likely to influence the processing and evaluation of a message is anger. Previous research showed that persuasive messages framed with the appraisals of certainty, control, and blame can trigger anger, and the intensity of felt anger in turn determines processing ability and subsequent behavioral intentions (Turner, 2007; Walter et al., 2019). Some studies also showed that angry people are more inclined to recur to accessible and relevant heuristics when processing information that otherwise they would process analytically (Moons and Mackie, 2007). In the case of persuasive messages, recipients are often aware of the persuasive intent of the message and may feel that the message threatens their freedom of opinion and action. This feeling activates reactance aimed at the reestablishment of the threatened freedom, leading recipients to react with anger,

counterarguments, as well as attitudes and behavior that run counter to the message intent (Dillard and Shen, 2005; Rains, 2013). To the best of our knowledge, however, no research has analyzed how exposure to message framing based on the self-regulatory framework induces anger in recipients, in turn influencing message processing and evaluation. In the present study, we investigated whether this would be the case and whether anger would play a role in influencing attitude and intention change toward RPMC.

The Present Study

Based on the above literature, in the present study we proposed and tested a composite theoretical model to understand the cognitive and emotional mechanisms activated by message exposure in the case of gain, non-loss, non-gain, and loss messages on RPMC reduction. Our starting point was the model proposed and tested by Di Massimo et al. (2019) and Carfora et al. (2020b), in which baseline attitude, baseline intention, and message evaluation were key predictors of attitude and future intention to engage in RMPC, although differently according to the same four message conditions.

In the present study, we aimed at further assessing the processes that underlie message persuasiveness and framing effects. We expected that a model considering both cognitive and emotional dimensions would best explain receivers' message evaluation, attitude, and intention after reading the messages. To test this expectation we compared the fit of different models: (a) a model in which we considered the relationships between baseline attitude and intention toward RPMC and message evaluation, and in turn, the relationships between message evaluation and receivers' attitude and intention toward RPMC after reading the messages; (b) a pure cognitive model in which we considered the possible mediating role of systematic and heuristic processing; (c) a pure emotional model in which we considered the possible mediating role of message-induced fear and message-induced anger; and (d) an integrated cognitive-emotional model in which we considered both the cognitive (systematic and heuristic processing) and the emotional dimensions (message-induced fear and anger) as predictors of message evaluation, attitude, and intention.

In consideration of what was discussed in the introduction, we expected that the last and integrated model would be the one with the highest plausibility conditioned to observed data. This model is illustrated in **Figure 1**. Based on the literature discussed above, we tested these main hypotheses:

1) message-induced fear positively influences systematic processing (hypothesis 1a, H1a) and message evaluation (hypothesis 1b, H1b);
2) message-induced anger positively influences heuristic processing (hypothesis 2a, H2a), and negatively influences both systematic processing (hypothesis 2b, H2b) and message evaluation (hypothesis 2c, H2c);
3) systematic processing positively influences message evaluation (hypothesis 3, H3);
4) heuristic processing negatively influences message evaluation (hypothesis 4, H4);
5) a more positive evaluation of the message leads to higher attitude toward reduced RPMC (hypothesis 5, H5);
6) a more positive attitude toward reduced RPMC leads to lower intention to eat red/processed meat (hypothesis 6, H6).

In the model, possible additional direct relationships among study variables are also controlled for. They include the influence of baseline (i.e., at time 1, T1) attitude and intention on all study variables after exposure to the messages (i.e., at time 2, T2). They also include direct relationships among the hypothesized predictors of message evaluation (systematic processing, heuristic processing, message-induced fear, and message-induced anger), and attitude and intention on the other. Finally, the direct effect of message-induced fear on heuristic processing is also controlled for.

A further aim of our study was to assess whether the hypothesized relations between variables would occur in all message conditions (gain, non-loss, non-gain, loss), and if so with what intensity. Given that literature on the cognitive and emotional processes involved in the four different types of framing effects is scarce, we did not make specific hypotheses in this regard, but only a series of research questions.

How far does message-induced fear influence systematic processing (research question 1a, RQ1a) and message evaluation (research question 1b, RQ1b) in the four different message conditions?

How far does message-induced anger negatively influence systematic processing (research question 2a, RQ2a) and message evaluation in the four message conditions (research question 2b, RQ2b)?

How far does systematic processing influence message evaluation in the four different message conditions (research question 3, RQ3)?

How far does heuristic processing influence message evaluation in the four different message conditions (research question 4, RQ4)?

How far does a more positive evaluation of the message lead to greater attitude toward reduced RPMC in the four message conditions (research question 5, RQ5)?

How far does a more positive attitude toward reduced RPMC lead to lower intention to eat red/processed meat in the four message conditions (research question 6, RQ6)?

METHOD

Participants

A number of Italian citizens were invited to participate in a university study on public communication. People received an email with a link to an online questionnaire developed through the Qualtrics platform (time 1—T1). One week after the completion of the questionnaire, again through the Qualtrics platform, participants were automatically and randomly assigned to four different conditions (gain, non-loss, non-gain, and loss messages) in the ratio 1:1:1:1 and were invited to read eight messages on the health consequences of eating red/processed meat. After reading the messages, participants were required to fill in a second questionnaire (time 2—T2). The initial sample

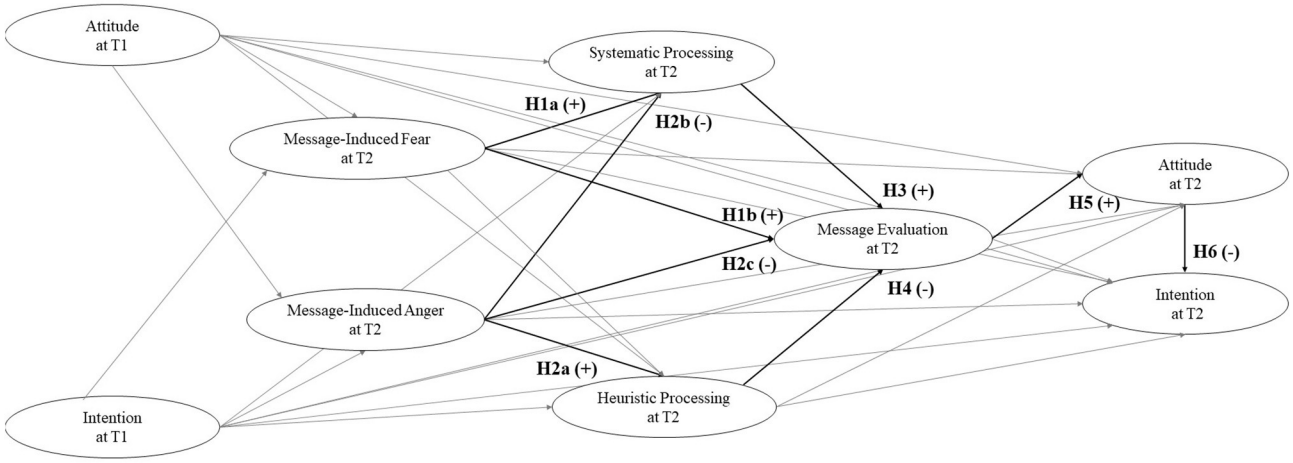

FIGURE 1 | A cognitive-emotional model to explain message framing effects. Gray lines represent additional paths considered in the model.

was made of $N = 834$ participants. Since the aim of the present study was to explore research questions and not to test specific hypotheses, we did not perform a power analysis to estimate the sample size (Amrhein et al., 2019). Participants who already ate <3 portions of red and processed meat per week ($N = 96$), participants who followed a specific diet (i.e., veganism, vegetarianism, or restrictive diets, $N = 124$), and participants who did not fully or accurately complete both questionnaires ($N = 70$) were then excluded. So, the final sample consisted of 544 participants, precisely 257 males and 288 females with an age ranging from 18 to 70 years (mean age = 39.97, $SD = 14.78$). In total, 9.8% of the participants had a primary level of education, 41.2% had a secondary level of education, 47.7% had a higher level of education, and the remaining 1.3% preferred not to declare. In addition, 38.9% of the participants were unmarried, 41.20% were married, 8.80% lived together, 6% were separated or divorced, 0.30% were widows, and the remaining 4.8% preferred not to declare their civil status. Participants were randomly distributed in the four message conditions as follows: gain message condition $N = 134$; non-loss message condition $N = 134$; loss message condition $N = 141$; non-gain message condition $N = 135$.

Pre-test Measures

At the beginning of the first questionnaire participants reported their age, gender, education, and typical diet (e.g., veganism, vegetarianism or restrictive diets). Then, they read a definition of "red/processed meat consumption" ("red/processed meat is defined as mammalian meat, that is red when it is raw and dark in color when cooked. This includes beef, lamb, pork, venison, and goat, and processed meat, like beef burgers, bacon, sausages, etc. One serving is roughly the same size as a deck of cards, that is, at least two servings of vegetables per day"). After that, participants responded to a series of questions aimed at measuring their baseline attitude and intention toward RPMC.

Attitude toward reduced RPMC was measured using a semantic differential scale ranging from "1" to "7" (e.g., "eating little red/processed meat is… bad—good"; Carfora et al., 2017). Higher values indicated a more positive attitude toward a reduced red/processed meat consumption. Cronbach's alpha was 0.91.

Intention toward RPMC was assessed with three items on a seven-point Likert scale (e.g., "In the next month, how often do you intend to eat red/processed meat?"; never (1)—every day (7); Carfora et al., 2017). Higher scores indicated a greater intention to eat little red/processed meat. Cronbach's alpha was 0.97.

Message Intervention

One week after completing the first questionnaire all participants were invited to read eight messages (∼14 words each) describing the health consequences of eating red/processed meat, and formulated in prefactual terms ("if only…"; see Carfora et al., 2019a,b). Participants read different messages according to the experimental condition to which they had been randomly assigned. Participants in the *gain message condition* read messages on the positive health outcomes associated to little RPMC (e.g., "If you eat little red meat and cold cuts, you will improve the health of your stomach"). Participants in the *non-loss message condition* read messages informing about how eating little red/processed meat is connected to preventing negative health outcomes (e.g., "If you eat little red meat and cold cuts, you will avoid damaging the health of your stomach"). Participants in the *non-gain message condition* read messages emphasizing how eating excessive red/processed meat is related to missing out on positive health consequences (e.g., "If you eat a lot of red meat and cold cuts, you will miss the chance to improve the health of your stomach"). Finally, participants in the *loss message condition* read messages about the negative health outcomes of eating too much red/processed meat (e.g., "If you eat too much red meat and cold cuts, you will damage the health of your stomach"). The full list of messages is reported in **Appendix 1**.

Post-test Measures

After reading the messages, participants were administered a questionnaire aimed at measuring the dimensions described below.

Systematic processing was measured with five items, asking participants to state how deeply they had processed the information presented in the messages (e.g., "I tried to think about the importance of the information for my daily life"; adapted from Smerecnik et al., 2012). Answers were given on a 7-point Likert scale, from (1) "strongly disagree" to (7) "strongly agree." Higher values indicated a deeper processing of the messages. Cronbach's alpha was 0.87.

Heuristic processing was measured with five items, asking participants to state how superficially they processed the information presented in the messages (e.g., "While reading the messages I did not think about the arguments presented"; adapted from Smerecnik et al., 2012). Answers were given on a 7-point Likert scale, from (1) "strongly disagree" to (7) "strongly agree." Higher values indicated higher heuristic processing of the messages. Cronbach's alpha was 0.70.

Message-induced fear was measured with six items pertaining to the degree to which reading messages had made participants feel fearful (e.g., "To what extent when reading these messages did you feel scared?"; adapted from Brown and Smith, 2007). Answers were given on a 7-point Likert scale, from (1) "not at all" to (7) "completely." Higher values indicated a higher participant's fear after reading the messages. Cronbach's alpha was 0.91.

Message-induced anger was measured with three items related to how irritated the receivers felt after reading the messages (e.g., "To what extent when reading these messages did you feel irritated?"; adapted from Brown and Smith, 2007). Answers were given on a 7-point Likert scale, from (1) "not at all" to (7) "completely." Higher values indicated a higher participant's anger after reading the messages. Cronbach's alpha was 0.80.

Message evaluation was measured with six items asking participants to state how involved they had been in the messages (e.g., "The message was very interesting"; adapted from Godinho et al., 2016). Answers were given on a 7-point Likert scale, from (1) "strongly disagree" to (7) "strongly agree." Higher values indicated a higher participant's positive evaluation of the messages. Cronbach's alpha was 0.90.

Finally, we measured receivers' attitude toward reduced RPMC and intention to eat red/processed meat after the message exposure, with the same scale used at time 1. Cronbach's alpha was 0.99 for attitude and 0.78 for intention.

Data Analysis

We adopted a fully Bayesian approach (Kruschke and Liddell, 2017) and all analyses were performed with the R software and programming language (R Development Core Team, 2016), with the rstan (Carpenter et al., 2017; Stan Development Team, 2018) and blavaan (Merkle and Rosseel, 2015) packages. Following a model selection approach (Burnham and Anderson, 2003; Fox, 2015), we first compared a series of multivariate models, to test our hypotheses and to assess which model would have the best plausibility conditioned to the observed data. Following the rationale exposed in the introduction and summarized in "the present study" section above, we considered and compared the following models.

- Model 0 (M0), a null model assuming no co-variances amongst the observed variables.
- Model 1 (M1), a baseline model estimating the association between attitude and intention at T1 and message evaluation, attitude, and intention at T2.
- Model 2 (M2), testing the associations of M1 plus those related to systematic and heuristic processing.
- Model 3 (M3), testing the associations of M1 plus those related to message-induced fear and message-induced anger.
- Model 4 (M4), testing the associations among all considered variables (**Figure 1**).

In each model, parameters were simultaneously estimated by using a multigroup approach considering the four different message conditions (gain, non-loss, non-gain, loss).

To select the best model, we considered the leave-one-out cross-validation information criterion (LOOIC) (Vehtari et al., 2017), where lower values suggest a better fit to the data, and Akaike weights, which represent an estimate of the probability that the model will make the best prediction in new data conditional upon the set of models considered (Burnham and Anderson, 2003; Wagenmakers and Farrell, 2004). Each model was fitted using the Bayesian Markov Chain Monte Carlo estimation method based on 4,000 iterations in four chains considering 8,000 post-warmup draws. Convergence was assessed by examining the potential scale reduction factor (PSRF) (Gelman and Rubin, 1992). By adopting a model comparison approach, we were able to estimate which model would provide the best explanation of the data.

After identifying the best model, we investigated the relationships among variables in each message condition. To do so, we analyzed parameter posterior distributions and summarized these distributions using posterior means and 90% highest posterior density intervals (HPDI) (Tiao and Box, 1973; Kruschke, 2011). Differently from confidence intervals in the frequentist approach, HPDI provides a direct representation of the most credible values of the estimated parameter (coefficient regression in the current study) after accounting for prior believes. A 90% HPDI represents the narrowest interval containing 90% of posterior samples. When HPDI does not include 0 (or it only contains a small proportion of values that are close to zero), it is reasonable to conclude that 0 is not a credible value and therefore an effect and/or an association can be reasonably supported.

RESULTS

Model Selection

Table 1 reports the goodness of fit indices of the four models tested and the null model. Consistent with our expectation, in Model 2 the addition of the systematic and heuristic processing of the message to the basic Model 1 increased the model capacity to predict participants' attitude and intention toward RPMC. Similarly, in Model 3 the addition of message-induced fear and anger to the basic Model 1 increased the goodness of fit, and the

TABLE 1 | Model comparison results.

	LOOIC	se.LOOIC	W
M4	9980.91	121.93	1.00
M3	10171.51	122.01	0.00
M2	10372.05	124.94	0.00
M1	10545.82	126.38	0.00
M0	14368.72	147.68	0.00

LOOIC, leave-one-out cross-validation information criterion (Vehtari et al., 2017); se.LOOIC, standard error; W, Akaike weight.

increment was higher when compared to the one from Model 1 to Model 2. Finally, the cognitive-emotional model including all considered variables (i.e., Model 4) was the best model to predict participants' attitude and intention after message exposure. This model had the lowest LOOIC and the highest model weight and offered support to our six research hypotheses (H1—H6) regarding the relations among message-induced fear and anger, systematic processing, message evaluation, and attitude toward reduced RPMC.

Comparison Among Message Conditions

After selecting Model 4 as the best model, we analyzed the parameter estimates of the model in the four message conditions (gain, non-loss, non-gain, loss). All parameter estimates are reported in **Appendix 2**. Below we will consider the predictors of all endogenous dimensions, but we will focus our comments especially on the cognitive and emotional predictors related to our six main research questions, namely, how message-induced fear predicted systematic processing (H1a; see section Systematic Processing) and message evaluation (H1b; see section Message Evaluation), how message-induced anger predicted heuristic processing (H2a; see section Heuristic Processing), systematic processing (H2b; see section Systematic Processing), and message evaluation (H2c; see section Message Evaluation), how systematic processing predicted message evaluation (H3; see section Message Evaluation), how heuristic processing predicted message evaluation (H4; see section Message Evaluation), how message evaluation was related to attitude toward reduced RPMC (H5; see section Attitude Toward Reduced RPMC at T2), and finally how attitude toward reduced RPMC was related to intention to eat red/processed meat (H6; see section Intention to Eat Red/Processed Meat at T2).

Message-Induced Fear

To interpret the effects of baseline attitude toward red/processed meat consumption and intention to eat red/processed meat on message-induced fear, we used the posterior distribution of regression coefficients (90% HDPI intervals are included in square brackets). The comparison among message conditions showed that in the gain message condition participants were less scared by the message when they had a high baseline positive attitude toward reducing RPMC ($\beta = -0.07$; [−0.14; −0.001]). In the other message conditions message-induced fear was instead independent of baseline attitude. In no message condition was message-induced fear predicted by baseline intention to eat red/processed meat.

Message-Induced Anger

Participants in the gain, non-loss, and loss conditions felt less message-induced anger when they had a more positive attitude toward reduced RPMC at time 1 (gain message condition: $\beta = -0.17$; [−0.25; −0.10]; non-loss message condition: $\beta = -0.13$; [−0.22; −0.03]; loss message condition: $\beta = -0.13$; [−0.23; −0.03]). This was not the case for participants in the non-gain message condition, who were irritated regardless of their attitude at T1. Finally, in all message conditions no significant relationship between receivers' intention at T1 and message-induced anger emerged. Thus, the feeling of anger after message exposure was independent of baseline intention to eat red/processed meat.

Systematic Processing

In all conditions, higher message-induced fear stimulated systematic processing and higher message-induced anger inhibited it, albeit with a different degree. Message-induced fear led to systematic processing in all message conditions (H1a), albeit more in the gain ($\beta = 0.80$ [0.17; 0.46]) and in the loss message conditions ($\beta = 0.91$; [0.61; 1.20]) than in the non-loss ($\beta = 0.61$; [0.33; 0.90]) and non-gain ($\beta = 0.67$; [0.37; 0.98]) conditions (RQ1a). Conversely, message-induced anger inhibited systematic processing in all conditions (H2b), albeit more in the gain ($\beta = -0.92$; [−1.22; −0.63]) and in the loss conditions ($\beta = -0.79$; [−1.05; −0.72]) than in the non-loss ($\beta = -0.64$; [−0.91; −0.38]) and the non-gain ($\beta = -0.45$; [−0.74; −0.15]) conditions (RQ2a).

As to the other predictors of systematic processing, exposure to gain and non-loss messages induced more systematic processing of the message when receivers had a positive attitude toward reduced RPMC (gain message condition: $\beta = -0.13$; [0.002; 0.26]; non-loss message condition: $\beta = 0.14$; [0.06; 0.02]). This was not the case in the other two conditions (non-gain message condition: $\beta = 0.09$; [−0.07; 0.24]; loss message condition: $\beta = 0.08$; [−0.05; 0.21]). Finally, intention at T1 did not influence the degree to which participants processed the message systematically. For a representation of the posterior distributions of all coefficient regressions associated with the predictors of systematic processing in each message condition, see **Figure 2**. In each panel of the figure, the pink curve refers to data of the gain message condition, the purple curve is related to data of the non-loss message condition, the light blue curve refers to data of the non-gain message condition, and the green curve represents data of the loss message condition.

Heuristic Processing

In the gain, non-loss, and loss message conditions the more participants felt anger, the more they processed the message heuristically (H2a; gain message condition: $\beta = 0.45$; [0.15; 0.17]; non-loss message condition: $\beta = 0.45$; [0.17; 0.73]; loss message condition: $\beta = 0.23$; [0.02; 0.45]). Conversely, in the non-gain message condition receivers engaged in heuristic processing regardless of their experienced anger. In all conditions the other

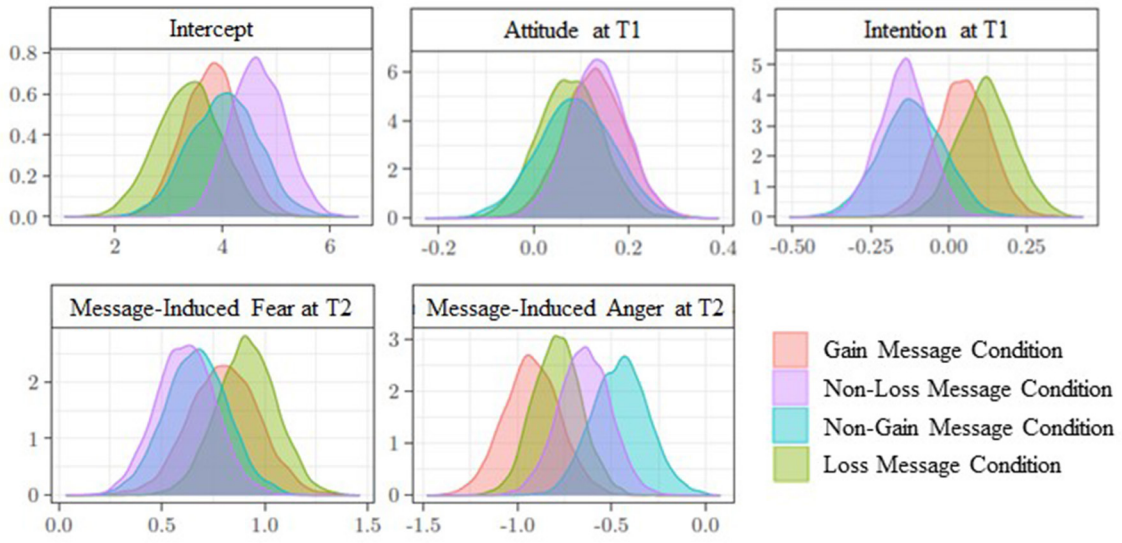

FIGURE 2 | Systematic processing at time 2. Posterior distributions of the parameters associated with predictors, according to message condition.

predictors (attitude and intention at T1 and message-induced fear) did not influence participants' heuristic processing.

Message Evaluation

Moving on to the predictors of message evaluation, message-induced fear positively predicted message evaluation in all conditions (H1b), and especially in the non-gain condition ($\beta = 0.79$; [0.51; 1.07]) (RQ1b). Conversely, message-induced anger negatively predicted message evaluation in all message conditions (H2c), and this was especially the case for the non-loss condition ($\beta = -0.62$; [−0.91; −0.35]) (RQ2b). Moreover, in all message conditions systematic processing positively predicted message evaluation (H3), albeit with a different degree (RQ3; gain message condition: $\beta = 0.62$; [0.48; 0.76]; non-loss message condition: $\beta = 0.55$; [0.40; 0.71]; non-gain message condition: $\beta = 0.58$; [0.44; 0.72]; loss message condition: $\beta = 0.70$; [0.57; 0.83]). Heuristic processing negatively predicted message evaluation only in the non-gain ($\beta = -0.19$; [−0.34; −0.04]) and loss ($\beta = -0.15$; [−0.31; −0.00]) message conditions (H4; RQ4). In all conditions the other predictors (attitude and intention at T1) did not (or only marginally) predict receivers' message evaluation. Posterior distributions of each coefficient regression associated with the predictors of message evaluation in all conditions are shown in **Figure 3**. **Table 2** shows the regression estimates of message evaluation.

Attitude Toward Reduced RPMC at T2

Positive attitude at T2 was predicted by positive message evaluation in the case of the gain ($\beta = 0.33$; [0.13; 0.53]) and the non-loss message conditions ($\beta = 0.34$; [0.15; 0.53]), but not in the case of the non-gain ($\beta = 0.11$; [−0.07; 0.29]) and the loss ($\beta = 0.18$; [−0.05; 0.41]) conditions (H5; RQ5). In addition, only in the case of gain messages did participants show a greater positive attitude toward reduced RPMC when they also reported a lower intention to eat red/processed meat at T1 ($\beta = -0.30$; [−0.46; −0.14]). In the case of loss messages, attitude at T2 was only predicted by attitude at T1 ($\beta = 0.29$; [0.27; 0.42]). Finally, in the case of non-gain messages, attitude at T2 was not affected by message evaluation but by higher message-induced fear ($\beta = 0.33$; [0.00; 0.66]) and lower message-induced anger ($\beta = -0.43$; [−0.71; −0.15]), showing that such messages influenced attitude at T2 through an emotional processing of its content. The posterior distributions of the parameters associated with the predictors of attitude toward reduced RPMC, divided by message conditions, are shown in **Figure 4**. **Table 2** shows the regression estimates of attitude at T2.

Intention to Eat Red/Processed Meat at T2

The posterior distributions of the parameters associated with the predictors of the intention to eat red/processed meat, divided by message condition, are shown in **Figure 4**. In all conditions, lower intention to eat red/processed meat at T2 was influenced by higher attitude toward reduced RPMC at T2 (H6 and RQ6; gain message condition: $\beta = -0.22$; [−0.34; −0.09]; non-loss message condition: $\beta = -0.16$; [−0.30; −0.02]; loss message condition: $\beta = -0.12$; [−0.23; −0.02]; non-gain message condition: $\beta = -0.12$; [−0.23; −0.003]). Again in all conditions intention at T2 was related to intention at T1 (gain message condition: $\beta = 0.40$; [0.28; 0.52]; non-loss message condition: $\beta = 0.44$; [0.30; 0.58]; loss message condition: $\beta = 0.55$; [0.43; 0.67]; non-gain message condition: $\beta = 0.38$; [0.25; 0.51]). Finally, lower intention at T2 was influenced by higher message-induced fear both in the gain [$\beta = -0.36$; [−0.61; −0.1]) and in the non-gain ($\beta = -0.24$; [−0.46; −0.02]) message conditions.

In sum, the above results fully confirmed our expectation according to which model including both cognitive (systematic and heuristic processing) and emotional (message-induced fear

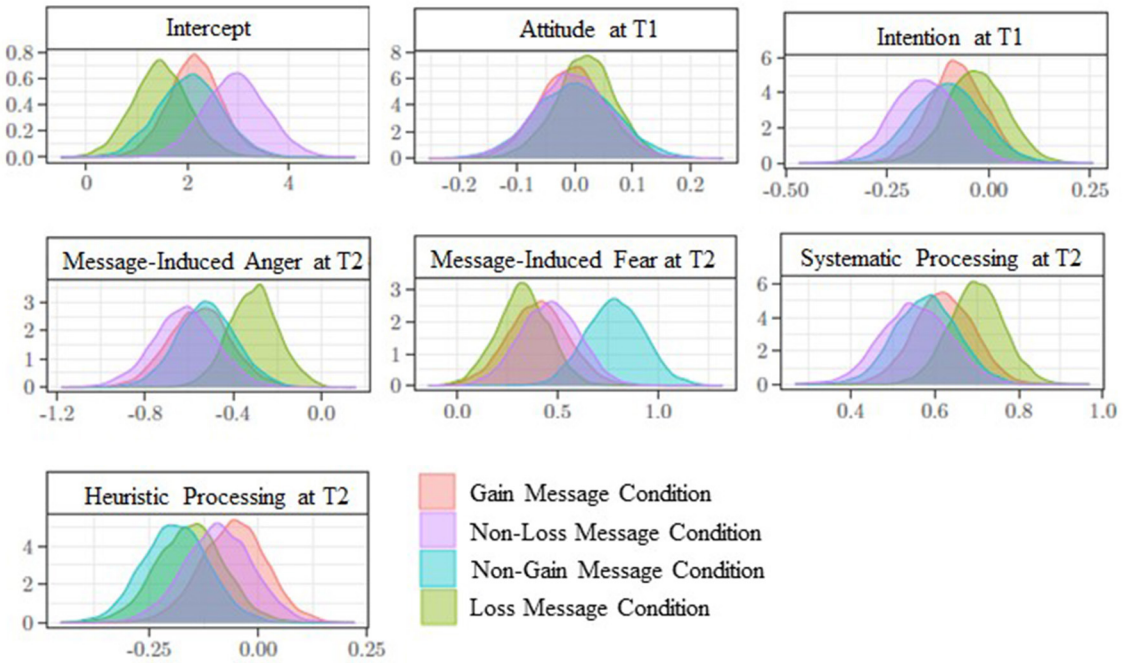

FIGURE 3 | Message evaluation at time 2. Posterior distributions of the parameters associated with the predictors, according to message condition.

TABLE 2 | Posterior regression estimates of message evaluation and attitude at T2 in the four message conditions.

	Message evaluation at T2				Attitude at T2			
Message condition	**Gain**	**Non-loss**	**Non-gain**	**Loss**	**Gain**	**Non-loss**	**Non-gain**	**Loss**
Attitude at T1	−0.01	−0.00	0.00	0.02	0.09	0.43*	0.17*	0.29*
Intention at T1	−0.08	−0.16	−0.10	−0.03	−0.30*	−0.15	−0.36*	−0.14
Message–induced fear at T2	0.40*	0.46*	0.79*	0.32*	−0.31	−0.03	0.33*	−0.21
Message–induced anger at T2	−0.55*	−0.62*	−0.52*	−0.30*	0.16	0.00	−0.43*	0.00
Systematic processing at T2	0.62*	0.55*	0.58*	0.70*	0.19	−0.06	0.07	0.02
Heuristic processing at T2	−0.06	−0.09	−0.19*	−0.15*	−0.01	−0.02	0.08	−0.04
Message evaluation at T2	-	-	-	-	0.33*	0.34*	0.11	0.18

**90% HPDI of the regression parameter does not include 0, thus the direct effect can be reasonably supported.*

and anger) dimensions would be best suited to explain the effects of exposure to messages on the health consequences of red/processed meat consumption. Most of the hypothesized relations between dimensions were therefore supported by data, with message-induced fear positively influencing systematic processing (H1a) and message evaluation (H1b), message-induced anger negatively influencing systematic processing (H2a) and message evaluation (H2b), systematic processing positively influencing message evaluation (H3), positive message evaluation leading to higher attitude toward RPMC reduction (H5), and positive attitude toward reduced RPMC predicting lower intention to eat red/processed meat (H6).

The comparison of the four message conditions on the integrated model allowed us to answer our research questions about the differential impact of the cognitive and emotional dimensions after exposure to differently framed messages. First, message-induced fear increased systematic processing in all conditions, and especially in the loss and gain message conditions (RQ1a). It also positively increased message evaluation in all conditions, especially in the case of non-gain messages (RQ1b).

Second, message-induced anger inhibited systematic processing in all conditions, and especially in the gain condition (RQ2a). It also led to a more negative evaluation of the message, especially in the non-loss condition (RQ2b). Third, systematic processing positively influenced message evaluation in all conditions, and especially in the loss message condition (RQ3), while heuristic processing negatively influenced message evaluation in the non-gain and loss message conditions (RQ4). Fourth, in the case of gain and non-loss messages, but not in the case of non-gain and loss messages, a more positive evaluation

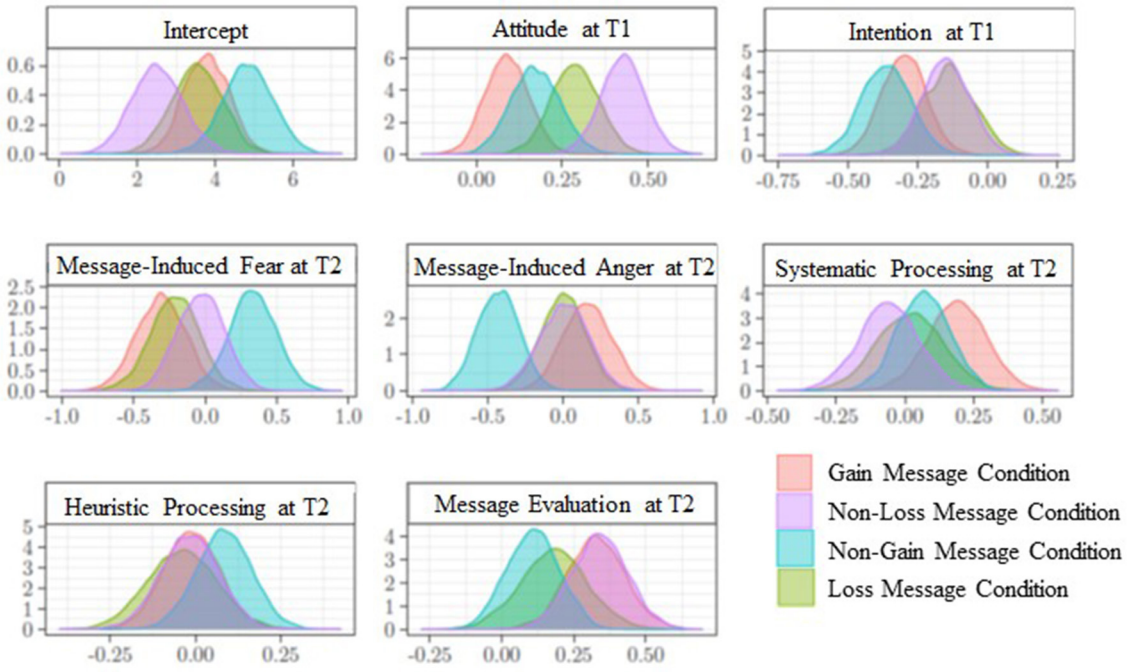

FIGURE 4 | Attitude at time 2. Posterior distributions of the parameters associated with predictors, according to message condition.

of the message (activated by systematic processing) led to higher attitude toward reduced RPMC (RQ5), which in turn led to lower intention to eat red/processed meat (RQ6). In regard to non-gain messages, attitude toward reduced RPMC was positively predicted by message-induced fear and negatively predicted by message-induced anger, showing that such messages influenced attitude mainly through an emotional reaction. Finally, in regard to loss messages, attitude was instead only predicted by baseline attitude.

DISCUSSION

The results of the present study clarify the emotional and cognitive mechanisms underlying the effects of health messages about reduced RPMC formulated with four different frames: gain, non-loss, non-gain, and loss. While gain messages presented the positive health outcomes deriving from reduced RPMC, non-loss messages informed receivers about the avoidance of negative health consequences through reduced RMPC, non-gain messages provided information about the missed positive health outcomes connected with high RPMC, and finally loss messages focused on the negative health outcomes connected with high RPMC. Using Bayesian analyses and comparing the fit of different models, we found that a model including both cognitive (systematic and heuristic processing of the messages) and emotional dimensions (message-induced fear and message-induced anger) leads to better understanding of how message evaluation predicts receivers' attitude and intention toward red/processed meat consumption, and has a better fit than models considering only either cognitive or emotional dimensions. We also assessed that some of the relationships among dimensions included in the model have different weight or even disappear in different message frames.

The above results offer two main contributions to research on framing effects in communication aimed to reduce RPMC. The first contribution regards the identification of key variables in the explanation of how cognitive and emotional mechanisms predict receivers' attitude and intention after being exposed to persuasive messages aimed at inducing a reduction of RPMC. Our hypothesized model, which was confirmed by the data, showed that message exposure activates a chain of emotional and cognitive reactions which end up influencing receivers' evaluation of the messages and, in turn, subsequent attitude and intention toward RPMC. More specifically, emotional reactions strongly influenced cognitive processing. Fear elicited by the messages was associated with systematic processing of the messages themselves. This in turn led to a positive evaluation of the message and increased positive attitude toward reducing RPMC and a lower intention to eat red/processed meat in the future. Conversely, anger elicited by the messages was associated with heuristic processing of the messages, which did not lead to any change in attitude or intention toward RPMC.

The second main contribution of our research regards the comparative analysis of how the four different message frames activated specific cognitive and emotional mechanisms and, in turn, affected attitude and intention. First, we showed that systematic processing positively influenced message evaluation in all message conditions. In the case of gain and non-loss message conditions, this positive evaluation in turn led to higher attitude toward reduced RPMC and lower intention toward RPMC. These

results suggest that presenting the positive consequences (gain) or the avoidance of negative consequences (non-loss) connected with reduced RPMC activates successful systematic processing of the message, which in turn influences message evaluation, attitude, and intention. The observed key role of systematic processing and its effects are consistent with the dual-process models of persuasion (Petty and Cacioppo, 1986; Eagly and Chaiken, 1993). In the case of non-gain and loss messages, systematic process also led to a more positive evaluation of the message, but this effect did not reverberate on a change in attitude or intention toward RPMC. This result suggests that cognitively processing the missed positive consequences (non-gain) or the negative consequences (loss) associated with reduced RPMC interrupted the persuasive effect of the message on receivers' attitude and intention after the message evaluation. Why this interruption occurs might be explained in the light of the role of the emotional factors, as commented below.

We also showed how emotions influenced the systematic processing of the message in the various message conditions. In all conditions the perception of fear activated a fruitful chain of message elaboration (via systematic processing and then a positive evaluation of the message), leading to higher attitude toward reduction and lower intention to eat red/processed meat, albeit only in the case of gain and non-loss messages. These results support the idea of fear as being a compelling persuader (Tomkins, 1984), able to direct cognitive processes (Izard, 1993). As shown by a long history of research, inducing fear is an effective communication strategy to influence receivers' attitude and intention, given its ability to stimulate systematic processing based on a large number of issue-relevant thoughts (e.g., Meijnders et al., 2001; Slater et al., 2002; Meyers-Levy and Maheswaran, 2004; De Hoog et al., 2007). This is more likely to happen when fear is moderate. In our study, gain and non-loss messages very likely stimulated a moderate level of fear, that motivated central processing. However, in the case of gain messages the perception of fear was reduced by participants' positive attitude toward the reduction of their RPMC at T1. This finding may be seen in the light of the cognitive dissonance theory and the related confirmatory bias (Festinger, 1962; Nickerson, 1998). Receivers who positively evaluated reduced meat consumption but ate more meat than recommended, and who received information about the benefits associated with reduced consumption, were possibly confronted with an experience of an inconsistency between their attitude and their behavior. In this case, they might have limited the systematic processing of gain messages to avoid contradictory information (confirmation bias).

Unlike the case of gain messages, in the case of non-loss messages the perception of fear activated a successful chain of message elaboration, regardless of receivers' attitude at T1. Thus, non-loss messages can be considered as the most efficient frame in inducing attitude and intention via a fruitful emotional, and then cognitive message processing that leads to attitude and intention change. This promising effect of the non-loss message can be partially attributed to loss aversion and negativity bias (Kühberger et al., 1999). Proposing the avoidance of negative outcomes directs the attention to the possible negative consequences of one's behavior and triggers some fear. Consequently, the acquisition of fearful and negative information induces greater information processing than does positive information, as suggested by the negativity bias theory (Rozin and Royzman, 2001). A greater elaboration may then induce greater attitude and intention change. This finding is consistent with a prior study by Carfora et al. (2020b), also comparing gain, non-loss, non-gain, and loss messages, and showing that non-loss messages were indeed the most effective messages, apt to involve and persuade the majority of receivers, independent of their prior beliefs.

In the case of loss messages, the elicitation of fear led to systematic processing and a positive evaluation of the message content. Relying on a negative bias, the acquisition of negative information led to greater information processing than the acquisition of positive information. However, the elaboration of loss messages did not converge on higher attitude and lower intention toward red/processed meat consumption, probably because it activated high levels of fear that in turn induced resistance to the message (Witte, 1992; Ruiter et al., 2001). The loss-framed messages were therefore not effective in impacting on attitude and intention at T2. These findings contribute to further clarify when message-induced fear becomes counterproductive (Popova, 2014). In the case of loss messages, fear probably acted as a cue for people to use defensive strategies, to reduce potential emotional distress associated with the read messages (Witte, 1992; Ruiter et al., 2001).

Finally, in the case of non-gain messages a further different effect of induced fear emerged. Fear directly predicted higher attitude toward reduced RPMC and lower intention to eat red/processed meat, regardless of systematic processing of the message. Probably, the non-gain frame scared successfully participants, not activating defensive strategies but also bypassing systematic processing. This latest point may be counterproductive long-term in regard to the persuasiveness of this message frame because, according to the dual-process model, only when receivers activate systematic processing is the message internalized, resulting in a longer and more stable attitude change (Eagly and Chaiken, 1993).

Anger also played a relevant role in influencing systematic processing and evaluation of the messages, but in a negative direction. This result is coherent with previous evidence according to which anger mobilizes cognitive mechanics for the purpose of defending oneself, and these include resistance to a message inducing anger (Brown, 2001). It is also consistent with previous research showing that angry people tend to use heuristics to process information (Moons and Mackie, 2007). Similar to what happened for fear, in the non-gain message condition (and not in the other conditions) anger was directly related to a negative attitude toward reducing RPMC at T2.

Our research has several limitations. First, in the light of the existing gap between intentions to perform a certain behavior and its actual performance (Hagger and Chatzisarantis, 2014), the lack of a measurement of the actual behavior is the most important limitation of the present study. Second, our sample was restricted to Italian people, thus the data may not be generalized to other countries. Third, the measures used in our questionnaire lacked manipulation checks. Fourth, we cannot exclude the risk of self-selection bias, as participants were invited

for a study on public communication. Fifth, we did not adopt an open-science approach by pre-registering our hypotheses and analysis plan. Finally, participants were exposed only once to short messages on health outcomes, thus we were able to assess only small and short-term effects. Messages delivered over a longer time span and with repeated exposure (e.g., Caso and Carfora, 2017; Carfora et al., 2018) could yield larger and long-term effects on recipients' attitudes and intentions.

Future research should carefully retest our preliminary results on the mechanisms involved in processing messages on RPMC formulated with different frames, sending messages over a longer period of time. Moreover, future studies could verify whether gain-, non-loss-, non-gain-, and loss-framed messages systematically differ in the level of positive emotions they engender, and whether message-induced positive emotions are linked directly to persuasive outcomes. Future studies could also verify whether the cognitive and emotional processing of gain, non-loss, non-gain, and loss messages are the same when the presented outcomes are different from the ones presented here. We cannot exclude that there might be systematic differences among messages that propose the same behavior to obtain different outcomes. For example, the reduction of RPMC to avoid negative environmental consequences could be felt as too distant in time and thus non-loss frames could resonate as less convincing than was the case in the present study. Similarly, a close consideration of how health messages focused on different recommended behavior (e.g., sugary food and junk food consumption) which may align with one frame type over another would be useful. Future studies could also deepen our understanding of the effects of the four types of message frames considering their fit with individual characteristics, such as the utilitarian or hedonic approach toward food purchasing (Lombardi et al., 2017), or consumers' trust toward the health recommendation provided by public authorities (Carfora et al., 2019c; Cembalo et al., 2019).

CONCLUSION

To sum up, in the present study we validated a model explaining how messages differing according to the regulatory framework model (i.e., gain, non-loss, non-gain, and loss messages) influence receivers' evaluation of the messages, as well as attitude and intention toward red/processed meat consumption. Our results respond to the need for theoretical advancement in the area of the underlying mechanisms elicited by message framing (Rothman et al., 2020) and show the plausibility of a model including both the cognitive and emotional dimensions elicited by message exposure. Starting from the assumption that both cognitive and emotional mechanisms underlie the persuasiveness of a message, we showed that a model of persuasion that articulates how message-induced negative emotions may influence information processing and subsequent attitude and intention. In the case of gain and especially non-loss messages, systematic processing, supported by a moderate level of fear, strongly contributed to the persuasive effect of the messages. Instead, the effects of loss and non-gain messages were more determined by emotional reactions and less mediated by systematic processing, ending up with reduced persuasive power.

In conclusion, our study introduced and tested an inclusive reference model to explain the effects of message frames based on the presence/absence of positive/negative outcomes of expected behaviors and aimed at changing the attitudes and behaviors of the receivers. It will be up to future research to further investigate the possibility of applying this model to messages aimed at modifying attitudes and intentions other than the one investigated here, as well as verifying if and how the differences in the mechanisms studied here also depend on individual differences among receivers.

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 Department of Psychology—CoCatholic University of the Sacred Heart. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

VC proposed the research questions, planned the research design, and took responsibility for data collection and the manuscript. MP analyzed the data and supervised their interpretation. PC supervised conception, research design, and interpretation of data. She also thoroughly revised the manuscript in regard to content and style. All authors contributed to the article and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.583209/full#supplementary-material

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Personalized Nutrition Advice: Preferred Ways of Receiving Information Related to Psychological Characteristics

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The primary goal of this study is to be able to discern specific types of consumers in terms of their psychosocial characteristics who may need different ways of receiving dietary advice. Knowing these types will enable a better fit of advice to consumers' psychosocial characteristics, hereby stimulating healthy eating as the probability of compliance to the advice can potentially increase. The study draws upon several psychological theories to distinguish unique underlying factors that can subsequently be used to personalize nutrition information for consumers. A number of general psychological scales (self-regulation, action and coping self-efficacy, social comparison, intrinsic motivation, health info processing, need for cognition and for affect, and regulatory focus) are filled out by 988 respondents, including their preferences for receiving personalized forms of nutrition advice. The set of joint items from various psychological constructs is analyzed using a Principal Component Analysis to find underlying psychological characteristics. The PCA produces four components (explaining 51% of variation), that could be interpreted as 'intrinsic interest and capabilities for healthy eating,' 'perceived difficulty to eat healthily,' 'self-worth insecurity,' and 'seeking positive challenges,' respectively. By means of a Logistic Regression these components are able to predict preferences for different forms of receiving nutrition advice. This first component shows that a mind set for maintaining a healthy diet goes together with an interest in receiving an advice on what do to and on how that will affect one's health. The second component predicts a preference for a fixed moment to receive information/advice. This may be a strategy of those that perceive difficulties to eat healthily, to help them control their healthy food intake. The insecurity that the third component models seems to lead to a wish for receiving specific advice about their health situation at fixed moments in time. The fourth component is a small component, therefore its prediction of a wish for an advice focussing on prevention of negative consequences is probably not a strong result. The study does point out that there appear different psychosocial types of consumers, that may benefit by being addressed according to their preference for receiving nutrition advice on specific moments, of a specific level of detail or pointing at the type of consequences the advice has. A better

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fit of the advice to the psychosocial characteristics of the recipient, captured in the identified components in the current study, may lead to an increase in compliance, although that will have to be further investigated in subsequent work.

Keywords: health advice, nutrition advice, psychological scales, personalized nutrition and health advice, psychosocial characteristics

INTRODUCTION

Many people in the Western world currently have an unhealthy lifestyle, which in part is the result of consumers' diets which overall are relatively unhealthy. For instance because they consume too much meat, have a high (saturated) fat intake, and consume too little fruits and vegetables (Bray and Popkin, 1998; Pomerleau et al., 2005). Such unhealthy diets increase the odds of consumers getting various (chronic) diseases, such as diabetes or cardiovascular diseases (Wing et al., 2001). One type of approach to persuade consumers to eat more healthily is to provide consumers with nutrition information (e.g., Block and Peracchio, 2006; Glanz et al., 2012; Wendel et al., 2013). This nutrition information can be provided to consumers in a generic manner, where all consumers receive the same information (in terms of content and form), or in a more personalized manner. The concept of personalized nutrition in this study entails that nutrition information is provided to consumers taking into account some of their psychological characteristics. Consequently, content and/or form of the information can be personalized based on these characteristics. The aim is that this will make the provided nutrition information more personally relevant (e.g., Brug et al., 1999), in turn leading to a higher compliance. Perceiving more benefits than risks drives this higher compliance and ambivalent feelings and eating context can be barriers (Berezowska et al., 2015; Reinders et al., 2020). Overall, personalizing nutrition information has been shown to be more effective in affecting consumers' food choices than providing consumers with generic nutrition information (e.g., Brug et al., 2003; Elder et al., 2009; Livingstone et al., 2016; Celis-Morales et al., 2017), which also demonstrates the potential of personalized nutrition advice as a strategy to ultimately reduce the incidence of diseases and consequently health costs (Stewart-Knox et al., 2016).

Nutrition information can be personalized in different ways. A distinction can be made between a biological/medical basis on the one hand and a behavioral/psychological basis on the other hand (Ordovas et al., 2018). The majority of studies that have addressed effects of personalized nutrition on consumers' food choices have used a biological/medical basis to personalize nutrition information. Examples are a personalized nutrition approach based on blood parameters, anthropometrics and dietary habits (Zeevi et al., 2015), on epigenetics (vel Szic et al., 2015) or on nutrigenomics (Ronteltap et al., 2013; Berezowska et al., 2015).

Behavioral or psychological approaches to personalize nutrition information have been more scarce. Many behavior change techniques used in this field originate from psychological theories (Peters et al., 2015). Psychological characteristics of consumers can strongly affect consumers' behavior, such as the food choices they make (e.g., Mela, 2001; Gibson, 2006; Köster, 2009), although to our knowledge these psychological insights have not yet been applied to personalize nutrition information. Macready et al. (2018) developed a study protocol for a personalized nutrition approach based on multiple behavior change techniques, which included the Theory of Planned Behavior (Ajzen and Manstead, 2007), social cognitive theory (Bandura, 1989), and the Information-Motivation-Behavioral Skills Model (Fisher et al., 2002). However, identifying which behavior change techniques, based on psychological theories, are most relevant to include in a personalized nutrition intervention is challenging, as the practice of including these is currently still mostly exploratory (Macready et al., 2018).

While each theory will have its own merits, there is overlap between the psychological theories in the sense that they draw on either individual cognitions, capabilities and motivation, or on contextual and/or social variables (Davis et al., 2015). This overlap makes it difficult to pinpoint which factors can be distinguished, as also noted by Macready et al. (2018). The primary goal of this study is to draw upon several psychological theories in an attempt to distinguish unique underlying factors that can subsequently be used to personalize nutrition information for consumers, to ultimately stimulate healthy eating. A secondary goal is to explore the relation between the identified factors and consumers' preferences for receiving certain forms of dietary advice/information. In this way, we check to what extent the identified factors can provide a clearer and hopefully leaner psychological basis for personalizing nutrition information.

A meta-analysis of Noar et al. (2007) points at several behavior change techniques and psychological characteristics that can be effective for personalized approaches to promote healthy behavior in general (not specifically in relation to nutrition). Their overview, combined with the behavior change techniques and underlying psychological characteristics as used by Macready et al. (2018), provide our starting point to make a selection of psychological theories. Below we provide a short overview of the theories we draw upon, including a short elaboration on why they could be useful for personalizing nutrition information.

We stress that our approach is of an exploratory nature, and not hypothesis-driven. We include a set of scales based on them potentially capturing relevant psychological traits, not based on theoretical considerations about what traits may cause a specific type

of consumer to prefer specific types of food and health related information.

Psychological Theories as a Basis for Personalizing Nutrition Information

Personalized nutrition advice is a tool to help individuals regulate their dietary behaviors. In the current study, we take into account various psychological theories focused on individual differences, in terms of capabilities and dispositions that potentially affect preferences for dietary advice and whether the advice will be processed and in turn can affect compliance rates and dietary behaviors. Following an advice mainly involves conscious processes, like goal setting and self-monitoring (Rankin et al., 2017). Social Cognitive Theory (SCT; Bandura, 1977) gives insight into how individuals regulate their behavior to achieve goals that can be maintained over time. Bandura (1991) elaborates that an interaction between personal factors (self-reflective capabilities that give individuals some control over their thoughts, feelings, motivation and actions) and environmental matters (e.g., social influences, role models, behavioral standards) influences self-regulation skills and behavior. Therefore, we included *self-regulation*, *self-efficacy* (the extent to which one feels capable of performing a certain behavior) and *social comparison* in our study. Within the Health Action Process Approach model (HAPA; Schwarzer, 1992, 1999) *self-efficacy* is further subdivided into *action self-efficacy* and *coping self-efficacy*. *Action self-efficacy* refers to the capability to imagine success scenarios, anticipate potential outcomes of strategies and initiate new behaviors. *Coping self-efficacy* refers to the capability to deal with barriers that arise. Both *action self-efficacy* and *coping self-efficacy* are included in our study. Based on Self-Determination Theory, a motivational theory that gives insight into the reason behind self-regulation (SDT; Ryan and Deci, 2000), we also included *intrinsic motivation*. *Intrinsic motivation* is referred to when one is enjoying an activity in itself, without other reasons than performing the activity. Intrinsic motivation has been shown an important predictor of long term behavior change (Ryan and Deci, 2000; Orji et al., 2013).

Personalized advice can increase the effect of a message by achieving a fit between a person and a message. According to the Elaboration Likelihood Model (ELM; Petty and Cacioppo, 1986), information can be processed in two different ways, namely via the content of a message, i.e., based on its meaning (the central processing route) or via the appearance of a message (the peripheral processing route). The central route is used when individuals are motivated, capable and able to attentively take in information. When this is not the case, the peripheral route is used. When it comes to healthy diets, there are differences between individuals, in motivation, capability and ability (e.g., Dibsdall et al., 2003), which according to ELM leads to different information processing routes (Cacioppo et al., 1984; Trumbo and McComas, 2003). Therefore, we included *information processing* from ELM (central & peripheral information processing) in the current study.

Haddock et al. (2008) found that people differ in their general need to have information about matters (need for cognition) and in their need for affect, through praise and reinforcement. They found that a cognitive message is more persuasive among cognition-oriented individuals (i.e., individuals who have a high *need for cognition*), whereas an affective message is more persuasive among affect-oriented individuals (i.e., individuals who have a high *need for affect*). Similar effects were demonstrated by Mayer and Tormala (2010), who suggest that personalizing nutrition information based on peoples' *need for cognition* and *need for affect* can be effective in stimulating people to make more healthy food choices. Therefore, we included the constructs *need for affect* and *need for cognition* in our study.

Regulatory Focus Theory posits differences between people in motivational orientation, namely a *promotion* or *prevention focus* (Higgins, 1997). People with a *promotion focus*, focus on achieving positive outcomes and primarily think "How would I like to be?". People with a *prevention focus*, focus on preventing negative outcomes and primarily think "How should I be?". Research shows that framing information in terms of gains is more effective for people with a *promotion focus*, and using loss-frames is more effective for people with a *prevention focus* (Lee and Aaker, 2004). The majority of studies in the review by Ludolph and Schulz (2015) confirmed that regulatory fit enhances the effectiveness of health messages. Thus, we also included *regulatory focus* in our study.

In the current study the items from the above mentioned psychological constructs have been combined in one online survey (see **Table 1**; more details on the survey can be found in the "Materials and Methods" section).

TABLE 1 | Used constructs in the survey, their number of items and the answering scale (and number of answer categories) used (top part); binary questions about the preference for feedback (lower part).

Construct	Number of items	Answering scale (number of answer categories)
Self-regulation	5	Likert (7)
Action self-efficacy	7	Likert (7)
Coping self-efficacy	13	Not difficult – very difficult (7)
Social comparison	10	Likert (7)
Intrinsic motivation	6	Very untrue – true (7)
Health info processing	8 (4 + 4)	Likert (7)
Need for cognition	3	Likert (7)
Need for affect	6 (3 + 3)	Likert (7)
Regulatory focus	10 (5 + 5)	Likert (7)
Preference for feedback		
Focus of advice	1	Binary choice
Information activity	1	Binary* choice
Amount of information	1	Binary* choice

But see **Supplementary Appendix 3.*

MATERIALS AND METHODS

Sample and Procedure

An online survey was conducted in August 2018 under 1,013 respondents in the Netherlands. The survey was administered by a professional market research company (MSI-ACI Europe BV). The respondents were approached by email. As the data was gathered anonymously and only average scores were used in the analyses, no formal ethical approval needed to be officially obtained. At the start of the study participants were informed about the global goal of the study namely, to map individuals' choices and opinions about personalized nutrition advice. The participants were explained that they could refrain from filling out the survey at any moment and could quit without providing any reason for their withdrawal. To ensure a nationally representative sample, respondents were quota-sampled based on gender, age, highest level of completed education and income. Due to a lack of variation in their responses, 25 respondents were excluded[1], thus the final sample consisted of 988 respondents with a completely filled out survey. The final sample contained 486 males and 500 females (2 respondents did not fill out their gender) and a mean age of 46.2 years ranging from 18 to 75 years. These, and some more, demographics can be found in **Supplementary Appendix 1**.

The questionnaire started with a measurement of the psychological characteristics. Respondents then continued with several multiple choice questions which measured their stated preferences for receiving certain forms of personalized nutrition and health advice or information. Finally, the demographics were assessed.

Measures

Validated scales were used to measure the various constructs. When necessary, the items were translated to Dutch using back-translation and reversed items were framed positively, because reversed items have shown to be able to lead to measurement problems like unduly complex factor structures (cf. Weijters and Baumgartner, 2012).

Self-regulation with regard to healthy eating was measured using a 5-item scale developed and validated by Kliemann et al. (2016). The items were answered on seven-point Likert scales ranging from 1 (strongly disagree) to 7 (strongly agree). *Action self-efficacy with regard to healthy eating* was measured with 7 items (based on Wilson-Barlow et al., 2014). The items were also answered using seven-point Likert scales ranging from 1 (strongly disagree) to 7 (strongly agree). *Coping self-efficacy with regard to healthy eating* was measured with 13 items from the Eating Self-Efficacy Scale (ESES), based on Glynn and Ruderman (1986). These items were answered on seven-point scales ranging from 1 (not difficult at all) to 7 (very difficult). *Social comparison* was measured with a 10-item questionnaire from Gibbons and Buunk (1999). The items were answered on seven-point Likert scales ranging from 1 (strongly disagree) to 7 (strongly agree). *Intrinsic motivation to eat healthily* was measured with 6 items that assessed self-reports of interest and enjoyment of healthy eating (Ryan and Deci, 2000), items were answered on seven-point scales ranging from 1 (very untrue) to 7 (very true). *Healthy information processing* was measured with 8 items −4 items measured central processing and 4 items measured peripheral processing– based on Trumbo and McComas (2003). *Need for cognition* was measured with 3 items based on Cacioppo et al. (1984). *Need for affect* was measured with 3 items that assessed approaching emotions and 3 items that assessed avoiding emotions based on Appel et al. (2012). *Regulatory focus* was measured with 5 items assessing prevention focus and 5 items assessing promotion focus based on Haws et al. (2010). Items for information processing, need for cognition, need for affect and regulatory focus were all measured with seven-point Likert scales ranging from 1 (strongly disagree) to 7 (strongly agree). An overview of the items in the survey is presented in **Table 1**.

All constructs and their items, means, standard deviations and Cronbach's alphas are shown in **Supplementary Appendix 2**. The Cronbach's alpha's are all rather high, ranging from 0.71 to 0.95, indicating that our sample answered like expected with respect to the psychological scales, which were designed to show only one underlying concept.

Three questions were asked concerning the preferred way that respondents would like to receive health advice or feedback about their health status (bottom part of **Table 1**). The following concepts were probed by these questions about receiving personalized feedback on respondents' health status or receiving personalized health advice (for the verbatim items, see **Supplementary Appendix 3**):

- Focus of advice: preference for information on either how to obtain positive results, or on how to prevent negative consequences.
- Information activity: preference for looking for advice when the respondent itself wishes it, or to always receive advice on the same fixed moment.
- Amount of information: preference for short, to-the-point information or for detailed information that includes explanations about why the advice is good for the respondent.

For all three items answer categories with low frequencies (below 10%) were deleted from the analyses (see also **Supplementary Appendix 3**). The 2nd and 3rd answer category from the 'amount of information' item were merged. The reason is the fact that the detailed information mentioned in the 2nd category may for many respondents have included what is specifically named in the 3rd. These questions were measured with a single-item, also to keep the survey relatively concise; in many cases, single-item measures perform equally well as multiple-item measures of the same construct (Bergkvist and Rossiter, 2007).

[1]These 25 respondents had 0 standard deviation in their responses to items measuring regulatory focus (prevention focus vs. promotion focus) and/or need for affect (approach vs. avoidance of affect), in combination with scoring only '1,' '2,' '6,' or '7' in all these responses. Given that these two constructs contain opposite items (e.g., A '7' in one item indicates a high prevention focus, while a '7' in a next item indicates a high promotion focus), these 25 respondents were excluded.

Analysis of Data

Principal Component Analysis

A Principal Component Analysis (PCA) was conducted on the 68 items in the survey (using SPSS v.23), which resulted in a four dimensional solution on which a Varimax rotation was performed. The scores for this four dimensional model are used to predict reported preferences for three different forms in which dietary health information can be provided to people. These predictions have been carried out separately by means of three logistic regression analyses (using SPSS v.23). The reason to carry out three separate logistic regressions, rather than combining these into one model in order to include interactions between dependent variables is rather practical. One of the aims of this study was to explore the possibility to use the psychological profiles obtained to provide tailored dietary advice in a specialized computer program (ultimately in a smartphone-app). The three dependent variables are linked to matters that could be separately implemented in such an app. Furthermore, in hindsight, the correlations between the three variables turned out to be very low (**Supplementary Material**).

RESULTS

Principal Component Analysis

The amount of variance in the four component (correlation) PCA model is 51% and the choice for this four component model is not based on a formal criterion like the eigenvalue > 1 criterion (in a full dimensional PCA, without *post hoc* rotation, this would have yielded a 12 component model with the component 5 through 12 together containing 12% variance). Visual inspection of the scree graph (see **Supplementary Material**) suggested a four component model, although the fourth component contains a mere 8% of variation. All four components showed an interpretable set of loading items (see **Table 2**), although the fourth component should be interpreted with caution due to its low amount of explained variance. Loadings with an absolute value < 0.3 are not used to interpret the components nor are they shown in **Table 2**.

The first component (18% VAF) shows items that concern an intrinsic interest in healthy eating, combined with the will (and capability) to maintain a healthy diet. The first component (18% VAF), coined '*intrinsic interest and capabilities for healthy eating,*' combines six items from the scale 'intrinsic motivation for healthy eating,' seven items from 'action self-efficacy concerning healthy eating,' eight items from 'information processing concerning healthy eating,' and five items from 'self-regulation concerning healthy eating.' These items have loadings over 0.44 on this component.

The second component (13% VAF) contains all items regarding 'coping self-efficacy' (Schwarzer and Renner, 2000). These items all concern a difficulty in maintaining a healthy diet, under a broad range of circumstances, which includes a variety of eating occasions and emotional occurrences. These items can therefore be viewed as (a general lack of) coping self-efficacy to eat healthily. We label this second component "*perceived difficulty to eat healthily*."

The third component (12% VAF) shows a general attitude which we interpret as a form of '*self-worth insecurity*.' It contains the ten items from the 'social comparison' scale, three 'emotion avoidance' items from the 'need for affect' scale and one 'prevention focus'-item from the 'regulatory focus' scale. Most items loading on this component (loadings over 0.47) point to a social comparison orientation and an avoidance to experience emotions.

The fourth component contains a mere 8% of variance and contains the three items from the 'need for cognition' scale, the three 'approach emotions'-items from the 'need for affect' scale, five 'promotion focus'-items and one 'prevention focus'-item from the 'regulatory focus' scale. These items have loadings over 0.43 on this component. Thus, the items in this component appear related to seek cognitive challenges, seek positive results and seek the experience of emotions. We interpret and label this component as "*seeking positive challenges*." Three other 'prevention focus'-items also loaded on this component, however, we decided not to take this into consideration because they either had low loadings (below 0.38) or a similar (low) loading on more than one component.

In summary, we have thus reified the four components as follows:

(1) Intrinsic interest and capabilities for healthy eating,
(2) Perceived difficulty to eat healthily,
(3) Self-worth insecurity,
(4) Seeking positive challenges.

Relation Between the Components and Personalized Health Feedback Preferences

The three separate logistic regressions show that some of the four principal components predict some of the three dependent variables. The results of the three logistic regressions are given in **Table 3**. Significant ($p < 0.05$) results are indicated by italicizing the corresponding lines in the table.

Figure 1 presents an overview of the findings, the extent to which the four components can predict the stated preferences for receiving advice/information.

The logistic regression predicting *Focus of advice* (a preference to receiving advice pointing at ways to prevent negative consequences) shows a significant effect ($p = 0.02$) only for the 4th component ('*seeking positive challenges*'), with an odd ratio of 0.80. An increase of the score on the 4th component results in a lowering of the probability of preferring to receive advice when it shows how to prevent negative consequences.

Information activity (a preference to receiving information on fixed moments) shows to be predicted by both the 2nd component (*perceived difficulty to eat healthily*, $p = 0.04$) and the 3rd component (*self-worth insecurity*, $p = 0.00$). A higher score on the 2nd component results in a heightened (odd ratio 1.18) probability for a preference for receiving information on a fixed moment, analogously does a higher score on component 3 with an odd ratio of 1.35.

The third logistic regression shows that *amount of information* (a preference to receiving detailed information pointing out what

TABLE 2 | Loadings of items on the four components.

Item from the survey	Component			
	1	2	3	4
Action self-efficacy with regard to healthy eating – I am able to eat a variety of healthy foods to keep my diet balanced.	0.749			
Healthy information processing (central) – When the topic of healthy eating comes up, I always try to learn more about it.	0.734			
Intrinsic motivation to eat healthily – I (want to) eat healthily. . .: because I like being involved with healthy eating.	0.731			
Action self-efficacy with regard to healthy eating – I am able to choose recipes based on nutritional value.	0.731			
Intrinsic motivation to eat healthily – I (want to) eat healthily. . .: because I enjoy eating healthy.	0.730			
Intrinsic motivation to eat healthily – I (want to) eat healthily. . .: because I thought about it a lot and I believe it is important for many aspects of my life.	0.721			
Self-regulation with regard to healthy eating – I follow my eating intentions.	0.715			
Action self-efficacy with regard to healthy eating – I am able to modify recipes to make them healthier.	0.710			
Action self-efficacy with regard to healthy eating – Based on my knowledge of nutrition, I am able to choose healthy foods at restaurants and from stores.	0.690			
Self-regulation with regard to healthy eating – I do not get distracted from my eating intentions.	0.672	−0.322		
Intrinsic motivation to eat healthily – I (want to) eat healthily.: because I want to take responsibility for my own health.	0.670			
Self-regulation with regard to healthy eating – If I am not eating in the way I intend to, I make changes.	0.670			
Intrinsic motivation to eat healthily – I (want to) eat healthily. . .: because I am interested in finding new ways to eat healthy.	0.663			
Action self-efficacy with regard to healthy eating – When I feel hungry, I am able to easily choose healthy food over less healthy options.	0.656			
Healthy information processing (central) – Healthy eating is an important issue, and it has been important to me to decide on how I feel about it.	0.651			
Intrinsic motivation to eat healthily – I (want to) eat healthily. . .: because it is important to me to be as healthy as possible.	0.650			
Healthy information processing (peripheral) – The information I have at this time meets all of my needs for knowing about how to eat healthy.	0.635			
Healthy information processing (central) – In order to be completely informed about the issue of healthy eating, I feel that the more viewpoints I can get, the better off I will be.	0.635			
Healthy information processing (peripheral) - I feel quite capable of finding and using the information that I need in order to decide how to eat healthy.	0.632			
Healthy information processing (peripheral) – I have been able to make a decision about how concerned I am about not eating healthy by using my existing knowledge.	0.620			
Healthy information processing (central) – I have made a strong effort to carefully examine the scientific information presented on the question of healthy eating.	0.602		0.303	
Action self-efficacy with regard to healthy eating – I am able to consume fruits and vegetables in most of my meals.	0.587			
Action self-efficacy with regard to healthy eating – If I choose to indulge in unhealthy food, I am able to appropriately compensate later.	0.554			
Self-regulation with regard to healthy eating – I'm good at resisting tempting food.	0.507	−0.425		
Healthy information processing (peripheral) – On the issue of healthy eating, I am willing to put my trust in the experts.	0.449			
Self-regulation with regard to healthy eating – I find it easy to remember what I have eaten throughout the day.	0.438			
Coping self-efficacy with regard to healthy eating – It is difficult to keep a healthy diet: when I feel restless.		0.847		
Coping self-efficacy with regard to healthy eating – It is difficult to keep a healthy diet: when I feel upset.		0.836		
Coping self-efficacy with regard to healthy eating – It is difficult to keep a healthy diet: when I feel frustrated.		0.830		
Coping self-efficacy with regard to healthy eating – It is difficult to keep a healthy diet: when I am irritable.		0.827		
Coping self-efficacy with regard to healthy eating – It is difficult to keep a healthy diet: when I am tense.		0.826		
Coping self-efficacy with regard to healthy eating – It is difficult to keep a healthy diet: when I am depressed.		0.826		
Coping self-efficacy with regard to healthy eating – It is difficult to keep a healthy diet: when I am angry.		0.795		
Coping self-efficacy with regard to healthy eating – It is difficult to keep a healthy diet: when tempting food is in front of me.		0.722		
Coping self-efficacy with regard to healthy eating – It is difficult to keep a healthy diet: when I am hungry.		0.692		
Coping self-efficacy with regard to healthy eating – It is difficult to keep a healthy diet: when I am with friends.		0.661		

(Continued)

TABLE 2 | Continued

Item from the survey	Component			
	1	2	3	4
Coping self-efficacy with regard to healthy eating – It is difficult to keep a healthy diet: during a social occasion dealing with food, like a restaurant or dinner party.		0.627		
Coping self-efficacy with regard to healthy eating – It is difficult to keep a healthy diet: around holiday time.		0.609		
Coping self-efficacy with regard to healthy eating – It is difficult to keep a healthy diet: when I want to enjoy my food.		0.591		
Social comparison – I am the type of person who often compares myself with others.			0.815	
Social comparison – If I want to find out how well I have done something, I compare what I have done with how others have done.			0.801	
Social comparison – I often compare myself with others with respect to what I have accomplished in life.			0.791	
Social comparison – I consider my situation in life relative to that of other people.			0.790	
Social comparison – I often compare how I am doing socially (e.g., social skills and popularity) with other people.			0.786	
Social comparison – I pay a lot of attention to how I do things compared with how others do things.			0.779	
Social comparison – I always like to know what others in a similar situation would do.			0.738	
Social comparison – I often try to find out what others think who face similar problems as I face.			0.686	
Social comparison – If I want to learn more about something, I try to find out what others think about it.			0.651	0.317
Regulatory focus (prevention) – I worry about making mistakes.			0.570	
Need for affect (avoid) – I do not know how to handle my emotions, so I avoid them.			0.562	
Need for affect (avoid) – If I reflect on my past, I see that I tend to be afraid of feeling emotions.			0.526	
Need for affect (avoid) – I find strong emotions overwhelming and therefore try to avoid them.			0.495	
Social comparison – I often like to talk with others about mutual opinions and experiences.			0.467	0.424
Regulatory focus (promotion) – In general I am focussed on reaching positive outcomes.				0.639
Need for cognition – I really enjoy a task that involves coming up with new solutions to problems.				0.623
Need for cognition – I like to have the responsibility of handling a situation that requires a lot of thinking.				0.606
Regulatory focus (promotion) – When I see an opportunity for something I like, I get excited right away.				0.575
Regulatory focus (promotion) – I frequently imagine how I will achieve my hopes and aspirations.			0.314	0.542
Regulatory focus (promotion) – I feel like I have made progress toward being successful in my life.	0.321			0.527
Need for affect (approach) – Emotions help people to get along in life.				0.526
Regulatory focus (promotion) – When it comes to achieving things that are important to me, I find that I perform as well as I would ideally like to.	0.324			0.522
Regulatory focus (prevention) – In general I am focussed on preventing negative outcomes.				0.487
Need for affect (approach) – It is important for me to be in touch with my feelings.				0.462
Need for cognition – I would prefer complex to simple problems.				0.456
Need for affect (approach) – I think that it is important to explore my feelings.				0.430
Regulatory focus (prevention) – I frequently think about how I can prevent failures in my life.			0.325	0.426
Regulatory focus (prevention) – In general I obey rules and regulations.				0.376
Regulatory focus (prevention) – Being careful has prevented me from getting into trouble at times.				0.300

Only loadings with an absolute value I 0.3 are shown.

to do and how this affects one's health) can be predicted by the 1st ($p = 0.01$) and 3rd ($p = 0.00$) component ('*intrinsic interest and capabilities for healthy eating*' and '*self-worth insecurity*,' resp.). A higher score on component 1 results in a 1.22 times higher probability of preferring detailed information, a higher score on component 3 in a 1.38 times higher probability of preferring detailed information.

DISCUSSION

Personalizing nutrition information can be an effective manner to increase compliance and lead to consumers making more healthy food choices (e.g., Brug et al., 2003; Elder et al., 2009). However, previous studies have mostly used a biological/medical basis to personalize nutrition information. In the current study, we extend previous work that shows a relation between psychological characteristics and both dietary choices (e.g., Mayer and Tormala, 2010; Ludolph and Schulz, 2015; Macready et al., 2018) and compliance with personalized advice (Berezowska et al., 2015; Livingstone et al., 2016; Celis-Morales et al., 2017; Rankin et al., 2017; Reinders et al., 2020) and aim to develop a psychological approach to personalize nutrition information based on an elaborate questionnaire (Macready et al., 2018). Furthermore, the current study also explores the relation between the (psychological) components and respondent preferences for certain forms in which dietary information can be provided. The latter provides an indication of the degree to which this psychological approach to personalize nutrition information can be a basis to predict respondent preferences for how respondents

TABLE 3 | Results of the three logistic regressions, Lines holding significant predictions ($p < 0.05$) italicized [in the table: regression weight b, their standard errors (s.e.), Wald statistics, significance values, odd ratios and the lower and upper borders of the 95% confidence interval for the odd ratios, respectively].

Focus of advice [$\chi^2(4) = 12.7$, $p = 0.013$]	***b***	***s.e.***	**Wald**	**Sig.**	**Odd ratio**	**95% c.i. for odd ratio**	
						Lower	**Upper**
Component 1	−0.139	0.094	2.156	0.142	0.870	0.723	1.048
Component 2	−0.140	0.096	2.131	0.144	0.869	0.720	1.049
Component 3	0.170	0.098	3.014	0.083	1.185	0.978	1.436
Component 4	*−0.223*	*0.096*	*5.408*	*0.020*	*0.800*	*0.663*	*0.966*
Constant	−1.94	0.098	391.357	0.000	0.144		
Information activity [$\chi^2(4) = 18.9$, $p = 0.001$]							
Component 1	0.017	0.080	0.045	0.832	1.017	0.869	1.191
Component 2	*0.164*	*0.081*	*4.111*	*0.043*	*1.178*	*1.005*	*1.380*
Component 3	*0.302*	*0.080*	*14.240*	*0.000*	*1.353*	*1.156*	*1.582*
Component 4	0.032	0.080	0.164	0.685	1.033	0.883	1.209
Constant	−1.07	0.078	186.478	0.000	0.342		
Amount of information [$\chi^2(4) = 32.7$, $p < 0.000$]							
Component 1	*0.196*	*0.069*	*8.070*	*0.005*	*1.217*	*1.063*	*1.394*
Component 2	0.102	0.068	2.233	0.135	1.107	0.969	1.266
Component 3	*0.323*	*0.069*	*22.027*	*0.000*	*1.381*	*1.207*	*1.581*
Component 4	−0.014	0.068	0.040	0.841	0.986	0.863	1.128
Constant	0.064	0.068	0.889	0.346	1.066		

In parentheses below the dependent variables name the model χ^2 its d.f.'s and significance value p.

would like to receive nutrition information (e.g., in detailed form or not). Ultimately the findings can be used for the development of smartphone apps by which consumers can choose to receive dietary advice in a manner befitting their psychological profile.

Principal Components

In the current study, we conducted a PCA which delivered four components: *intrinsic interest and capabilities for healthy eating*, *perceived difficulty to eat healthily*, *self-worth insecurity* and *seeking positive challenges*.

The first component ('intrinsic interest and capabilities for healthy eating') combines all the items from the action self-efficacy, self-regulation, intrinsic motivation and information processing scales. That the four scales jointly load on the first component in this study, hence correlate, can mean that they measure the same underlying construct in the context of food and healthy eating. Scores on this component increase as respondents have a higher intrinsic motivation and a higher involvement in eating healthily (this is the central route in the ELM of Cacioppo et al., 1984), a higher action self-efficacy and a higher self-regulation. We interpret this as the higher people score on this component, the more they show a combination of an intrinsic interest and having the capabilities to eat healthily. Intrinsic motivation and a high involvement in a certain issue pertain to an intrinsic interest, in this case for healthy eating. Action self-efficacy and self-regulation pertain to having the capability to eat healthily, according to respondents' own perception. Self-efficacy has also been seen as a motivational aspect of self-regulation (Dinsmore et al., 2008), which theoretically connects action self-efficacy to both self-regulation and intrinsic motivation.

Motivation and capability are often treated as separate concepts in behavioral theories (e.g., Social Cognitive Theory, Bandura, 1977; Health Action Process Approach model, Schwarzer, 1992, 1999; Theory of Planned Behaviour Ajzen and Manstead, 2007). However, the two concepts are important in the sense that behavioral models such as the Motivation, Opportunity, Ability (MOA) model (Ölander and Thøgersen, 1995) state, that behavior change is more likely when an individual is both motivated and capable to change one's behavior.

Based on this first PCA-component, it can be suggested that the motivational aspect of self-regulation, is indeed tied to respondents' level of self-efficacy to change their diet. Self-regulation also has a more cognitive part, which in this component is reflected in the form of information processing. Previous work has linked information processing with self-regulation, specifically with regard to self-regulated learning (e.g., Winne, 2001). This can be interpreted for the current study, as respondents aiming to learn how to eat more healthily in a self-regulated manner, and processing the necessary information in order to do so.

Items referring to difficulties with following a healthy diet load together on the second component ('perceived difficulty to eat healthily'). These items all stem from the same self-efficacy scale (Glynn and Ruderman, 1986). That they score uniquely on this component, and apparently do not clearly correlate with any other items in this survey shows that they act as a single force in the whole of the survey in this study. There thus seems to be a general trend which is strong enough to surface in our sample of 988 respondents. This is not in line with the original scale (Glynn and Ruderman, 1986), which comprises of two components, namely difficulty eating healthily when experiencing negative affect (NA) and difficulty eating healthily during socially acceptable circumstances (SAC). In the specific

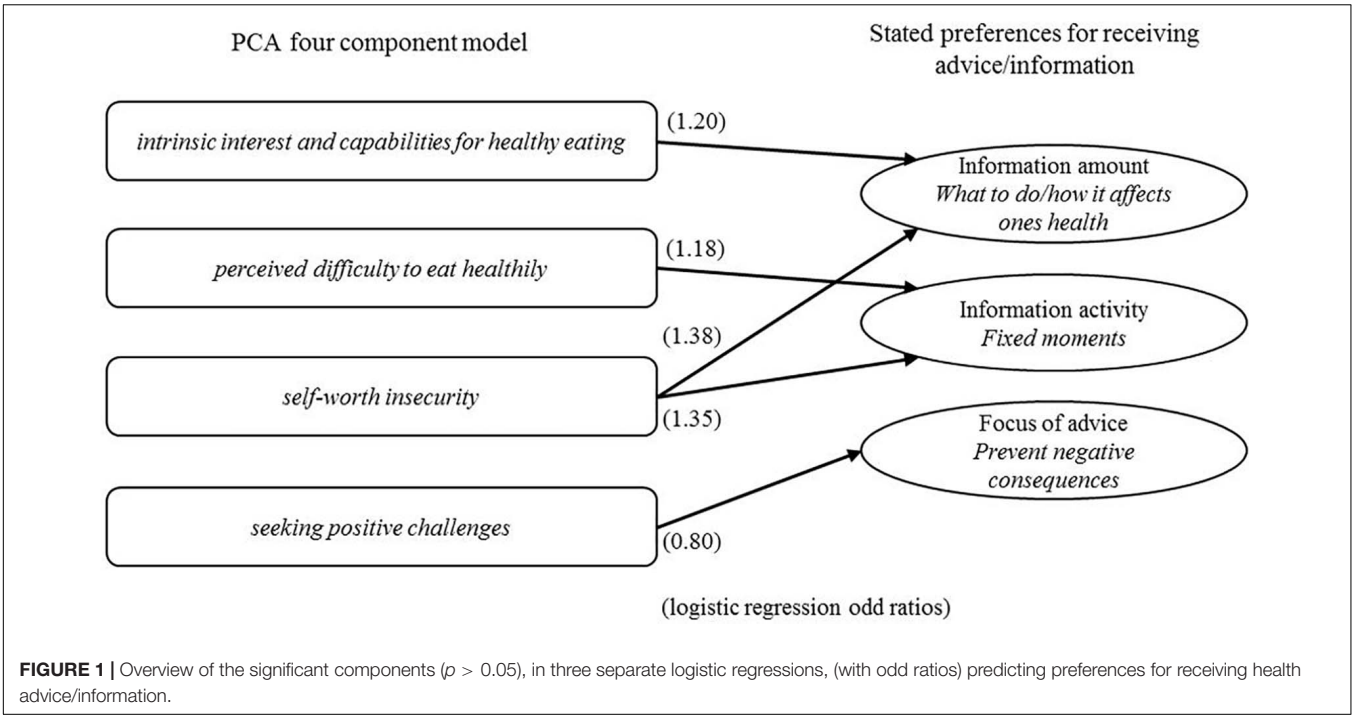

FIGURE 1 | Overview of the significant components ($p > 0.05$), in three separate logistic regressions, (with odd ratios) predicting preferences for receiving health advice/information.

food and health context of this survey these two components may not have been distinguished by the respondents, in the sense that difficulty to eat healthily in terms of NA and SAC appears to be connected to each other. This may indicate that the component structure can depend on the specific context of this survey.

The fact that the first and second component are built from domain-specific items explicitly concerning food and/or health is noteworthy. This may point at a methodological artifact where items that are comparably stated, or are on similar matters, are scored alike. The reason that the first and second component are separate components, can be explained by the fact that the components have a different focus (Bandura, 1977). Items in the second component focus on the *difficulty* to perform healthy dietary behaviors, whereas the items in the first component focus on *positive motivations and capabilities* with regard to eating healthily. And as mentioned before, reversed items often result in a separate component (Weijters and Baumgartner, 2012).

Most items loading on the third component ('self-worth insecurity') point to psychosocial characteristics of a type of individual that compares his/her behavior to others in order to judge his/her own behavior, and at an avoidance to experience emotions. One reason why people might structurally compare themselves to others is that they are insecure about themselves (Maslow et al., 1945; White et al., 2006) and have a lower self-worth (Crocker and Wolfe, 2001). Similarly, people attempt to avoid emotions when emotional lows are expected that affect one's self-worth (Crocker and Knight, 2005), thus avoiding emotions can be tied to maintaining one's self-worth.

The fourth component ('seeking positive challenges') combines items from the 'need for cognition' scale, the 'approach emotions'-items from the 'need for affect' scale, and 'promotion focus'-items and 'prevention focus'-item from the 'regulatory focus' scale. The latter two sets of items are not easy to reconcile as this component seems to combine a promotion focus with a prevention focus, which are traits believed to be not in line with each other. We must again stress that the fourth component represents a rather low amount of variance in the data, so it is does not represent a very strong force to explain this result. Nevertheless it appeared interpretable as 'seeking positive challenges', and we have included it in the prediction models.

We observe that the first two components are food related components. Component 3 and 4 are related to general psychosocial characteristics, which are not specifically related to food. This suggests that, in these results, answers to the food related items are unrelated to answers to general items, as the four components are uncorrelated (the varimax rotation maintains orthogonality of the PCA components).

Prediction of Feedback Preferences

This first component ('intrinsic interest and capabilities for healthy eating') shows up as predictor of the 'information amount' in the logistic regression. A mind set for maintaining a healthy diet seems to go together with an interest in receiving an advice/information on what do to, together with information on how the advice will affect one's health, compared to only receiving an advice. So individuals who have intrinsic interest and capabilities to eat healthily prefer extra information on why an advice is good for their health in addition to receiving dietary advice.

The second component ('perceived difficulty to eat healthily'), tallies with it predicting a preference for a fixed moment to receive information/advice. This may be a strategy of those that perceive a difficulty in themselves, to help them control their

healthy food intake. They may see themselves unable to cope with a freedom to find information on their own account, hence making it more likely that a form of advice is chosen that is received on a fixed moment.

Component 3 ('self-worth insecurity'), together with the first component, predicts a preference to receiving information/advice together with instructions about what to do and how it relates to one's health. Component 3, together with the second component, also predicts a preference for a fixed moment to receive information/advice. The insecurity of the individuals scoring high on this component seems to lead to a wish for specific information/advice about their health situation at fixed moments in time. The social comparison part of the third component, seems to be in line with wanting to receive specific information and instruction with the advice, as the advice comes from others, which enables a social comparison.

The fourth component negatively predicts the preference for advice with a focus on preventing negative consequences. As this component models 'seeking positive challenges', this seems to make sense, with the proviso that the merger of both a prevention and a promotion focus appears strange. Note that this component contains a mere 8% variance in the data, so this component's size is not very large, which may lead to the possibility that it combines small effects, despite their being theoretically not compatible.

That four scales, adapted to focus on food and health, together make up the first component suggests that these four underlying constructs merge when seen in the context of food and health. Intrinsic motivation, self-efficacy, information processing and self-regulation appear to correlate highly when seen in the context of food and health. This points at the possibility to reduce the set of items in future surveys designed to probe relevant psychological parameters of a sample of respondents, in a food and health context.

Study Limitations

One potential limitation of the study is that for the 'preference for feedback' constructs single-item measures were used. However, in many cases single-item measures perform just as well as multiple-item measures (Bergkvist and Rossiter, 2007). Since the psychological constructs are relatively complex, we decided to use validated, multiple-item scales for those constructs, but to use single-item measures for the more simple choice constructs. Also keeping in mind the need to keep the survey relatively concise. Future research could test whether the findings of the current study are similar when also using multiple-item measures for the choice constructs.

Furthermore, though we aimed to keep the survey concise, potentially part of the respondents could have experienced a sense of respondent fatigue. Typically, an average maximum length of 20 min is recommended for a survey before respondent fatigue becomes an issue (Cape and Phillips, 2015; Revilla and Ochoa, 2017). This was taken into account when designing the survey, also by limiting the number of items. It was also agreed with the market research company before the survey was sent out to double-check the survey would take no longer than 20 min to complete.

For the current study, an online survey was administered relying on self-reports from participants. This can have certain disadvantages as is discussed by McDonald (2008), such as for instance participants responding in manners through which they can view themselves as favorable. To account for these potential drawbacks of self-reports, follow-up research can include actual behavioral measures with actual consequences, such as performing a study where the outcome variable is not a self-reported choice, but actually choosing a certain format of nutrition advice that participants subsequently receive.

CONCLUSION

This study shows that it is possible to use psychological characteristics to predict the way consumers would like to receive advice/information about their health status (and diet). It also points out that there are different personalities of consumers, that may benefit from being addressed according to their preference for receiving advice/information on specific moments, of a specific level of detail and pointing at the type of consequences the advice has. When developing a computer program (typically a smartphone app) it is advisable to tailor the way health advice is provided to the type of consumer. The latter can be assessed by, e.g., asking the user of the app some questions upon installation of the app. The long survey in this study is not suited for this, but the PCA points at a way to reduce the length to a low number of questions.

Compliance to an advice was not addressed in this study, obviously that is the ultimate 'proof of the pudding' that needs to be further investigated, possibly with the survey presented here as an instrument for tailoring advice. Based on the four component PCA model a reduction of items can be achieved, to in a more concise manner personalize nutrition advice. Of course this basically means the construction of a new psychological scale, specifically focused at 'food and health'-related psychological characteristics. Such a scale will need to be studied and analyzed in detail before it can validly be applied in subsequent studies in this field.

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

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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SUPPLEMENTARY MATERIAL

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