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Global challenges, local impacts: Rethinking governance, sustainability, and consumption in light of climate change

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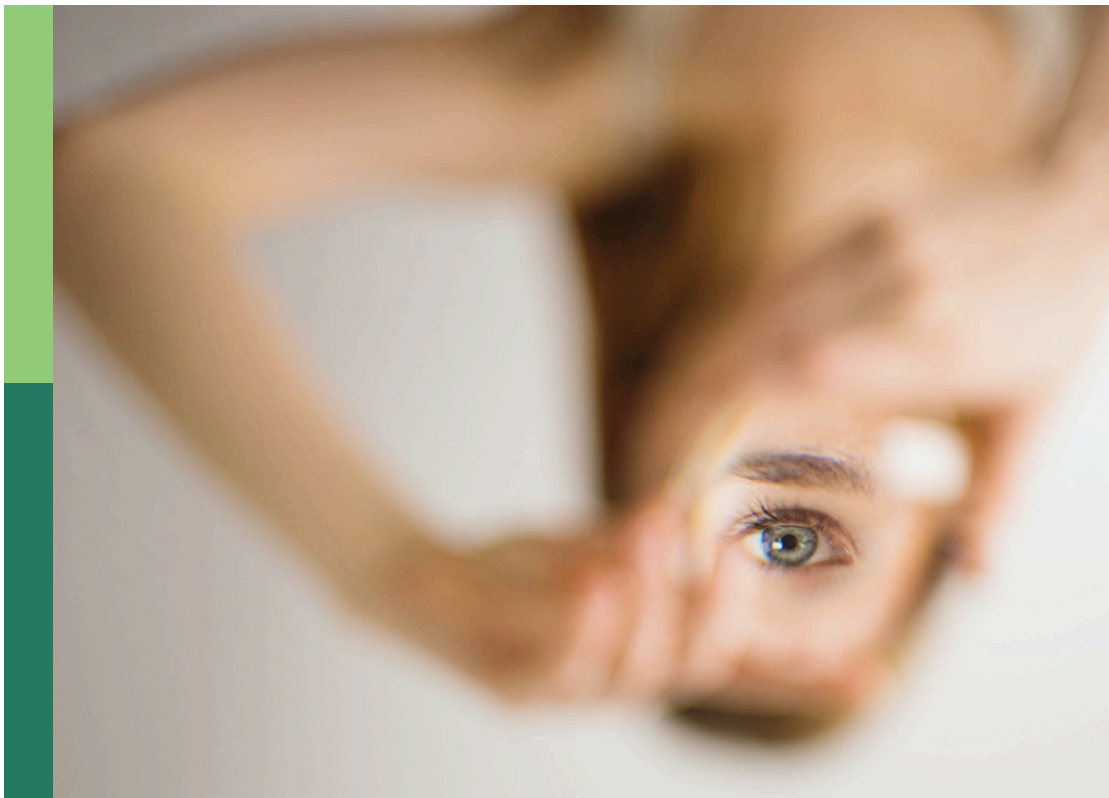

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Global challenges, local impacts: Rethinking governance, sustainability, and consumption in light of climate change

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Non-green influencers promoting sustainable consumption: Dynamic norms enhance the credibility of authentic pro-environmental posts

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Social media influencers can raise awareness for sustainability, and establish norms related to a more sustainable lifestyle. Although non-green influencers can reach a wider audience, they might face credibility issues when communicating about sustainable consumption. In the present 2×2 online mixed method experiment ($N = 386$), we explored the effect of two credibility-enhancing strategies (authenticity vs. referring to experts) and the presence (vs. lack of) of dynamic norms (information about how other people's behavior is changing over time) on the perceived credibility of the post. Results indicated that referring to expert opinion enhanced perceived post credibility. However, if an authentic message was combined with dynamic norms, it reduced the frequency of mentions of the lack of credibility. Both credibility measures were positively associated with the persuasiveness of the message. These findings can contribute to the growing literature of credibility-enhancing strategies and dynamic norms. The study also provides practical suggestions for non-green influencers on effective communication of sustainable consumption.

KEYWORDS

authenticity, credibility, dynamic norm, expert opinion, social media influencer, sustainable consumption

1. Introduction

1.1. Sustainability messages from green and non-green influencers

Social media can be used to raise awareness for and rapidly disseminate information about sustainability to younger people who are less approachable *via* traditional media (Johnstone and Lindh, 2018; Chan et al., 2020). The role of social media influencers—content providers with considerable follower base, perceived as opinion leaders (Uzunoglu and Misci Kip, 2014; Evans et al., 2017)—in promoting sustainable lifestyle and eco-consciousness constitutes an emerging research area in the field of sustainability communication. Previous research was mainly concerned about green influencers or promoting sustainable products and services. For instance, Pittman and Abell (2021) found that green influencers with less followers are more persuasive in promoting sustainable products. Kapoor et al. (2022) examined how argument quality affected the persuasiveness of eco-friendly hotel recommendations and found that attribute-based messages that provided objective and rational information were more persuasive than simple recommendations.

Some social media influencers are experts in specific areas like beauty, fitness, or sustainability, while others produce entertaining content or document their everyday life such as lifestyle influencers (Lou and Yuan, 2019; Campbell and Farrell, 2020). Besides green influencers whose profile and activities are centered around sustainability; non-green influencers can also encourage sustainable consumption. They can reach a larger, less eco-conscious audience. Moreover, as their lifestyle is usually not perfectly green, they do not generate reactance in their audience by pointing out the difference between the users' ideal and actual sustainable selves (Jin et al., 2019). On the other hand, posts about sustainability from a non-green influencer can raise concerns regarding credibility as they are not perceived as experts in the field, nor do they showcase a sustainable lifestyle that could make them trustworthy and authentic sources about sustainability. Moreover, when people's expectations are not met (i.e., when a non-green influencer posts about sustainability), it is likely that information processing will be more complicated that can consequently lower the credibility of the message (Marsh and Yang, 2021). Thus, we aimed to investigate how non-green influencers can communicate sustainable messages such as the reduction of single-use plastic in an effective and credible way by manipulating two variables: the type of credibility-enhancing strategy used in the social media post and the presence of dynamic norms.

1.2. Expert opinion argument

Expertise is one of the core components of the communicator's credibility that affects the persuasiveness of a message in a way that higher perceived expertise is associated with higher perceived source credibility, which in turn leads to greater acceptance of the persuasive message (Ohanian, 1990). Moreover, when the source is an expert, it may motivate recipients to take the message more seriously (Kruglanski et al., 2005). Experts can "confer authority" on other sources (Kruglanski et al., 2005). Indeed, the use of expert opinion consists of citing someone's opinion who is an authority (expert) in the field, similarly to the use of literature references in research papers (Hoeken and Hustinx, 2003). Previous findings indicated that expert opinion is as persuasive as statistical and causal evidence, and more persuasive than anecdotal evidence (Hoeken and Hustinx, 2003). Consequently, we hypothesized that including an expert's opinion in a social media post can positively affect the credibility of the message as it triggers the authority heuristic ("expert statements can be trusted") (Sundar, 2008). Message credibility is defined as the perceived veracity of the content and focuses on how the content of the communication is perceived (Appelman and Sundar, 2016).

1.3. The role of authenticity

Social media influencers are usually considered authentic and trustworthy sources (Djafarova and Rushworth, 2017). Trustworthiness constitutes another key factor of source credibility: higher perceived trustworthiness leads to higher perceived credibility, which in turn results in better persuasiveness (Ohanian, 1990). On the other hand, along with originality and spontaneity, trustworthiness is an integral part of authenticity (Enli, 2015). Authenticity includes what is perceived to be real and true regarding the source, the message, or the interaction; it also concerns the perceived gap between the influencer's claimed and real identities (Lee, 2020). As authenticity overlaps with credibility, if an influencer increases the authenticity of the post, and thereby, the credibility of the message, this could possibly lead to better persuasiveness.

According to self-determination theory, authenticity is associated with intrinsic (authentic) motivation that stems from the individual's own interests and values rather than being the result of external pressures (Ryan and Deci, 2000). As users are generally skeptical about green claims (Matthes and Wonneberger, 2014), if a non-green influencer posts about sustainable consumption, inauthenticity can trigger inferences about the influencer's ulterior, extrinsic motives such as posting about sustainability to gain more followers or improve their image by promoting a trending topic. Influencers might adapt different strategies to be perceived as authentic such as using personal language or having a unique style of communication expressed in the consistent choice of text and images (Abidin and Otis, 2016). Moreover, influencers can convey a more authentic image if they express how passionate they are about a topic (Audrezet et al., 2020). Thus, we propose that if the influencer expresses passion for sustainability while using their own communication style consistently, it can increase the authenticity of the post that in turn leads to higher message credibility.

1.4. Dynamic norms

Social information, including social norms can be effective tools in influencing one's pro-environmental behavior (Fanghella et al., 2019; Bruchmann et al., 2021). Moreover, social norms can be formed through exposure to media (Rimal and Storey, 2020). Therefore, social media influencers could be used to shape the norms of younger users that would promote a more sustainable lifestyle. However, when an unsustainable behavior is accepted in the society (i.e., meat consumption), referring to the norm (i.e., most people regularly eat meat) will probably not encourage people to change their behavior in a more sustainable direction. Instead, it can serve as a rationale to maintain unsustainable behavior ("if the majority does it, there is nothing wrong with it"). In that case, it is more effective to highlight the change of norm over time instead of promoting the actual norm (Sparkman and Walton, 2017). Indeed, previous research found that dynamic norms are effective in promoting sustainable behavior when the unsustainable behavior is still widely accepted in the society (Sparkman and Walton, 2017; Loschelder et al., 2019; Sparkman et al., 2021). Moreover, referring to the increasing number of individuals who think sustainable consumption is important can trigger bandwagon heuristic ("if others think it is important, I should think so, too") that leads to increased message credibility (Sundar, 2008). Consequently, we propose that including dynamic norms in an influencer post that contains a sustainability message can increase the credibility of the post compared to the same post without dynamic norms.

1.5. Overview of the present research

The aim of the current study is to explore how non-green influencers can communicate effectively about sustainable

consumption. It appears that the lack of credibility can play a crucial role in this mechanism, since non-green influencers are not sustainability experts, and the authenticity of such communication is also questionable as it may not meet the audience's expectations. Therefore, we tested two different credibility-enhancing strategies to examine which one has a more powerful positive effect on post credibility. We also examined whether dynamic norms could strengthen the credibility increase of the authenticity and expert strategies. Finally, based on previous empirical findings (Martínez-López et al., 2020), we also tested whether message credibility is positively related to the perceived persuasiveness of the message.

To examine these effects, we chose the topic of reducing single-use plastics such as PET bottles as it represents a considerable environmental issue (Chen et al., 2021). In summary, we posited that if a non-green influencer refers to an expert's opinion about the consequences of single-use plastics or they apply strategies to increase the authenticity related to sustainability, these strategies could have a positive impact on the credibility of a social media post encouraging the reduction of single-use plastics, especially PET bottles. Moreover, we also examined whether the presence of dynamic norms reinforce the positive effect of the two credibility-enhancing strategies.

2. Method

2.1. Participants and procedure

We designed a 2 (credibility-enhancing strategy: expert opinion vs. authenticity) × 2 (presence of dynamic norm: control vs. dynamic norm) online experiment. The study was approved by the Institutional Ethics Committee of the first author's university (no.2021/266-4). The research protocol was in accordance with the Declaration of Helsinki. All participants provided informed written consent at the beginning of the study.

According to the a-priori power analysis, a sample size of 387 persons was required to detect a small effect ($\eta_p^2 = 0.02$) at 0.8 power. Thus, we aimed for a sample of 400 respondents. However, after cleaning the database, the final convenience sample comprised 386 participants ($M_{age} = 22.0$ years, $SD_{age} = 3.88$, 71.9% female): 73.1% of them are BA students, almost half of them (47.2%) resides in the capital city, while an additional 21.8% lives in a smaller town, and 16.6% lives in a county capital.

2.2. Experimental stimuli

A fitness/lifestyle influencer was chosen for this experiment with 207 000 followers (11/2022). He is well-known to a larger audience due to his reality show appearances, and his posts are regularly reviewed by the national media. Although he is not a typical climate activist, he regularly posts pro-environmental content including participation in climate demonstrations or cooperation with the local Greenpeace organization. All participants were familiar with the influencer, and 12.7% claimed that they followed him on a social media platform.

To increase ecological validity, we used an already published photo of the lifestyle-fitness influencer, and we selected extracts of his social media posts about sustainability (i.e., reference to grandchildren, the David Attenborough documentary or partying) which we used to create posts that correspond to the experimental manipulations.

The main message of all four Instagram posts was about reducing PET plastic usage: *"Don't buy PET bottles, drink from a glass bottle instead!"*. In the expert opinion condition, we used the following main argument: *"I saw in the @davidattenborough documentary on Netflix that PET bottles often end up in the water as rubbish, and this is bad for the seas, the oceans and the animals living in it"*. Dynamic norms were presented as: "*More and more people care about the PET pollution every day"*.

In the authenticity condition, we used the following main argument: *"I want to hear my grandchildren saying that grandpa [name of the influencer] did not pollute our Planet with plastic sh@t!"*. Dynamic norms were presented as: *"More and more people join us in the PET-free party"*.

2.3. Measures

2.3.1. Post credibility

We adapted a credibility scale from Cotte et al. (2005). Three items ($\alpha = 0.935$) measured the perceived credibility of the post (*"The image and the text of the post is believable."*, *"This post is truthful."*, *"This post is realistic."*) rated on a 5-point Likert (1:Strongly disagree) to (5:Strongly agree).

2.3.2. Lack of credibility

We also formulated an open-ended question *("If you were to talk about the post to one of your friends, what would you say?"*). The question was posed after the quantitative measures including the credibility scale. Answers to this question were coded based on whether they mentioned that the post is not credible (1), or they did not mention anything about the post's credibility (0). Coding was executed by two independent coders who achieved acceptable interrater agreement (weighted Kappa = 0.726). Disagreements were discussed until coders reached consensus. Typical verbatims that were coded as mentioning lack of credibility included *"not credible"*, *"hypocritical"*, *"he acts as if he were eco-friendly"* or *"he does not act in line with what he writes"*.

2.3.4. Persuasiveness

Persuasiveness was assessed with one question (*"To what extent do you think that the post is persuasive?"*). Answers were given on a slider from 0 (very unlikely) to 100 (very likely).

2.4. Statistical analysis

Statistical analysis was performed using SPSS 27. First, descriptive statistics were calculated. Subsequently, we examined the internal consistency of the measures used in this study. Second, we examined the equal distribution of the control and demographic variables across experimental groups. Third, we conducted a two-way ANOVA to test whether post credibility is affected by the manipulated variables, and a binary logistic regression to test whether the lack of credibility of the post – a variable derived from the qualitative data – is affected by the manipulated variables. Finally, a hierarchical

regression analysis was conducted to examine the predictive power of the two credibility variables on the persuasiveness of the post.

3. Results

We conducted several one-way ANOVAs to test the equal distribution of age, familiarity with the influencer, attitudes toward plastic and practices related to plastic waste avoidance before comparing the effect of the experimental stimuli across experimental groups. Results indicated equal distribution (all $p > 0.480$). In the following step, we conducted χ^2 tests to test the equal distribution of gender, education, and place of residence. Results indicated equal distribution regarding education and place of residence (all $p > 0.318$). However, gender was not equally distributed across the experimental groups [$\chi^2(3) = 12.2$, $p = 0.007$]. Thus, gender was included in all subsequent analyses as a covariate.

We conducted a two-way ANOVA using the type of credibility-enhancing strategy and the presence of dynamic norms as independent variables and post credibility as dependent variable. Results indicated no interaction effect between the two independent variables [$F_{(1,379)} = 1.30$, $p = 0.254$, $\eta_p^2 = 0.003$]. However, a significant main effect of credibility-enhancing strategy was found [$F_{(1,379)} = 18.6, p < 0.001, \eta_p^2 = 0.047$] (see Figure 1). Expert opinion was perceived as more credible than authenticity management ($M_{exp} = 2.98$, $SD_{exp} = 1.27$ vs $M_{role} = 2.48$, $SD_{role} = 1.16$). However, we note that for both the expert opinion and authenticity management conditions, the credibility was below the medium scale point (3).

In the following step, a binary logistic regression was conducted to test the interaction effect of credibility-enhancing strategy and the presence of dynamic norms on the lack of credibility. Results indicated a significant interaction effect between the two predictor variables ($B = -1.12$, Wald $\chi^2(1) = 6.56$, $p = 0.01$) (see Figure 2). In the authenticity-enhancing condition, compared to the expert condition, when dynamic norms were present, it was less likely that respondents mention that the post lacked credibility. However, the same effect could not be observed when the post contained an expert opinion argument.

Finally, we examined whether the spontaneous mention of lack of credibility had an incremental predictive power on the persuasiveness of the post by conducting a hierarchical regression analysis. First, we calculated Spearman's rank correlation to assess the relationship between the two credibility measures. Results indicated a moderate negative correlation [$r(386) = -0.552, p < 0.001$). Then, we included the quantitative measure of post credibility as predictor variable and gender as covariate in the hierarchical regression model. Finally, spontaneously mentioned lack of credibility was added to the model. Results indicated a significant R^2 change [$R^2_{change} = 0.014$, F_{change} (1, 370) = 14.2, $p < 0.001$]. Both credibility measures significantly predicted the persuasiveness of the post [post credibility: $b = 0.706$, $t(370) = 18.5$, $p < 0.001$, lack of credibility: $b = -0.143$, $t(370) = -3.77$, $p < 0.001$].

4. Discussion

Although attitudes toward sustainability are generally positive, those who adopt sustainable consumption habits in their everyday lives still represent a minority in the general population (Kumar, 2016; Chwialkowska, 2019). Moreover, people tend to underestimate the general concern about climate change (Sparkman et al., 2022). It is crucial to raise people's awareness of environmental issues and environmental risks (Li et al., 2022). While green influencers mostly attract followers who are interested in sustainability, non-green influencers can reach a wider, more heterogeneous audience. When encouraging sustainable consumption, non-green influencers have the potential to raise awareness among those who are not involved in living a sustainable lifestyle. On the other hand, non-green influencers face the issue of lack of credibility and potential greenwashing when posting about sustainability. In this study, we examined the effect of two different credibility-enhancing strategies and the presence of dynamic norms on the perceived credibility of the message. We also tested how the two different credibility measures that we assessed are related to the persuasiveness of the message.

First, the present results indicated a robust main effect of expert opinion argument vs. increasing authenticity on message credibility: including an expert opinion in the social media post led to increased message credibility. Thus, as proposed by Kruglanski et al. (2005), we provided empirical evidence that expert authority can be effectively conferred on other sources to increase message credibility regarding a sustainability topic. Moreover, the present results showed that referring to an expert opinion is more effective than the authenticity-increasing strategy that we tested. A possible explanation is that perceived similarities between the influencer and the audience also conveys authenticity (Abidin and Otis, 2016). In the present case, respondents might have perceived the influencer as being very different from them. Consequently, the lack of perceived similarity prevented them from engaging with the influencer and consider his efforts of promoting a sustainable message as being real and authentic. Besides, the study sample represented the general audience that can react in a different way compared to followers. For instance, authenticity plays a key role in the successful promotion of green lifestyle for followers (Chwialkowska, 2019), and followers perceive the influencer who promotes a sustainable product as more trustworthy with higher levels of intrinsic motives (Breves and Liebers, 2022). In contrast, the present results showed that a more rational approach of referring to expert opinion can lead to higher credibility perception for a general audience who are probably less involved with the influencer.

Second, somewhat surprisingly, no main effect of dynamic norms was found, or any interaction effects between the credibility-enhancing strategies and the presence of dynamic norms that would have affected the credibility of the message. One possible explanation of the present results might be the differences in the experimental settings: previous studies (see Sparkman and Walton, 2017; Sparkman et al., 2021) did not use an influencer as the source of message, nor did they include dynamic norms in a social media post or tested the effect of dynamic norms together credibility-enhancing strategies either. Furthermore, dynamic norms did not trigger the bandwagon heuristics either ("if others think it is important, I should think so, too"), probably because the perceived distance between the respondents and the influencer was large; thus, respondents did not feel the urge to identify with the trend described in the influencer's post.

Third, the present results showed that dynamic norms decreased the occurrence of spontaneous mentions of the lack of post credibility when included in the authenticity-enhancing post. On the other hand, the inclusion of dynamic norms in the expert

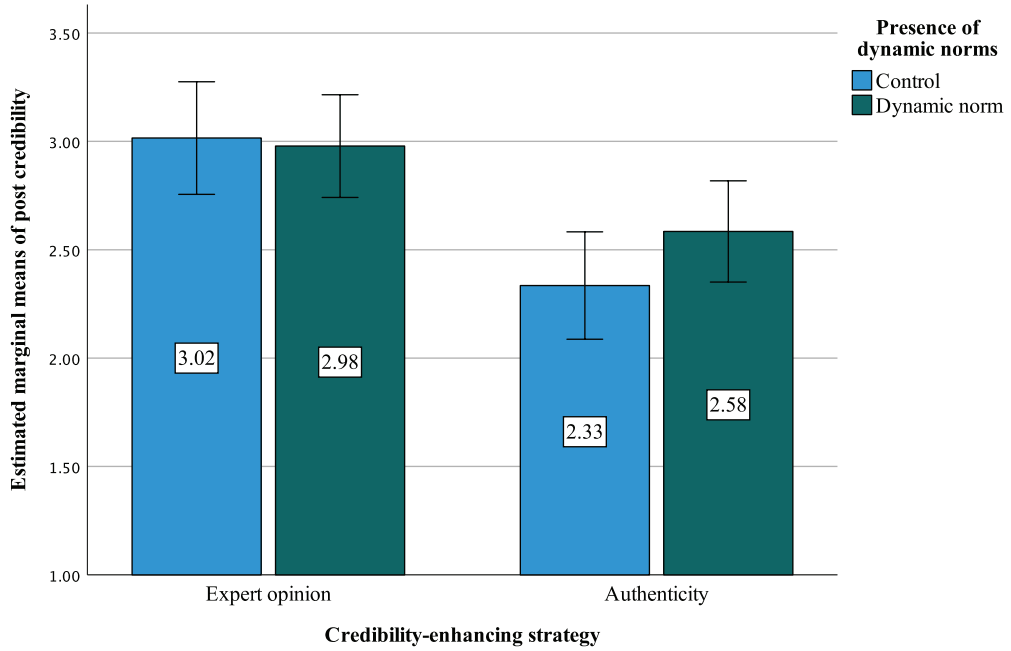

FIGURE 1
Testing the interaction effect of the credibility-enhancing strategy and the presence of dynamic norms on post credibility. The graph represents the estimated marginal means of post credibility that we compared with the two-way ANOVA ($N = 386$). Results indicated that expert opinion improved the credibility of the post; however, we did not observe any interaction effect of the credibility-enhancing strategies and dynamic norms.

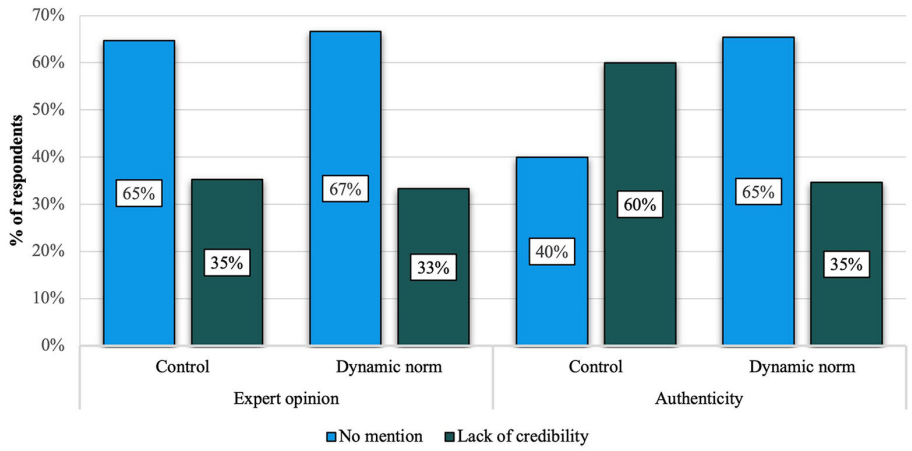

FIGURE 2
The interaction effect of the credibility-enhancing strategy and the presence of dynamic norms on the spontaneous mention of lack of credibility. The graph represents the percentage of respondents who mentioned/did not mention the lack of credibility by experimental condition ($N = 386$). Results indicated that dynamic norms improved the credibility of the post in the authenticity enhancing condition compared to its control; however, we did not observe such a salient difference regarding the expert opinion argument.

opinion post did not affect the spontaneous mentions of the lack of credibility. We would like to underline the difference between the two credibility measures that we used in the study: the quantitative measure assessed the credibility of the post while the binary variable derived from the qualitative data assessed the perceived incredibility (lack of credibility) of the post. Thus, those who were exposed to the authenticity post with the dynamic norms might have not found the post more credible, instead, their perceptions of incredibility were attenuated. This result confirms our early assumption that non-green influencers communicating sustainable consumption may face a credibility issue: they are not sustainability experts, nor do they build a sustainable image as green influencers do; therefore, their sustainable communication can be perceived as greenwashing. Further confirming this assumption, post credibility scores were relatively low in the present study.

Regarding the interaction effect, the perceived similarity between the influencer and the respondent plays an important role in how

authenticity (Audrezet et al., 2020) and dynamic norms (Sundar, 2008) affect credibility. This common underlying mechanism might have led to a positive synergic effect on credibility, explaining why dynamic norms decreased the lack of credibility when included in the authenticity-enhancing post, but they did not have the same effect when included in the expert opinion post. The effect of expert opinion on credibility is based on authority that does not require any engagement or perceived similarity with the influencer. Alternatively, as the authenticity-enhancing post was shorter than the expert opinion post, it is possible that the dynamic norm embedded in the expert opinion post was hard to perceive, and it was ignored without deeper processing.

Finally, it was demonstrated that besides the quantitative credibility measure, the lack of credibility of the post also significantly contributed to the explanation of the post's persuasiveness. These results are in line with previous research on the relationship between post credibility and persuasiveness (Martínez-López et al., 2020). Furthermore, the results also underline the importance of increasing the credibility perception of non-green influencers' sustainable communication. Indeed, lack of credibility can constitute an important barrier to the potential benefits of sustainable communication by non-green influencers.

4.1. Limitations

This study is not without limitations. First, we prioritized the ecological validity of the research. For this purpose, we used stimuli based on extracts of real influencer posts. More structured stimuli set, controlled for wording, length and other characteristics of the message could allow for the elimination of potential confounding variables. Second, a more structured stimuli set should also comprise a control condition without any credibility-enhancing strategies to assess the potential positive effects of credibility-enhancing strategies separately. Future research might consider adding other credibility-enhancing strategies to the research design. Third, the study sample represented a general audience. The study should be replicated among the followers of the influencer to explore possible differences in the effects. Fourth, persuasiveness was measured using one single item, which could be replaced with a more sophisticated scale. Furthermore, future studies should include different measures such as perceived similarity, authenticity, and source credibility to explore the underlying mechanisms of the effects demonstrated in this study. Finally, the generalizability of the present results is limited as we tested one sustainable message from one influencer. Future research should consider testing different sustainable messages from different influencers. Moreover, future research should consider testing the effect of messages posted by lifestyle influencers vs. green influencers.

5. Conclusion

In this study, we explored how non-green influencers can effectively increase the credibility of their posts about sustainable consumption. We tested two different credibility-enhancing strategies: referring to expert opinion and enhancing authenticity by expressing passion toward sustainability in a way that fits to the influencer. Besides, we also examined whether dynamic norms increase the effect of the credibility-enhancing strategies. According to our results, referring to expert opinion is a more effective credibility-enhancing strategy among general audience than the authenticity-increasing strategy. Moreover, dynamic norms included in the authenticity post decrease the perceived lack of credibility compared to the control condition. Results can be explained by the different underlying mechanisms of the credibility-enhancing strategies. Our study contributes to the sustainability communication literature by highlighting the importance of credibility-enhancing strategies in the case of non-green social media influencers.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found at: Open Science Framework https://doi.org/10.17605/OSF.IO/5TZGX.

Ethics statement

The studies involving human participants were reviewed and approved by the Institutional Review Board of ELTE, Hungary (no.2021/266-4). The patients/participants provided their written informed consent to participate in this study.

Author contributions

ÁB, ÁZ, and GO contributed to the conception and study design. ÁB collected the data, performed the statistical analysis, and wrote the first version of the manuscript. All authors contributed to manuscript revision, read the final version, approved the publication of the manuscript, and agreed to be accountable for all aspects of the work.

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Conflict of interest

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

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References

Abidin, C., and Otis, M. (2016). "Influencers tell all. Unravelling Authenticity and Credibility in a Brand Scandal" in *Blurring the Lines: Market-Driven and Democracy-Driven Freedom of Expression*. ed. M. Edström, A. T. Kenyon, and E. M. Svensson. (Novi, MI: Nordicom), 153–161.

Appelman, A., and Sundar, S. S. (2016). Measuring message credibility: construction and validation of an exclusive scale. *J. Mass Commun. Q.* 93, 59–79. doi: 10.1177/1077699015606057

Audrezet, A., Kerviler, D. E., and Guidry Moulard, G. (2020). Authenticity under threat: when social media influencers need to go beyond self-presentation. *J. Bus. Res.* 117, 557–569. doi: 10.1016/j.jbusres.2018.07.008

Breves, P., and Liebers, N. (2022). Greenfluencing the impact of parasocial relationships with social media influencers on advertising effectiveness and followers' pro-environmental intentions. *Environ. Commun.* 77, 1–15. doi: 10.1080/17524032.2022.2109708

Bruchmann, K., Chue, S. M., Dillon, K., Lucas, J. K., Neumann, K., Parque, C., et al. (2021). Social comparison information influences intentions to reduce single-use plastic water bottle consumption. *Front. Psychol.* 12: 612662. doi: 10.3389/fpsyg.2021.612662

Campbell, C., and Farrell, J. R. (2020). More than meets the eye: the functional components underlying influencer marketing. *Business Horizons* 63, 469–479. doi: 10.1016/j.bushor.2020.03.003

Chan, A. K. M., Nickson, C. P., Rudolph, J. W., Lee, A., and Joynt, G. M. (2020). Social media for rapid knowledge dissemination: early experience from the COVID-19 pandemic. *Anaesthesia* 75, 1579–1582. doi: 10.1111/anae.15057

Chen, Y., Awasthi, A. K., Wei, F., Tan, Q., and Li, J. (2021). Single-use plastics: production, usage, disposal, and adverse impacts. *Sci. Total Environ.* 752, 141772. doi: 10.1016/j.scitotenv.2020.141772

Chwialkowska, A. (2019). How sustainability influencers drive green lifestyle adoption on social media: the process of green lifestyle adoption explained through the lenses of the minority influence model and social learning theory. *Manage. Sust. Dev.* 11, 33–42. doi: 10.2478/msd-2019-0019

Cotte, J., Coulter, R. A., and Moore, M. (2005). Enhancing or disrupting guilt: the role of ad credibility and perceived manipulative intent. *J. Bus. Res.* 58, 361–368. doi: 10.1016/S0148-2963(03)00102-4

Djafarova, E., and Rushworth, C. (2017). Exploring the credibility of online celebrities' Instagram profiles in influencing the purchase decisions of young female users. *Comput. Hum. Behav.* 68, 1–7. doi: 10.1016/j.chb.2016.11.009

Enli, G. (2015). *Mediated authenticity: How the Media Constructs Reality*. New York, NY: Peter Lang.

Evans, N. J., Phua, J., Lim, J., and Jun, H. (2017). Disclosing instagram influencer advertising: the effects of disclosure language on advertising recognition, attitudes, and behavioral intent. *J. Int. Adv.* 17, 138–149. doi: 10.1080/15252019.2017.1366885

Fanghella, V., D'Adda, G., and Tavoni, M. (2019). On the use of nudges to affect spillovers in environmental behaviors. *Front. Psychol.* 10, 61. doi: 10.3389/fpsyg.2019.00061

Hoeken, H., and Hustinx, L. (2003). "The relative persuasiveness of different types of evidence," in *Proceedings of the fifth conference of the International Society for the Study of Argumentation*, ed. F. H. van Eemeren, J. A. Blair, C. A. Willard, and A. F. Snoeck Henkemans (Amsterdam: Sic Sat), 97–501.

Jin, S. V., Muqaddam, A., and Ryu, E. (2019). Instafamous and social media influencer marketing. *MIP* 37, 567–579. doi: 10.1108/MIP-09-2018-0375

Johnstone, L., and Lindh, C. (2018). The sustainability-age dilemma: a theory of (un)planned behaviour via influencers. *J Consumer Behav* 17, e127–e139. doi: 10.1002/cb.1693

Kapoor, P. S., Balaji, M. S., Jiang, Y., and Jebarajakirthy, C. (2022). Effectiveness of travel social media influencers: a case of eco-friendly hotels. *J. Travel Res.* 61, 1138–1155. doi: 10.1177/00472875211019469

Kruglanski, A. W., Raviv, A., Bar-Tal, D., Raviv, A., Sharvit, K., Ellis, S., et al. (2005). Says who? Epistemic authority effects in social judgment. *Adv. Exp. Soc. Psychol.* 37, 345–392. doi: 10.1016/S0065-2601(05)37006-7

Kumar, P. (2016). State of green marketing research over 25 years (1990-2014): literature survey and classification. *Market. Int. Planning* 34, 137–158. doi: 10.1108/MIP-03-2015-0061

Lee, E. J. (2020). Authenticity model of (mass-oriented) computer-mediated communication: conceptual explorations and testable propositions. *J. Comput. Mediated Commun.* 25, 60–73. doi: 10.1093/jcmc/zmz025

Li, X., Liu, Z., and Wuyun, T. (2022). Environmental value and pro-environmental behavior among young adults: the mediating role of risk perception and moral anger. *Front. Psychol.* 13, 771421. doi: 10.3389/fpsyg.2022.771421

Loschelder, D. D., Siepelmeyer, H., Fischer, D., and Rubel, J. A. (2019). Dynamic norms drive sustainable consumption: norm-based nudging helps café customers to avoid disposable to-go-cups. *J. Econ. Psychol.* 75, 102146. doi: 10.1016/j.joep.2019.02.002

Lou, C., and Yuan, S. (2019). Influencer marketing: how message value and credibility affect consumer trust of branded content on social media. *J. Int. Adv.* 19, 58–73. doi: 10.1080/15252019.2018.1533501

Marsh, E. J., and Yang, B. W. (2021). *One Believing Things That are not True: A Cognitive Science Perspective on Misinformation Misinformation and Mass Audiences*. (Austin, TX: University of Texas Press), 15–34.

Martínez-López, F. J., Anaya-Sánchez, R., Esteban-Millat, I., Torrez-Meruvia, H., D'Alessandro, S., Miles, M., et al. (2020). Influencer marketing: brand control, commercial orientation and post credibility. *J. Market. Manage.* 36, 1805–1831. doi: 10.1080/0267257X.2020.1806906

Matthes, J., and Wonneberger, A. (2014). The skeptical green consumer revisited: testing the relationship between green consumerism and skepticism toward advertising. *J. Adv.* 43, 115–127. doi: 10.1080/00913367.2013.834804

Ohanian, R. (1990). Construction and validation of a scale to measure celebrity endorsers' perceived expertise, trustworthiness, and attractiveness. *J. Adv.* 19, 39–52. doi: 10.1080/00913367.1990.10673191

Pittman, M., and Abell, A. (2021). More trust in fewer followers: diverging effects of popularity metrics and green orientation social media influencers. *J. Int. Market.* 56, 70–82. doi: 10.1016/j.intmar.2021.05.002

Rimal, R. N., and Storey, J. D. (2020). Construction of meaning during a pandemic: the forgotten role of social norms. *Health Commun.* 35, 1732–1734. doi: 10.1080/10410236.2020.1838091

Ryan, R. M., and Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am. Psychol.* 55, 68–78. doi: 10.1037/0003-066X.55.1.68

Sparkman, G., Geiger, N., and Weber, E. U. (2022). Americans experience a false social reality by underestimating popular climate policy support by nearly half. *Nat. Commun.* 13, 4779. doi: 10.1038/s41467-022-32412-y

Sparkman, G., Macdonald, B. N. J., Caldwell, K. D., Kateman, B., and Boese, G. D. (2021). Cut back or give it up? The effectiveness of reduce and eliminate appeals and dynamic norm messaging to curb meat consumption. *J. Environ. Psychol.* 75, 101592. doi: 10.1016/j.jenvp.2021.101592

Sparkman, G., and Walton, G. M. (2017). Dynamic norms promote sustainable behavior, even if it is counternormative. *Psychol. Sci.* 28, 1663–1674. doi: 10.1177/0956797617719950

Sundar, S. S. (2008). "The main model: a heuristic approach to understanding technology effects on credibility," in *Digital Media, Youth, and Credibility,* ed M. J. Metzger and A. J. Flanagin. (Cambridge, MA: The MIT Press), 73–100.

Uzunoglu, E., and Misci Kip, S. (2014). Brand communication through digital influencers: leveraging blogger engagement. *Int. J. Inf. Manage.* 34, 592–602. doi: 10.1016/j.ijinfomgt.2014.04.007

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Small-scale urban design interventions: A framework for deploying cities as resource for mental health and mental health literacy

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With roughly half of the global population living in cities, urban environments become central to public health often perceived as health risk factors. Indeed, mental disorders show higher incidences in urban contexts compared to rural areas. However, shared urban environments also provide a rich potential to act as a resource for mental health and as a platform to increase mental health literacy. Based on the concepts of salutogenesis and restorative environments, we propose a framework for urban design interventions. It outlines (a) an output level, i.e., preventive and discursive potentials of such interventions to act as biopsychosocial resources, and (b) a process level, i.e., mechanisms of inter- and transdisciplinary collaboration of researchers and citizens in the design process. This approach aims at combining evidence-based, salutogenic, psychosocially-supportive design with a focus on mental health. Implementing low-threshold, resource-efficient options in the existing urban context brings this topic to the public space. Implications for the implementation of such interventions for citizens, researchers, and municipality stakeholders are discussed. This illustrates new directions of research for urban person-environment interactions, public health, and beyond.

KEYWORDS

urban environment, restorative cities, urban mental health, mental health literacy, salutogenesis, psychosocially-supportive design, evidence-based design, participation

1. Introduction

About 55% of the global population is living in cities and this trend is expected to rise up to 68% by 2050 (United Nations, 2018). This renders urban environments central to public health. Often, urban environments are perceived as health risk factors due to, e.g., noise, pollution, crowding, and anonymity (Gruebner et al., 2017). Indeed, mental disorders show higher incidence in urban contexts compared to rural areas, generally increasing, e.g., due to the COVID-19-pandemic (Fofana et al., 2020) as well as due to climate change (Hickman et al., 2021). Mental health problems such as anxiety disorders, major depression, and schizophrenia occur up to 56% more frequently in urban areas than in rural areas (Peen et al., 2010; Prina et al., 2011). With regard to higher incidences of schizophrenia in urban contexts, research suggests that these are associated with increased social stress (Lederbogen et al., 2011). In addition, phenomena such as homelessness or crime are more prevalent in urban

areas compared to rural areas (Adli, 2017). Worldwide, mental disorders affect one in eight adults (WHO, 2022). Despite the diversity and increasing prevalence of mental disorders, the topic of mental health continues to be plagued by misconceptions and stigmas (Angermeyer et al., 2013). Such stigmatization often leads to an aggravation of the symptoms and increases the psychological strain for those affected and their relatives (Sickel et al., 2014). Studies show that mental health literacy, i.e., knowledge that helps to recognize, manage, or prevent mental disorders (Jorm et al., 1997), can promote attitudes toward people affected by mental disorders, especially for depression (Svensson and Hansson, 2016). However, levels of mental health literacy are only low to moderate worldwide (e.g., Jorm, 2012; Dang et al., 2020). At the same time, provision of psychotherapy services is precarious in the US (Andrilla et al., 2018) as well as in Europe (Priebe and Wright, 2006; Bundespsychotherapeutenkammer, 2018) with long waits for a first consultation and strong variation between urban and rural areas. This situation calls for low-threshold possibilities not only in treatment, but more importantly in the prevention of mental disorders – including mental health literacy. As mental health is still a topic mainly discussed behind closed doors (i.e., in doctors' offices, clinics, consulting rooms, and lecture halls), we see shared urban environments as opportunities to decrease stigmatization of mental disorders through communication and psychoeducation. This is in line with other recent endeavors such as the development of mental health first aid programmes (e.g., Kitchener and Jorm, 2008), which aim at teaching people of the general public how to identify and understand signs of mental health problems in order to provide initial help.

The relationship between the built environment and health and wellbeing has been subject to research in a variety of disciplines for decades (e.g., Rubin et al., 1998). This research has been largely prompted by Ulrich's (1984) influential article on the window view from a hospital room and its beneficial effect on the recovery from surgery when facing a tree instead of a brick wall. While Ulrich explicitly pointed to the less monotonous character of the nature scene as a confounding factor, his article can be seen as a corner stone for the biophilic design paradigm (e.g., Kellert et al., 2008). Further concepts on the relationship between society and space originate mainly from social geography (constructivist and structuration theory perspectives; Backhaus and Müller-Böker, 2006) and include questions about preconditions for successful appropriation of space (Werlen, 2000), ways of appropriating space, and rules of appropriation. From a psychological point of view, space appropriation represents the (experienced) change of a space that occurs through mental (e.g., remembering) or physical (e.g., painting) activities (Rump and Richter, 2009). Thus, appropriation transforms an initially neutral, unfamiliar environment into one that is personally meaningful (Steg and de Groot, 2018). Influencing our built environment meets basic human needs for autonomy and competence (e.g., Vollmer et al., 2020). In terms of public space, appropriation behavior increases attachment to these places (Rioux et al., 2017), which in turn is associated with increased social participation in the neighborhood (Mihaylov and Perkins, 2013).

Against this backdrop, there are no prototypical cities that can be designed perfectly for everyone. Rather, it is a matter of taking into account the specific needs of local residents and visitors and creating opportunities for participation and appropriation (Vollmer et al., 2020). Therefore, we argue that urban environments not only pose risks but also act as an insufficiently considered resource for mental health of citizens and to address mental health issues in the public space in a low-threshold way (van der Wal et al., 2021). Whereas many other frameworks (e.g., Vollmer et al., 2020; Roe and McCay, 2021; Bornioli and Subiza-Pérez, 2022) eventually advocate for long term urban planning approaches to foster mental health, we aim at shedding light on smaller and easily implementable design interventions that make use of the given surroundings and its inherent potentials. Without neglecting the profound utility of approaches that are more comprehensive and include long term urban planning processes, this complementary concept allows cities to quickly address mental health and mental health literacy in a cost and time effective manner. In this article, we outline a framework for putting this idea into practice.

2. Theoretical background

Urban mental health is a complex topic that asks for interdisciplinary collaboration. In this article, we aim to integrate perspectives from (a) environmental and health psychology, (b) design research, and (c) urban planning. To that aim, we first draw on these disciplines' theoretical stock, before we develop a conceptual framework for deploying cities as resource for mental health and mental health literacy in terms of output and processes. Finally, we discuss the benefit of the framework in theoretical and practical implementation.

2.1. Psychological perspectives on urban mental health

The relations between urban environments and mental health are complex, including both resources (e.g., access to healthcare and education) as well as stressors (e.g., noise and crowding) (cf. Vollmer et al., 2020). Following a fundamental perspective in environmental psychology, the built environment affects human health on different levels (Kirsty et al., 2018; Wasfi and Kestens, 2021). These impacts range from physical aspects (e.g., traffic safety, reaction to heat; Tong et al., 2021) to psychological processes (e.g., stress due to crowding, loneliness due to anonymity; Knöll et al., 2018) to behavioral aspects (e.g., car usage due to low walkability; Sugiyama et al., 2019). At the same time, humans are not fully at the mercy of the environments but have opportunities – at least to a certain extent – to shape the environments we engage with, for example through relocation or space appropriation (Steg and de Groot, 2018). Concerning mental health, this leads to two different effects (Gruebner et al., 2017): causal effects (i.e., direct influences of social-spatial environment of the city on people) as well as selective processes (i.e., features of the city, such as supply structures and job opportunities, that favor the influx of certain groups of people). Both effects shape the interaction between people and their (urban) environments.

More specifically, in environmental psychology, a prominent line of research on environments and health concerns *restorative environments* (Hartig, 2004). These comprise the idea that natural as well as built environments can help restore depleted resources consumed during the day and reduce stress, which can in turn

support physical as well as mental health (Roe, 2010; Weber and Trojan, 2018; Scopelliti et al., 2019). This represents an additional function of urban space apart from providing supply structures, housing and working. To date, there is a strong focus on the positive significance of the natural environment in cities (e.g., green spaces, Astell-Burt et al., 2021; urban trees, Marselle et al., 2020; water, White et al., 2021; for an overview, see Hartig, 2021), with weaker emphasis on the built environment (Bornioli and Subiza-Pérez, 2022). From there, we can extract two characteristics that amplify the importance of public space as restorative environments: (a) reduced action range (e.g., due to pandemic lockdown, health or financial constraints; Nieuwenhuijsen, 2020), (b) lacking resources for private recreational opportunities and spaces (e.g., garden, balcony; Astell-Burt et al., 2014). While reduced action range requires a decentralization of recreational potential across the city, low-income and high-density areas underline the importance of accessibility of recreational public spaces. In line with this, design measures in the urban context can reduce or exacerbate social inequalities, as impressively demonstrated in an early study by Moore (1985).

Drawing on concepts from health psychology such as the *Salutogenic Model of Health* (Antonovsky, 1979) can help to further develop the idea of urban contexts as restorative and health-promoting environments. In accordance with this model, the aim is not to avoid stress and other burdens and risk factors in general, but to find ways for people to remain healthy despite high stress levels (von Lindern et al., 2017). Following Antonovsky's concept, health promotion is to be understood as a continuous process whose endeavor is to move closer toward health on a continuum between illness and health (cf. Bengel et al., 1998). Of decisive importance here is the sense of coherence postulated by Antonovsky, which can be divided into the three aspects of "comprehensibility," "manageability," and "meaningfulness" (Bengel et al., 1998, p. 28 f.). As also taken up later under the term *Salutogenic Design* (Dilani, 2005), the built environment can have a significant influence on the expression of this sense of coherence (e.g., Rehn, 2019).

The distinction of different types of health, e.g., mental and physical, is rooted in the *Biopsychosocial Model of Health* (Engel, 1977), which is an alternative to the biomedical understanding of health. Coming from systems theory, the salutogenic and the biopsychosocial approach can be merged to the intention of developing health-promoting measures (instead of disease-fighting) taking into account biological, psychological, and social elements (instead of biological only). Although this paper focuses primarily on mental health, this cannot be clearly distinguished from other facets of a holistic concept of health (cf. WHO, 1946). Findings from fields such as psychoneuroimmunology (e.g., Schubert, 2011), embodiment (Barsalou et al., 2003) and psychosomatics (e.g., Davidson et al., 2003) suggest a systemic interdependence in which mental wellbeing is both a manifestation and a cause of health.

2.2. Design principles for promoting health and wellbeing

The effect of the urban context on health and wellbeing can be categorized into at least four different influencing factors (Baumgart et al., 2018): (1) the built environment, (2) social factors (e.g., social integration and mobility), (3) political administrative factors (e.g., density of close healthcare provision), and (4) symbolic factors (e.g., cityscape). While all of these categories pose important potentials and leverages for addressing health through urban interventions, this paper and the presented framework focus primarily on the built environment. Still, as all four categories are interrelated, the built environment can influence, e.g., symbolic factors of a city (its "look and feel") or social factors by providing affordances to facilitate social integration and reduce disparities (e.g., Bagnall et al., 2017). Apart from that, a growing body of literature points to direct effects of the built environment on health and wellbeing, e.g., through increasing physical activity (e.g., Center for Active Design, 2010), reducing stress (Ulrich et al., 2008; Knöll et al., 2018), or increasing accessibility and inclusion (Amin, 2018).

As a basis for architecture, design, and urban planning, scientific evidence has gained relevance in recent years related to an evidence-based design approach (Hamilton, 2003; Malkin, 2008; Devlin, 2014). This is where the later presented framework picks up by applying a broad spectrum of scientific evidence from psychology, urban planning, and design research in an interdisciplinary collaboration. The results obtained in such research-driven design approach can inform a human-centered design process (Visocky O'Grady and Visocky O'Grady, 2017).

While already early work from the 19th century draws interrelations between design and health (e.g., Nightingale, 1860, 1863), Ulrich's (1984) seminal paper on views from a hospital window can be seen as the starting point of extensive exploration of the impact of design on health and wellbeing. Continuously, frameworks elaborated on this idea emphasizing partly different design aspects such as therapeutic landscapes (Gesler, 1993), psychosocially-supportive design (Ulrich, 1997), salutogenic design (Dilani, 2005), healing environments (Dijkstra, 2009), and biophilic design (Kellert et al., 2008; Ryan and Browning, 2020). Whereas these frameworks mainly focus on direct effects on health and wellbeing, other approaches extend this scope by addressing how design can influence health behavior (e.g., Fogg, 2003; Lockton et al., 2010; Michie et al., 2014; Rehn, 2018). In some cases, this includes aspects of gamification and approaches of augmented reality (e.g., Knöll et al., 2014; Halblaub et al., 2015). Some of these paradigms represent the theoretical basis upon which a number of design tools and guidelines for urban and public design were created. These include the Active Design Guidelines (Center for Active Design, 2010), the Building Healthy Places Toolkit (Urban Land Institute, 2015), the Assembly Civic Design Guidelines (Center for Active Design, 2018), and the Great Place Guide (Australian Capital Territory, 2020).

One of the few models that focus specifically on mental health promotion in cities is the *Restorative Cities Framework* by Roe and McCay (2021). The model links numerous established theories and paradigms from design and architecture research (e.g., biophilic design and salutogenic design) and psychology (e.g., *Attention Restoration Theory*; Kaplan and Kaplan, 1989). It comprises seven characteristics that distinguish a city as "restorative": inclusive (i.e., equal access to health-promoting services, including, e.g., those with lower income), green (i.e., integrating nature into the urban core), blue (i.e., access to water), sensory (i.e., engage all five senses), neighborly (i.e., support social cohesion), active (i.e.,

promote cognitive and emotional wellbeing through movement), and playable (i.e., provide opportunities for creativity and play for all ages). This reflects the components of a biopsychosocial understanding of health (Engel, 1977), whose holistic approach forms the backdrop of this article.

Another design paradigm that poses a pillar upon which the later illustrated framework is built relates to *experience design* (XD) – an approach that is usually not applied to city planning and urban design but rather to retail and web design. One of the fundamental goals of experience design is to create coherent end-to-end experiences that aim at achieving a specific goal or satisfy one or more needs (e.g., Risdon et al., 2018). While the field of experience design uses terminology such as "channels," "touchpoints," and "service blueprints" whose explanation would go beyond the scope of this paper, the notion of "journey" poses a useful perspective for urban design in the context of mental health promotion. As Risdon et al. (2018 p. 88) point out, journeys can be operationalized as "the conceptual trip a person embarks upon to achieve a goal or satisfy one or more needs." With respect to urban design interventions, the conceptual link between physically separated concepts through a journey that can be adapted by users based on their time and willingness to continue can increase the effectiveness of the sum of all parts. In practice, tools from experience design such as "customer journey maps" can help to design the experience that is created by deliberately placing design interventions in a particular pattern across an urban context.

2.3. Potentials of participatory approaches for urban mental health

In urban development projects for health promotion, participatory approaches have become increasingly important, because aspects of mental health, society, space, and environment share entangled relations (WHO, 2016; UN-Habitat and WHO, 2020). The term *participation* is a widespread and frequently used term derived from the latin word "participo" which describes "the act of taking part in an event or activity." Following Arnstein (1969), we argue that the more influence someone has on a decision-making process, the greater his or her participation. As outlined earlier, the urban environment plays an important role in influencing health conditions. This is worth considering particularly against the backdrop of heterogeneous user groups in urban settings. This heterogeneity partly stems from changes in the human life-course, as people of all ages – from young children to elderly people – use public spaces. Considering the prevalence of mental health concerns across all ages (Global Burden of Disease Collaborative Network., 2021), this requires taking into account differing but also similar needs (e.g., addressed in universal design, Steinfeld and Maisel, 2012) in the development and design of interventions for urban mental health. In addition, there is a need to consider marginalized groups (e.g., different cultural backgrounds) and people with specific needs (e.g., neurodiverse people), as vulnerable groups are often insufficiently included in planning processes, leading to an underrepresentation of their needs in the resulting environments (Quilling and Köckler, 2018; UN-Habitat and WHO, 2020). Therefore, participatory processes are of special relevance for the development of health-promoting environments. We argue that these issues could be tackled through an approach that offers new models of participation, while focusing on the built environment and involving people of all ages as well as of marginalized groups – in this way, the intertwined aspects of mental health, space, and society could be addressed.

Critical urban theory has been concerned with issues of power and inequality in cities since the 1960s (Brenner, 2009), and while new participatory approaches are constantly developed, the way in which these methods are designed, arranged, and undertaken create barriers to participation (Kuder, 2016). Arnstein (1969) developed a typology of citizen participation in her essay "A ladder of citizen participation." The concept of a "ladder" or different successive "levels" is an easy-to-use concept that is applicable in different contexts, therefore, it is well known in the fields of urban planning, social work as well as urban health promotion. The concept was adapted over time to different requirements (e.g., *Circles of Decision*, Wright et al., 2008). Aspects of power still play an important role in participatory approaches today, because vulnerable target groups often do not feel empowered enough to take part in participation offers and sometimes lack the necessary means to articulate their needs and concerns in the way that is offered to them (Quilling and Köckler, 2018). Participatory approaches usually remain on the lower middle of Arnsteins ladder, i.e., on the rung of "informing" or "consultation." Frequently used methods are surveys, round tables, or fishbowl discussions (Kuder, 2016).

To tackle this shortcoming, the approach of *co-creation* offers a process in which participants jointly develop a solution without being the object of research or interview partners, but creators actively shaping their own environments (Jansen, 2018). Co-creation methods are increasingly used in urban planning (Mahmoud et al., 2021). Methods, e.g., from design research, can thus act as a vital link between urban planning and citizens. Using more practical or creative techniques (e.g., joint mapping of the built environment, photo-elicitation, Ortega-Alcázar and Dyck, 2012) than discursive techniques allows contributions from population groups that are otherwise often excluded from such processes (Leino and Puumala, 2021). Nevertheless, power imbalances need to be constantly addressed to avoid their reproduction (Leino and Puumala, 2021). Citizens' local knowledge is valuable to identify potentials of the built environment of a city, e.g., favorite places for recreation that otherwise are overlooked. Explicitly gathering the individual preferences of different user groups can contribute to a better understanding of their needs (e.g., due to their cultural background). In general, innovative participatory approaches are multifaceted, from StreetArt Festivals (Allianz Vielfältige Demokratie, 2017) to joint construction of buildings in the public space (Leino and Puumala, 2021). To this end, design research, and in particular the approach of design thinking, offers a wide-ranging assortment of methods (Kumar, 2013; Frazer and Kroll, 2022), in which design as a practice of designing acts as a strategic facilitator that seeks collective solutions through inter- and transdisciplinary processes.

Notably, small-scale interventions instead of large-scale projects offer a wide range of approaches that are cost-effective and quick to implement. The concepts of *urban acupuncture* and *tactical urbanism* both pursue these ideas, other frequently used terms are do-it-yourself urbanism or urban prototyping. While in traditional Chinese medicine acupuncture involves tiny

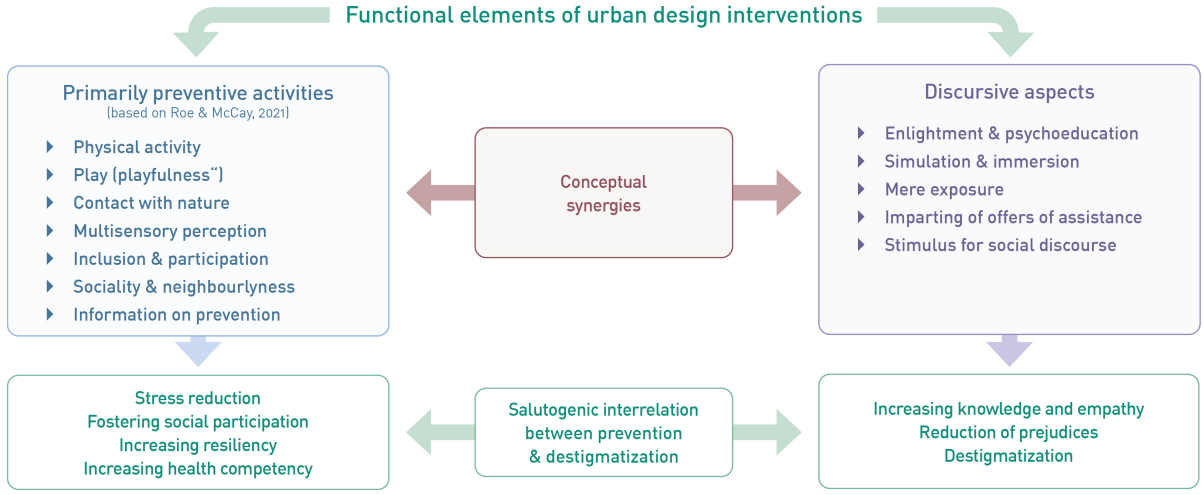

FIGURE 1
Overview of functional elements and their synergies to foster mental health and mental health literacy in the urban context.

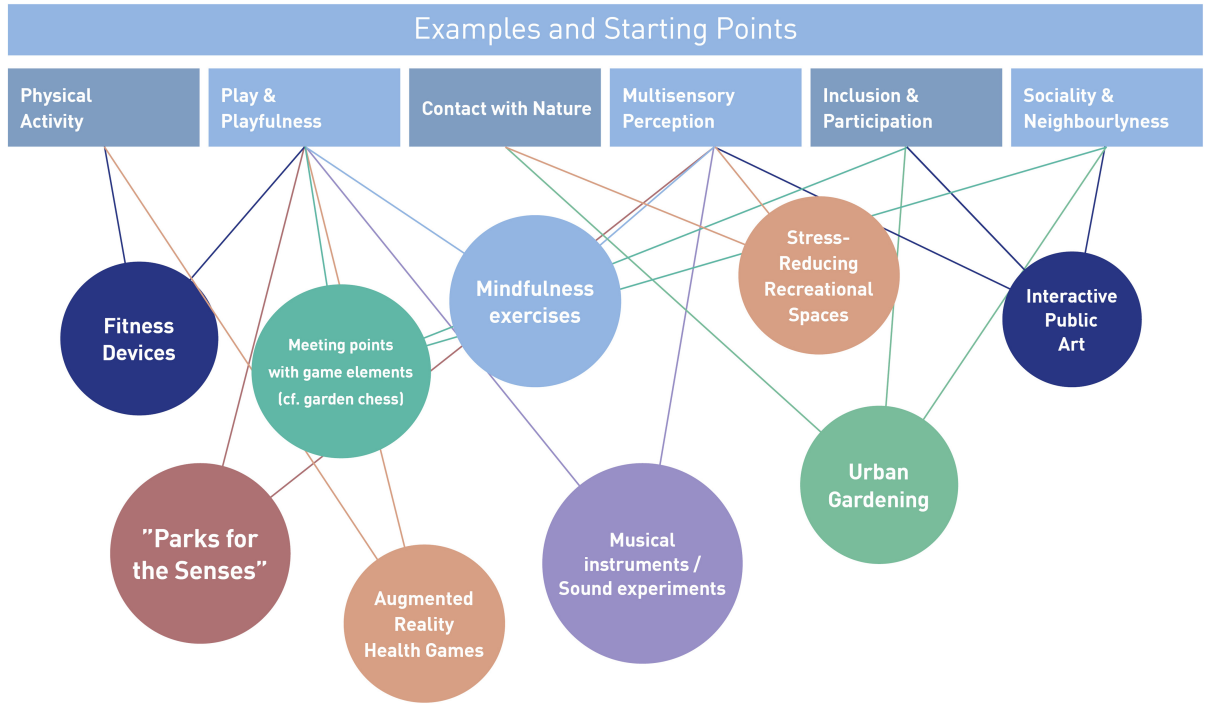

FIGURE 2
Examples of starting points for small-scale urban design interventions.

pinpricks to reduce pain, the concept of urban acupuncture uses small scale interventions in specific places to increase liveability in neighborhoods (Lerner, 2003; De Solà-Morales i Rubió et al., 2008; Casagrande, 2020). Lydon et al. (2011) promote a similar approach in the concept of tactical urbanism. Tactical urbanism focuses on small-scale interventions to redesign certain urban areas with the help of locals. The basic idea is to test new concepts on a small scale before scaling up and undertaking significant financial and/or political commitments. Co-creative processes can enrich both concepts in their practical implementation.

3. Conceptual framework for fostering urban mental health and mental health literacy

Against the backdrop of the aforementioned interdisciplinary theoretical analysis, we propose a conceptual framework for deploying cities as resources for mental health and mental health literacy. The framework builds upon the idea that urban settings act as both risk factors and resources (see Section “2.1.

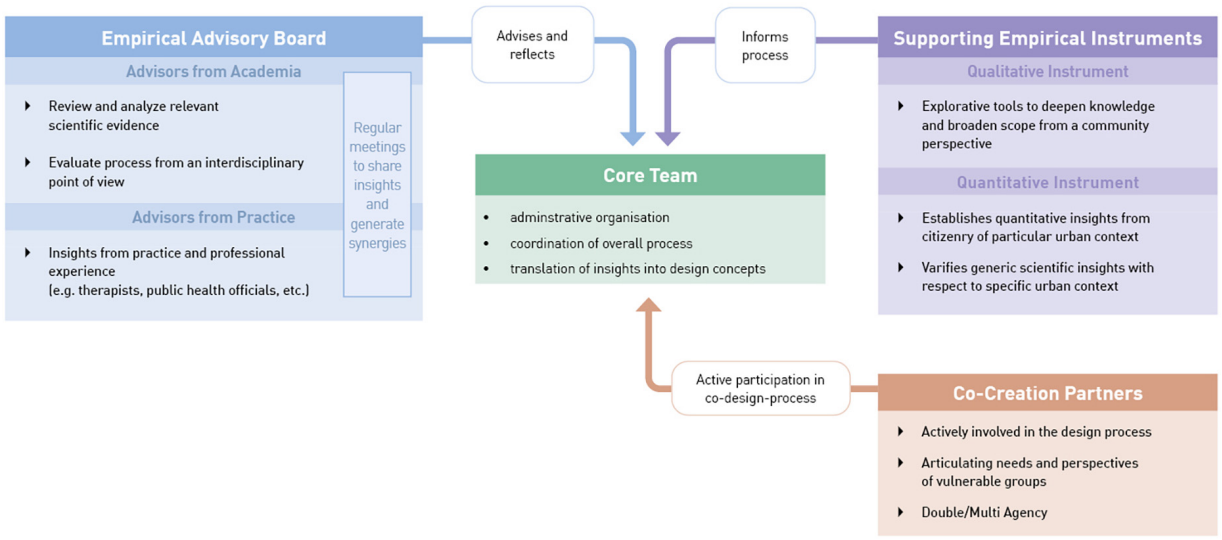

FIGURE 3
Structural model of the research and design process.

Psychological perspectives on urban mental health"). Deliberate design interventions that consider current best interdisciplinary evidence and suitable design paradigms can address the resources in an urban context (see Section "2.2. Design principles for promoting health and wellbeing"). In this design process, to address truly the needs of as many groups of citizens as possible, special attention needs to be paid to include especially vulnerable users (see Section "2.3. Potentials of participatory approaches for urban mental health"). Thus, a research-driven, interdisciplinary, evidence-based, and co-creative design process is required that considers and embraces multiple facets of the city's social fabric.

This conceptual framework consists of two levels: The *output* level illustrates the structural model and proposed effect mechanisms for urban design interventions. The *procedural* level refers to the mode of work and the organizational structure that is needed to co-create respective concepts.

3.1. Output level

Based on the presented theoretical background from (environmental) psychology, design research, and urban planning, we propose a set of interactive structures that are placed in specific locations in the urban context and directly refer to or even make use of their direct surroundings. These incorporate two main functions (**Figure 1**): (a) primarily preventive activities, (b) discursive aspects. At this point, we emphasize that examples illustrated in this chapter should only be seen as impulses and serve the purpose of stimulating further thinking and ideating without precluding context-sensitive design. Apart from that, we deliberately remain on an abstract level of analysis without introducing one specific intervention in order to keep the framework applicable to a wide range of design interventions and contexts.

First, building on the *Restorative Cities Framework* (Roe and McCay, 2021), design interventions in the urban context can offer or stimulate activities that proved to be beneficial for mental health and wellbeing. These include for example physical activity (Tamminen et al., 2020), exercises in mindfulness (Davidson et al., 2003), contact with nature (e.g., Alvarsson et al., 2010; Ryan et al., 2014; Salonen et al., 2022), and social interaction (Umberson and Montez, 2010). Additionally, urban design interventions can provide information on prevention of mental health issues such as stress reduction. The actual design of the given intervention and the activity addressed largely depend on the urban context at hand. Especially interventions that guide users' views or incorporate existing urban greenery by stimulating mindfulness, the urban context itself is the key element of the intervention and should therefore be carefully chosen and integrated. For instance, the growing body of literature on implementing and utilizing nature and the urban context for health benefits illustrates the wide range of design considerations when addressing health by design interventions (Beatley, 2016; Barron et al., 2019; Nieuwenhuijsen et al., 2022). Similar to the ideas of Wolf and Brinkley (2016), a systemic perspective is recommended when applying small scale design interventions to foster mental health. Both in scientific literature as well as realized urban practice, there is a broad range of examples of small-scale interventions as mentioned above. For instance, focusing mainly on physical activity and health in their project PREhealth, Halblaub Miranda et al. (2019) present a number of interventions aligned on a temporary fitness track in the city of Darmstadt. With regards to social interaction and creative stimuli, curated public street art projects combine a number of benefits outlined above. In the last decade, urban gardening initiatives and projects (e.g., Müller I. et al., 2022) illustrated the synergies of participatory approaches that fostered both ecological as well as social improvements for cities. The same applies to pocket parks and public fitness and play installations. Rendering otherwise neglected spaces such as building gaps into micro parks or offering low-threshold opportunities to work out or play mitigates local economic injustices and fosters not only

physical health but stimulates social interactions and feelings of belonging and participation. In their Project "Stadtflucht," Halblaub Miranda and Knöll (2016) make use of augmented reality tools to turn urban spaces into activity and puzzle games. By doing so, both social interaction and the element of playfulness (Graham and Burghardt, 2010) can contribute to mental health and wellbeing.

Figure 2 illustrates a number of examples or starting points for small scale interventions and their relation to categories outlined in **Figure 1**. Some of these examples merely refer to activities (e.g., "mindfulness exercise") without indicating a specific physical representation. These activities could for instance be addressed by visual cueing such as written or visualized instructions. Other examples are typically placed rather in rural or natural settings (e.g., "Parks of the Senses" are usually playground style sets of artifacts that stimulate multisensory interactions in parks or alongside beaches or lakes). However, we argue that these concepts represent enormous potential for the urban contexts when adapted to the specific spatial context. These urban settings pose a number of practical, regulatory and social requirements that need to be addressed when transferring these concepts. Therefore, close collaboration between public and urban designers and authorities is recommended.

Secondly, interventions can address discursive elements such as mental health literacy. Providing information on the emergence, relations, and possible treatment of mental health problems in the public space instead of behind closed doors holds the potential to increase mental health literacy on a low-threshold level. Addressing mental health in such an accessible way and people being confronted with the subject in their everyday lives – both subconsciously (through the mere exposure of the design interventions on their way to work, to the supermarket, or to the playground) as well as consciously through explicit involvement in the interventions (e.g., reading of information) – may achieve normalization and thus lose the connotation of a taboo. In addition, better understanding symptoms of mental health problems might reduce stigmas through information (Corrigan and O'Shaughnessy, 2007). Aspects of simulation and immersion could further increase empathy with those affected and at the same time increase awareness for mental health issues in oneself and one's surroundings. This element requires special attention to develop content that acknowledges the heterogenous user groups of urban public spaces, including people across all ages, from different cultural backgrounds as well as people facing mental and physical challenges. As with the preventive activities, a number of examples for addressing discursive elements can be found in scientific literature and practice. To facilitate learning processes regarding mental health, gamification approaches such as quizzes can be both useful and low-threshold. Furthermore, presenting small exercises that allow readers to directly experience for instance the interrelation between physical and psychological processes can be additionally persuasive. As an example, simple breathing protocols (e.g., "box breathing," see Balban et al., 2023) can be both educational and stress reducing. With regards to communication design, apart from graphic and textual illustrations physical models can further help understand general principles and increase curiosity of passersby. Apart from that, information in the public space on existing offerings of therapy, counseling, and support groups can help foster visibility. Furthermore, both activities and information can increase coping skills of people living with mental health problems. With this element, we explicitly go beyond other frameworks (e.g., Roe and McCay, 2021; Bornioli and Subiza-Pérez, 2022) mainly focusing on restoration. Both functions of the proposed interventions pose potential synergistic effects.

To find appropriate locations for such urban design interventions, we advocate a selection of suitable locations based on research and participatory processes. Explorative interviews and walk-along interviews can serve as means to direct researchers' attention to otherwise overlooked urban scenery. Ideas of changing perspectives on parking lots, old factory premises, or even cemeteries rooted in research on urban green (Kaplan et al., 1998; Harnik, 2012) may be transferred to other types of interventions in the urban context (see **Figure 2**) and thus foster the selection process. Also, the use of public participation geographic information systems (PPGIS) provides an approach for engaging marginalized groups through integrating and visualizing local knowledge in the form of (interactive) maps. Mapping emotions, behaviors, or activities in certain places can add to contextualize complex spatial information (Sieber, 2006) as a basis for detecting potential for small-scale design interventions, e.g., indicated through informal use. Furthermore, an evidence-based approach can help identify urban resources such as contact to nature (e.g., Ryan et al., 2014; Ryan and Browning, 2020) or views that promote prospect and refuge (Petherick, 2000). Like this, interventions can make use of their direct surroundings.

3.2. Process level

As stated before, in order to co-create effective urban design interventions that aim at fostering mental health for a broad range of users a particularly participatory approach is needed. At the same time, interdisciplinary scientific knowledge needs to be considered to make use of current best evidence. Based on these considerations, we propose a structural model that is built of four elements (**Figure 3**): At the core of this setup is the administrative and organizational management of the process, which we label as *Core Team*. Without implying any form of hierarchy, the task of this structural element is to coordinate the overall process and translate insights from all other parts into implementable design concepts. From a disciplinary point of view, it is advisable to incorporate experts for public design or other built environment specialists that provide sufficient know-how regarding design processes and the pragmatic needs and requirements of the public space.

In addition, the *Co-Creation Partners* represent a set of relevant stakeholders (e.g., from municipality, NGOs, and representatives from population groups). Public participation broadly distinguishes between three groups that need to be involved in participatory approaches: individuals, citizens' initiatives, and organized public (such as interest groups, associations). Interest groups and initiatives differ depending on the particular topic (Arbter, 2009). Representatives from different target groups or communities of interest are previously defined as relevant stakeholders through *Stakeholder Mapping* (de Vincente Lopez and Matti, 2016). This group is actively involved in creating new

concepts and evaluating them based on their particular role in the project. It is worth mentioning that people can act as "double agents" (Smizz and Walters, 2018) in the sense that they do not only represent one specific group (e.g., with certain vulnerabilities) but relate to other categories as well (Cameron and Grant-Smith, 2005). Participants can therefore, e.g., represent people living with mental health problems and commuters at the same time.

The structural element of an *Empirical Advisory Board* serves to provide guidance to the core team. Interdisciplinary advisors from academia review and analyze the relevant scientific evidence that needs to be considered for designing in the context at hand. Advisors from practice enrich the scientific evidence with experiential insights. The advisory board members meet regularly to evaluate the status of the project based on their synergetic expertise. From a methodological point of view, this advisory board needs to form a mode of work that allows the sharing of knowledge across and even beyond disciplines, which might require the establishment of a specific non-disciplinary lingo. To avoid mere multidisciplinary instead of inter- and transdisciplinary cooperation (Institute of Medicine., 2005), an integration of knowledge is needed, thus achieving truly new insights (Boix Mansilla et al., 2016). The rationale behind this element is the belief that for addressing complex issues such as urban mental health we should not rely on a single discipline but integrate expertise across disciplines (Gruebner et al., 2017) and if possible, across nations.

Finally, *Supporting Empirical Instruments* aim at informing the process by establishing insights from the citizenry of the chosen urban context. In doing so, citizens can be asked on design preferences, usage intentions, and existing knowledge, e.g., to validate initial drafts of urban design interventions. We assess this element to be necessary to translate generic scientific insights to the unique urban context at hand. Here, we distinguish qualitative methods (e.g., focus groups, walk-along interviews) from quantitative methods (e.g., surveys). Insights gained from applying both kinds of methods can complement each other in the design process.

A number of empirical tools and methods can be utilized in line with the quantitative instrument to evaluate the *status quo* of the urban environment at hand: The survey tool "StadtRaumMonitor" ("CitySpaceMonitor," translated by authors, Bundeszentrale für gesundheitliche Aufklärung, 2023) published by the German Federal Center for Health Education covers 15 constructs clustered into four categories (mobility; public space; supply, work and housing; social interaction). Comparably, the Scottish Government, Architecture and Design Scotland and NHS Health Scotland have developed the Place Standard tool (Our Place Team, 2023) as a simple and participatory evaluation tool for public places. These and other approaches can represent an empirical basis, upon which the participatory process of developing urban design interventions can take place.

4. Discussion

This paper aimed at integrating perspectives from environmental and health psychology, design research, and urban planning leading to a conceptual framework for urban design interventions in public space to act as biopsychosocial resources for urban mental health and mental health literacy in a low-threshold, resource-efficient way. On an output level, the framework presents preventive as well as discursive measures, thus including multisensory as well as cognitive engagement. On a process level, it depicts the interplay of different stakeholder groups to be included in the design process, ranging from researchers, to citizenry, as well as municipality. In doing so, we suggest a rich potential of urban environments to act as resources for mental health and to address mental health in the public space (van der Wal et al., 2021). Drawing on interdisciplinary literature and empirical findings, we first illustrated strong associations between mental wellbeing and environments along with the idea to use this relation through deliberate design interventions. In these considerations, we underlined the importance of co-creation in urban design interventions and described the possibilities as well as the pitfalls of participatory approaches. We conclude by discussing considerations for the application of our framework as well as limitations of our work.

4.1. Considerations on application of framework

As a pretest of the framework, in November 2022, we presented a simplified version of this framework to an interdisciplinary group of public health experts at the European Public Health Conference (Müller H. et al., 2022). In a workshop format, participants then interactively applied the framework to existing mental health issues in the urban context by referring to resources the city offers. The resulting ideas mainly addressed preventive aspects such as social participation and contact with nature, while discursive aspects were scarce. This may point to the benefit of an inter- and transdisciplinary development of interventions explicitly focusing on the twofold potentials described in the presented framework. While this workshop did not aim at a scientific validation of this framework, *ad hoc* concepts developed by subgroups of the audience showed both innovative and feasible approaches that addressed several considerations presented above. The overall feedback of the interdisciplinary group of experts from fields such as medicine, public health, and social sciences was positive and emphasized the relevance of the topic and innovative potential of this framework.

However, mental health is a sensitive topic that might act as a trigger for certain people. Therefore, it is crucial to include people with lived experiences in the design process of urban design interventions, especially when they entail simulation and immersion. In addition, mental healthcare professionals should be included in creating information material (e.g., psychoeducation) to ensure scientific validity. As the interventions discussed would be placed in urban public spaces, thus offering access to a wide range of people (e.g., in terms of age and educational background), the information provided should be edited in a way that is easily understandable and visually appealing at the same time. Here again, including people of different ages and backgrounds in the design process can increase accessibility to a wide range of users.

To successfully implement such interventions, we argue that citizens should be included in the research process addressing

measures to foster mental health in urban environments (Dooris and Heritage, 2013). In doing so, special efforts are required to include hard to reach target groups (e.g., people with low income). Researchers in such processes are required to unlearn their habitual way of doing research and welcome citizens from different backgrounds as experts of their cities.

Further, to successfully implement design interventions for fostering mental health and mental health literacy a close cooperation with the given municipality is needed. As there are various regulations to be considered in urban space, we recommend including municipality stakeholders from the very beginning of a project. Also, design interventions in public space are prone to vandalism, which should be taken into account. However, including citizens in the design process can help reduce vandalism through higher identification with the environment created (Brown et al., 2004). In addition to that, paradigms such as *Design against Crime* (e.g., Armitage and Ekblom, 2019) can be applied. Highlighting that the intended interventions should be cost-efficient and make use of already existing resources in the urban environment may facilitate dialogue with municipality stakeholders.

The proposed design interventions aim to increase prevention but also knowledge and thus agency regarding mental health in the general population. This is in line with other initiatives such as the Mental Health First Aid (MHFA) programme (Kitchener and Jorm, 2008), although in a less formal, institutionalized way. Instead, we propose especially low-threshold measures in public urban spaces to increase awareness for mental health as it gains importance in urban environments (Okkels et al., 2017). An extension of preventive measures with a low threshold is crucial to ensure accessibility by large shares of the urban population. In addition, reaching the largest possible share of the population is a prerequisite to contribute to destigmatization of the topic, as it allows enlightenment not only for a select few. To that aim, these measures need to be decentralized across the city in order to be reachable by people with reduced action range, as well. Further, we suggest to extent mental health literacy to empower people to be attentive to mental health issues, especially in times of crisis such as pandemic, war, and climate change, and to help reduce stigmatization through better information (Corrigan and O'Shaughnessy, 2007). Here, we expect changes in awareness through mere exposure to the topic in day-to-day life. As urban environments are complex systems, interdisciplinary perspectives (e.g., from urban planning, design, and psychology) can help create measures addressing this potential including existing urban features by using evidence-based, salutogenic design.

While this framework addresses resources and implementation protocols for the urban setting, it is likely that this approach is as useful for rural contexts, as well. Still, due to its density of people and offerings, cities pose a particularly rich playing field to pilot this concept.

4.2. Limitations and future research

Until now, the proposed framework remains on a conceptual level. Further elaboration for specific contexts and empirical validation is still needed to verify the assumed relations and effects of respective design interventions on citizens' mental health as well as their mental health literacy. To that aim, single small-scale design interventions could be put up in public spaces as experiments. Accompanying research (e.g., observations, cultural probes, and surveys) including a post-occupancy evaluation (e.g., Preiser and Nasar, 2008) would provide further insights into effectiveness of and reaction to possible interventions. So far, the framework provides an easily applicable approach to fostering mental health and mental health literacy in the urban context by inter- and transdisciplinary cooperation in an innovative way.

Importantly, the proposed urban design interventions are not meant to act as substitutes for psychotherapeutic treatment but could rather have a preventive (and potentially complementary) effect regarding mental disorders and could provide low-threshold information services when needed. The shortage of psychotherapeutic care cannot be solved by such interventions but needs to be tackled on a political level. Yet, contributing to a prevention or mitigation of mental disorders is an important asset addressed here.

5. Conclusion

Urban mental health is an increasing challenge of our time. To tackle this challenge, we aim for combining evidence-based, salutogenic, psychosocially supportive design to help increase awareness for mental health–instead of mainly physical health–by implementing low-threshold options in the existing urban context. To this end, inter- and transdisciplinary cooperation deems necessary as urban mental health is a complex topic, which requires the expertise from science as well as lived experience. With this innovative approach, we advocate physically bringing the topic of mental health to the built urban environment to raise awareness, contribute to a destigmatization of the topic and potentially foster mental health and mental health literacy. This promotes the idea that the urban built environment cannot only be restorative, but it also holds the potential to be informative as well as engaging in terms of mental health and mental health literacy for large shares of the population. As public spaces belong to the citizens, they are well used for fostering citizens' health. This illustrates new directions of research for urban person-environment interactions, public health, and beyond.

Data availability statement

The original contributions presented in this study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

HM: conceptualization, writing–original draft, and writing–review and editing. JR-G: conceptualization, visualization, and writing–original draft. AW: conceptualization and writing–original draft. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

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References

Adli, M. (2017). *Stress and the City: Warum Städte uns krank machen. Und warum sie trotzdem gut für uns sind*. München: Bertelsmann.

Allianz Vielfältige Demokratie (2017). *Wegweiser breite Beteiligung. Argumente, Methoden, Praxisbeispiele*. Berlin: Berlin Institut für Partizipation.

Alvarsson, J. J., Wiens, S., and Nilsson, M. E. (2010). Stress recovery during exposure to nature sound and environmental noise. *IJERPH* 7, 1036–1046. doi: 10.3390/ijerph7031036

Amin, A. (2018). Collective culture and urban public space. *City* 12, 5–24. doi: 10.1080/13604810801933495

Andrilla, C., Patterson, D. G., Garberson, L. A., Coulthard, C., and Larson, E. H. (2018). Geographic variation in the supply of selected behavioral health providers. *Am. J. Prev. Med.* 54(6 Suppl. 3), S199–S207. doi: 10.1016/j.amepre.2018.01.004

Angermeyer, M. C., Matschinger, H., and Schomerus, G. (2013). Attitudes towards psychiatric treatment and people with mental illness: Changes over two decades. *Br. J. Psychiatry* 203, 146–151. doi: 10.1192/bjp.bp.112.122978

Antonovsky, A. (1979). *Health, stress, and coping*. San Francisco, CA: Jossey-Bass.

Arbter, K. (2009). Öffentlichkeitsbeteiligung ja, aber wie? Standards für qualitätsvolle Beteiligungsprozesse. *jeDEM.* 1, 30–39. doi: 10.29379/jedem.v1i1.2

Armitage, R., and Ekblom, P. (eds) (2019). *Rebuilding crime prevention through environmental design. Strengthening the links with crime science*. London: Routledge.

Arnstein, S. (1969). A ladder of citizen participation. *J. Am. Plann. Assoc.* 35, 216–224. doi: 10.1080/01944366908977225

Astell-Burt, T., Feng, X., Mavoa, S., Badland, H. M., and Giles-Corti, B. (2014). Do low-income neighbourhoods have the least green space? A cross-sectional study of Australia's most populous cities. *BMC Public Health* 14:292. doi: 10.1186/1471-2458-14-292

Astell-Burt, T., Hartig, T., Eckermann, S., Nieuwenhuijsen, M., McMunn, A., Frumkin, H., et al. (2021). More green, less lonely? A longitudinal cohort study. *Int. J. Epidemiol.* 51, 99–110. doi: 10.1093/ije/dyab089

Australian Capital Territory (2020). *Great place guide. A guide to making great places*. Canberra, ACT: Australian Capital Territory.

Backhaus, N., and Müller-Böker, U. (2006). *Gesellschaft und Raum: Konzepte und Kategorien*. Zürich: Universität Zürich.

Bagnall, A. M., South, J., Di Martino, S., Mitchell, B., Pilkington, G., and Newton, R. (2017). *A systematic scoping review of reviews of the evidence for "What works to boost social relations" and its relationship to community wellbeing*. London: What Works Centre for Wellbeing.

Balban, M. Y., Neri, E., Kogon, M. M., Weed, L., Nouriani, B., Jo, B., et al. (2023). Brief structured respiration practices enhance mood and reduce physiological arousal. *Cell Rep. Med.* 4:100895. doi: 10.1016/j.xcrm.2022.100895

Barron, S., Nitoslawski, S., Wolf, K. L., Woo, A., Desautels, E., and Sheppard, S. R. J. (2019). Greening blocks: A conceptual typology of practical design interventions to integrate health and climate resilience co-benefits. *Int. J. Environ. Res. Public Health* 16:4241. doi: 10.3390/ijerph16214241

Barsalou, L., Niedenthal, P., Barbey, A., and Ruppert, J. (2003). "Social embodiment," in *The psychology of learning and motivation*, ed. B. Ross (San Diego, CA: Academic Press), 43–92. doi: 10.1016/S0079-7421(03)01011-9

Baumgart, S., Köckler, H., Ritzinger, A., and Rüdiger, A. (eds) (2018). *Planung für gesundheitsfördernde Städte*. Hannover: Akademie für Raumforschung und Landesplanung.

Beatley, T. (2016). *Handbook of biophilic city planning & design*. Washington D.C: Island Press. doi: 10.5822/978-1-61091-621-9

Bengel, J., Strittmatter, R., and Willmann, H. (1998). *Was hält Menschen gesund? Antonovskys Modell der Salutogenese – Diskussionsstand und Stellenwert. Forschung und Praxis der Gesundheitsförderung Band 6*. Köln: Bundeszentrale für gesundheitliche Aufklärung.

Boix Mansilla, V., Lamont, M., and Sato, K. (2016). Shared cognitive-emotional-interactional platforms: Markers and conditions for successful interdisciplinary collaborations. *Sci. Technol. Hum. Values* 41, 571–612. doi: 10.1177/0162243915614103

Bornioli, A., and Subiza-Pérez, M. (2022). Restorative urban environments for healthy cities: A theoretical model for the study of restorative experiences in urban built settings. *Landsc. Res.* 48, 152–163. doi: 10.1080/01426397.2022.2124962

Brenner, N. (2009). What is critical urban theory? *City* 13, 198–207. doi: 10.1080/13604810902996466

Brown, B. B., Perkins, D. D., and Brown, G. (2004). Incivilities, place attachment and crime: block and individual effects. *J. Environ. Psychol.* 24, 359–371. doi: 10.1016/j.jenvp.2004.01.001

Bundespsychotherapeutenkammer, (2018). *Ein Jahr nach der Reform der Psychotherapie-Richtlinie: Wartezeiten 2018*. Available online at: https://www.bptk.de/wp-content/uploads/2019/01/20180411_bptk_studie_wartezeiten_2018.pdf (accessed March 8, 2023).

Bundeszentrale für gesundheitliche Aufklärung (2023). *Der Stadtraummonitor – Wie lebenswert finde ich meine Umgebung?* Available online at: https://stadtraummonitor.bzga.de/ (accessed March 8, 2023).

Cameron, J., and Grant-Smith, D. (2005). Building citizens: Participatory planning practice and a transformative politics of difference. *Urban Policy Res.* 23, 21–36. doi: 10.1080/0811114042000335296

Casagrande, M. (2020). "From urban acupuncture to the third generation city," in *Nature driven urbanism. Contemporary urban design thinking*, ed. R. Roggema (Cham: Springer International Publishing), 131–153. doi: 10.1007/978-3-030-26717-9_7

Center for Active Design (2010). *Active design guidelines. Promoting physical activity and health in design*. New York, NY: City of New.

Center for Active Design (2018). *Assembly: Civic design guidelines*. New York, NY: Center for Active Design.

Corrigan, P. W., and O'Shaughnessy, J. R. (2007). Changing mental illness stigma as it exists in the real world. *Austr. Psychol.* 42, 90–97. doi: 10.1080/00050060701280573

Dang, H. M., Lam, T. T., Dao, A., and Weiss, B. (2020). Mental health literacy at the public health level in low and middle income countries: An exploratory mixed methods study in Vietnam. *PLoS One* 15:e0244573. doi: 10.1371/journal.pone.0244573

Davidson, R. J., Kabat-Zinn, J., Schumacher, J., Rosenkranz, M., Muller, D., Santorelli, S. F., et al. (2003). Alterations in brain and immune function produced

by mindfulness meditation. *Psychosom. Med.* 65, 564–570. doi: 10.1097/01.PSY.0000077505.67574.E3

De Solà-Morales i Rubió, M., Frampton, K., and Ibelings, H. (2008). *A matter of things*. Rotterdam: nai010 publishers.

de Vincente Lopez, J., and Matti, C. (2016). *Visual toolbox for system innovation. A resource book for practitioners to map, analyze and facilitate sustainability transitions*. Brussels: Climate KIC.

Devlin, A. S. (2014). *Transforming the doctor's office. Principles from evidence-based design*. New York, NY: Routledge.

Dijkstra, K. (2009). *Understanding healing environments. Effects of physical environmental stimuli on patients' health and well-being*. Enschede: University of Twente.

Dilani, A. (2005). A new paradigm of design and health in hospital planning. *World Hosp. Health Servic.* 41, 17–21.

Dooris, M., and Heritage, Z. (2013). Healthy cities: Facilitating the active participation and empowerment of local people. *J. Urban Health* 90, 74–91. doi: 10.1007/s11524-011-9623-0

Engel, G. L. (1977). The need for a new medical model: A challenge for biomedicine. *Science* 196, 129–136. doi: 10.1126/science.847460

Fofana, N., Latif, F., Sarfraz, S., Bilal, M., Bashir, M. F., and Komal, B. (2020). Fear and agony of the pandemic leading to stress and mental illness: An emerging crisis in the novel coronavirus (COVID-19) outbreak. *Psychiatry Res.* 291:113230. doi: 10.1016/j.psychres.2020.113230

Fogg, B. J. (2003). *Persuasive technology. Using computers to change what we think and do*. Amsterdam: Morgan Kaufmann. doi: 10.1145/764008.763957

Frazer, K., and Kroll, T. (2022). Skills building seminar: Design thinking: adopting a human-centred approach to tackling complex problems. *Eur. J. Public Health* 32(Suppl. 3):ckac129.531. doi: 10.1093/eurpub/ckac129.531

Gesler, W. M. (1993). Therapeutic landscapes: Theory and a case study of Epidauros, Greece. *Environ Plan D* 11, 171–189. doi: 10.1068/d110171

Global Burden of Disease Collaborative Network. (2021). *Global burden of disease study 2019 (GBD 2019) results*. Seattle, WA: Institute for Health Metrics and Evaluation (IHME).

Graham, K. L., and Burghardt, G. M. (2010). Current perspectives on the biological study of play: signs of progress. *Q. Rev. Biol.* 85, 393–418. doi: 10.1086/656903

Gruebner, O., Rapp, M., Adli, M., Kluge, U., Galea, S., and Heinz, A. (2017). Cities and mental health. *Deutsches Ärzteblatt Int.* 114, 121–127. doi: 10.3238/arztebl.2017.0121

Halblaub Miranda, M., and Knöll, M. (2016). Stadtflucht. Learning about healthy places with a location-based game. *Navigationen Zeitschrift Medien Kulturwissenschaften* 16, 101–118. doi: 10.25969/mediarep/1613

Halblaub Miranda, M., Vasquez Fauggier, G., and Knöll, M. (2019). *PREHealth: Designing health into urban green and blue infrastructures. The need for action in planning, policies, and research*. International Synthesis Report. Darmstadt: Technische Universität Darmstadt.

Halblaub, M., Hardy, S., Knöll, M., and Department of Management. (eds) (2015). "MoMe: A context-sensitive mobile application to research spatial perception and behaviour," in *Human mobility, cognition and GISc. Conference proceedings*, (Copenhagen: University Press), 29–30.

Hamilton, D. K. (2003). The four levels of evidence-based practice. *Healthc. Design* 11, 19–26.

Harnik, P. (2012). *Urban green: Innovative parks for resurgent cities*. Washington, DC: Island Press.

Hartig, T. (2004). "Restorative environments," in *Encyclopedia of applied psychology*, ed. C. Spielberger (Cham: Springer), 273–279. doi: 10.1016/B0-12-657410-3/00821-7

Hartig, T. (2021). "Restoration in nature: Beyond the conventional narrative," in *Nature and psychology, Nebraska symposium on motivation 67*, eds A. R. Schutte, J. C. Torquati, and J. R. Stevens (Cham: Springer Nature). doi: 10.1007/978-3-030-69020-5_5

Hickman, C., Marks, E., Pihkala, P., Clayton, S., Lewandowski, E., Mayall, E., et al. (2021). Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey. *Lancet Planet. Health* 5, e863–e873. doi: 10.1016/S2542-5196(21)00278-3

Institute of Medicine. (2005). *Facilitating interdisciplinary research*. Washington, DC: The National Academies Press, doi: 10.17226/11153

Jansen, S. (2018). *The seven principles to complete co-creation*. Amsterdam: BIS Publisher.

Jorm, A. F. (2012). Mental health literacy: Empowering the community to take action for better mental health. *Am Psychol.* 67, 231–243. doi: 10.1037/a0025957

Jorm, A. F., Korten, A. E., Jacomb, P. A., Christensen, H., Rodgers, B., and Pollitt, P. (1997). "Mental health literacy": a survey of the public's ability to recognize mental disorders and their beliefs about the effectiveness of treatment. *Med. J. Aust.* 166, 182–186. doi: 10.5694/j.1326-5377.1997.tb140071.x

Kaplan, R., and Kaplan, S. (1989). *The experience of nature: A psychological perspective*. Cambridge: Cambridge University Press.

Kaplan, R., Kaplan, S., and Ryan, R. L. (1998). *With people in mind: Design and management of everyday nature*. Washington DC: Island Press.

Kellert, S. R., Heerwagen, J., and Mador, M. (eds) (2008). *Biophilic design. The theory, science, and practice of bringing buildings to life*. Hoboken, NJ: Wiley.

Kirsty, C., Craig, C., and Wolstenholme, D. (eds) (2018). *Proceedings of the 5th European international conference on design health*. Sheffield: Hallam University.

Kitchener, B. A., and Jorm, A. F. (2008). Mental health first aid: An international programme for early intervention. *Early Interv. Psychiatry* 2, 55–61. doi: 10.1111/j.1751-7893.2007.00056.x

Knöll, M., Dutz, T. A., Hardy, S., and Göbel, S. (2014). *Urban exergames: How architects and serious gaming researchers collaborate on the design of digital games that make you move. Virtual, augmented reality and serious games for healthcare*. Berlin: Springer.

Knöll, M., Neuheuser, K., Cleff, T., and Rudolph-Cleff, A. (2018). A tool to predict perceived urban stress in open public spaces. *Environ. Plann. Urban Anal. City Sci.* 45, 797–813. doi: 10.1177/0265813516686971

Kuder, T. (2016). Starke lokale Demokratie: Leitlinien für eine hochwertige, inklusive Bürgerbeteiligung. *Vhw werkSTADT* 1, 1–12.

Kumar, V. (2013). *101 design methods. A structured approach for driving innovation in your organization*. Hoboken, NJ: Wiley.

Lederbogen, F., Kirsch, P., Haddad, L., Streit, F., Tost, H., Schuch, P., et al. (2011). City living and urban upbringing affect neural social stress processing in humans. *Nature* 474, 498–501. doi: 10.1038/nature10190

Leino, H., and Puumala, E. (2021). What can co-creation do for the citizens? Applying co-creation for the promotion of participation in cities. *Environ. Plann. C Politics Space* 39, 781–799. doi: 10.1177/2399654420957337

Lerner, J. (2003). *Urban acupuncture. Celebrating pinpricks of change that enrich city life*. Washington, DC: Island Press.

Lockton, D., Harrison, D., and Stanton, N. A. (2010). The design with intent method: A design tool for influencing user behavior. *Appl. Ergon.* 41, 382–392. doi: 10.1016/j.apergo.2009.09.001

Lydon, M., Bartman, D., Woudstra, R., and Khawarzad, A. (2011). *Tactical urbanism Vol.1. Short term action – long term change*. New York, NY: The street plans collaborative.

Mahmoud, I. H., Morello, E., Ludlow, D., and Salvia, G. (2021). Co-creation pathways to inform shared governance of urban living labs in practice: Lessons from three European projects. *Front. Sustain. Cities* 3:690458. doi: 10.3389/frsc.2021.690458

Malkin, J. (2008). *A visual reference for evidence-based design*. Concord, CA: Center for Health Design.

Marselle, M., Bowler, D., Watzema, J., Eichenberg, D., Kirsten, T., and Bonn, A. (2020). Urban street tree biodiversity and antidepressant prescriptions. *Sci. Rep.* 10, 1–11. doi: 10.1038/s41598-020-79924-5

Michie, S., Atkins, L., and West, R. (2014). *The behaviour change wheel. A guide to designing interventions (1st Ed.)*. London: Silverback.

Mihaylov, N., and Perkins, D. D. (2013). "Community place attachment and its role in social capital development," in *Place attachment. Advances in theory, methods and research*, eds L. C. Manzo and P. Devine-Wright (London: Routledge), 61–74. doi: 10.1371/journal.pone.0221148

Moore, P. (1985). *Disguised. A true story*. Nashville, TN: W Publishing Group.

Müller, H., Rehn-Groenendijk, J., and Wasmer, A. (2022). Workshop: Urban design interventions for fostering mental health and mental health literacy. *Eur. J. Public Health* 32(Suppl. 3), ckac129.394. doi: 10.1093/eurpub/ckac129.394

Müller, I., Pallagst, K., and Hammer, P. (2022). Revitalization of inner-city brownfields through urban gardening exemplified by the Kölner Neuland e.V. in Germany. *Ra Ximhai* 07, 165–196. doi: 10.35197/rx.18.03.2022.07.im

Nieuwenhuijsen, M. J. (2020). *COVID19 and the city: The COVID19 pandemic and the transformation of the city*. Barcelona: MJN Publishers.

Nieuwenhuijsen, M. J., Dadvand, P., Marquez, S., Bartoll, X., Barboza, E. P., Cirach, M., et al. (2022). The evaluation of the 3-30-300 green space rule and mental health. *Environ. Res.* 215:114387. doi: 10.1016/j.envres.2022.114387

Nightingale, F. (1860). *Notes on nursing. What it is, and What it is Not*, 1st Edn. New York, NY: D. Appleton and Company.

Nightingale, F. (1863). *Notes on hospitals*, 3rd Edn. London: Longman, Green, Roberts.

Okkels, N., Kristiansen, C. B., and Munk-Jørgensen, P. (2017). "Review of Urban Mental Health," in *Mental health and illness in the city. Mental health and illness worldwide*, eds N. Okkels, C. Kristiansen, and P. Munk-Jorgensen (Singapore: Springer). doi: 10.1007/978-981-10-0752-1_1-1

Ortega-Alcázar, I., and Dyck, I. (2012). Migrant narratives of health and well-being: Challenging 'othering' processes through photo-elicitation interviews. *Crit. Soc. Policy* 32, 106–125. doi: 10.1177/0261018311425981

Our Place Team (2023). *Place standard tool: How good is our place?* Available online at: https://www.ourplace.scot/essential-maintenance (accessed March 8, 2023).

Peen, J., Schoevers, R. A., Beekman, A. T., and Dekker, J. (2010). The current status of urban-rural differences in psychiatric disorders. *Acta Psychiatr. Scand.* 121, 84–93. doi: 10.1111/j.1600-0447.2009.01438.x

Petherick, N. (2000). Environmental design and fear. The prospect-refuge model and the university college of the Cariboo campus. *Western Geogr.* 10/11, 89–112.

Preiser, W., and Nasar, J. (2008). Assessing building performance: Its evolution from post-occupancy evaluation. *Int. J. Architec. Res. Archnet.* 2, 84–99. doi: 10.26687/archnet-ijar.v2i1.179

Priebe, S., and Wright, D. (2006). The provision of psychotherapy: An international comparison. *J. Public Ment. Health* 5, 12–22. doi: 10.1108/17465729200600022

Prina, A., Ferri, C., Guerra, M., Brayne, C., and Prince, M. (2011). Prevalence of anxiety and its correlates among older adults in Latin America, India and China: Cross-cultural study. *Br. J. Psychiatry* 199, 485–491. doi: 10.1192/bjp.bp.110.083915

Quilling, E., and Köckler, H. (2018). "Partizipation für eine gesundheitsfördernde Stadtentwicklung," in *Planung für gesundheitsfördernde Städte*, eds S. Baumgart, H. Köckler, A. Ritzinger, and A. Rüdiger (Hannover: Verlag der ARL), 101–117.

Rehn, J. (2018). "Design model for health behaviour change," in *Proceedings of the 5th European International Conference on Design Health*, eds C. Kirsty, C. Craig, and D. Wolstenholme (Sheffield: Hallam University).

Rehn, J. (2019). *Gesunde gestaltung. Priming- und placebo-effekte als gesundheitsverhaltenswirksame empiriegestützte gestaltungsmethodik*. Wiesbaden: Springer Fachmedien. doi: 10.1007/978-3-658-23555-0

Rioux, L., Scrima, F., and Werner, C. M. (2017). Space appropriation and place attachment: University students create places. *J. Environ. Psychol.* 50, 60–68. doi: 10.1016/j.jenvp.2017.02.003

Risdon, C., Quattlebaum, P., and Rettig, M. (2018). *Orchestrating experiences. Collaborative design for complexity*. New York, NY: Rosenfeld Media.

Roe, J. (2010). *The restorative power of natural and built environments: A mixed methods approach to restorative environments research*. Chisinau: Lambert Academic Publishing.

Roe, J., and McCay, L. (2021). *Restorative cities – urban design for mental health and wellbeing*. London: Bloomsbury. doi: 10.5040/9781350112919

Rubin, H., Owens, A., and Golden, G. (1998). *Status report (1998). An investigation to determine whether the built environment affects patient's medical outcomes*. Baltimore, MD: The Center for Health Design.

Rump, R., and Richter, P. (2009). "Aneignung von Raum," in *Architekturpsychologie*, ed. P. Richter (Lengerich: Pabst Science Publishers), 293–317.

Ryan, C. O., and Browning, W. D. (2020). "Biophilic design," in *Sustainable built environments*, ed. V. Loftness (New York, NY: Springer US), 43–85. doi: 10.1007/978-1-0716-0684-1_1034

Ryan, C. O., Browning, W. D., Clancy, J. O., Andrews, S. L., and Kallianpurkar, N. B. (2014). Biophilic design patterns. Emerging nature-based parameters for health and well-being in the built environment. *Int. J. Architec. Res.* 8, 62–76. doi: 10.26687/archnet-ijar.v8i2.436

Salonen, K., Hyvönen, K., Paakkolanvaara, J.-V., and Korpela, K. (2022). Flow with nature treatment for depression: participants' experiences. *Front. Psychol.* 12:768372. doi: 10.3389/fpsyg.2021.768372

Schubert, C. (ed.) (2011). *Psychoneuroimmunologie und Psychotherapie mit 10 Tabellen*. Stuttgart: Schattauer.

Scopelliti, M., Carrus, G., and Bonaiuto, M. (2019). Is it really nature that restores people? A comparison with historical sites with high restorative potential. *Front. Psychol.* 9:2742. doi: 10.3389/fpsyg.2018.02742

Sickel, A. E., Seacat, J. D., and Nabors, N. A. (2014). Mental health stigma update: A review of consequences. *Adv. Ment. Health* 12, 202–215. doi: 10.1080/18374905.2014.11081898

Sieber, R. (2006). Public participation geographic information systems: A literature review and framework. *Ann. Assoc. Am. Geogr.* 96, 491–507. doi: 10.1111/j.1467-8306.2006.00702.x

Smizz, S., and Walters, J. (eds) (2018). *Double agency. Prologue. Sheffield Hallam University's Lab4Living Research*. Available online at: https://www.docdroid.net/iH5ec6I/double-agency-a5-finished-pdf (accessed March 8, 2023).

Steg, L., and de Groot, J. (2018). *Environmental psychology: An introduction*, 2nd Edn. Hoboken, NJ: Wiley. doi: 10.1002/9781119241072

Steinfeld, E., and Maisel, J. L. (2012). *Universal design. Creating inclusive environments*. Hoboken, NJ: Wiley.

Sugiyama, T., Cole, R., Koohsari, M. J., Kynn, M., Sallis, J. F., and Owen, N. (2019). Associations of local-area walkability with disparities in residents' walking and car use. *Prev. Med.* 120, 126–130. doi: 10.1016/j.ypmed.2019.01.017

Svensson, B., and Hansson, L. (2016). How mental health literacy and experience of mental illness relate to stigmatizing attitudes and social distance towards people with depression or psychosis: A cross-sectional study. *Nord. J. Psychiatry* 70, 309–313. doi: 10.3109/08039488.2015.1109140

Tamminen, N., Reinikainen, J., Appelqvist-Schmidlechner, K., Borodulin, K., Mäki-Opas, T., and Solin, P. (2020). Associations of physical activity with positive mental health: a population-based study. *Ment. Health Phys. Act.* 18:100319. doi: 10.1016/j.mhpa.2020.100319

Tong, S., McGregor, G., and Kinney, P. (2021). Urban heat: An increasing threat to global health. *BMJ* 375:n2467. doi: 10.1136/bmj.n2467

Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science* 224, 420–421. doi: 10.1126/science.6143402

Ulrich, R. S. (1997). A theory of supportive design for healthcare facilities. *J. Healthc. Design* 9, 3–7.

Ulrich, R. S., Zimring, C., Zhu, X., DuBose, J., Seo, H.-B., Choi, Y.-S., et al. (2008). A review of the research literature on evidence-based healthcare design. *Health Environ. Res. Design J.* 1, 61–125. doi: 10.1177/193758670800100306

Umberson, D., and Montez, J. K. (2010). Social relationships and health: a flashpoint for health policy. *J. Health Soc. Behav.* 51(Suppl.), S54–S66. doi: 10.1177/0022146510383501

UN-Habitat and WHO (2020). *Integrating health in urban and territorial planning. A sourcebook*. Geneva: World Health Organization.

United Nations (2018). *World urbanization prospects: The 2018 revision, online edition. File 2: Percentage of population at mid-year residing in urban areas by region, subregion and country, 1950-2050*. Available online at: https://population.un.org/wup/Download (accessed March 8, 2023).

Urban Land Institute (2015). *Building healthy places toolkit: Strategies for enhancing health in the built environment*. Washington, DC: Urban Land Institute.

van der Wal, J., van Borkulo, C., Deserno, M., Breedvelt, J., Lees, M., Lokman, J., et al. (2021). Advancing urban mental health research: from complexity science to actionable targets for intervention. *Lancet Psychiatry* 8, 991–1000. doi: 10.1016/S2215-0366(21)00047-X

Visocky O'Grady, J., and Visocky O'Grady, K. (2017). *A designer's research manual*. Beverly, NJ: Rockport.

Vollmer, T., Koppen, G., and Kohler, K. (2020). Wie Stadtarchitektur die Gesundheit beeinflusst: Das PAKARA-Modell. *Bundesgesundheitsblatt* 63, 972–978. doi: 10.1007/s00103-020-03188-7

von Lindern, E., Lymeus, F., and Hartig, T. (2017). "The restorative environment – A complementary concept for salutogenesis studies," in *The handbook of salutogenesis*, ed. M. B. Mittelmark (Cham: Springer), 181–194. doi: 10.1007/978-3-319-04600-6_19

Wasfi, R., and Kestens, Y. (2021). "Built environment and health," in *Urban form and accessibility*, eds C. Mulley and J. D. Nelson (Amsterdam: Elsevier), 187–205. doi: 10.1016/B978-0-12-819822-3.00005-5

Weber, A. M., and Trojan, J. (2018). The restorative value of the urban environment: A systematic review of the existing literature. *Environ. Health Insights* 12:1178630218812805. doi: 10.1177/1178630218812805

Werlen, B. (2000). *Sozialgeographie – eine einführung*. Bern: Haupt.

White, M. P., Elliott, L. R., Grellier, J., Economou, T., Bell, S., Bratman, G. N., et al. (2021). Associations between green/blue spaces and mental health across 18 countries. *Sci. Rep.* 11:8903. doi: 10.1038/s41598-021-87675-0

WHO (1946). *Constitution of the World Health Organization*. Geneva: World Health Organization.

WHO (2016). *Global report on urban health. Equitable, healthier cities for sustainable development*. Geneva: World Health Organization.

WHO (2022). *World mental health report: Transforming mental health for all*. Geneva: World Health Organization.

Wolf, K. L., and Brinkley, W. (2016). *Sites to systems: Nearby nature for human health*. Annapolis, MD: TKF Foundation.

Wright, M. T., Block, M., and Unger, H. (2008). Partizipation in der Zusammenarbeit zwischen Zielgruppe, Projekt und Geldgeber. *Gesundheitswesen* 70, 748–754. doi: 10.1055/s-0028-1102955

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When narratives speak louder than numbers: the effects of narrative persuasion across the stages of behavioural change to reduce air pollution

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Is narrative persuasion effective when promoting new behaviours in favour of the environment? Does this effectiveness vary depending on whether individuals are already thinking about changing? This paper has two main objectives: (1) to explore how individuals at different stages of the behavioural change process perceive air pollution, focussing on the perceived psychological distance of its environmental risks (Study 1); and (2) to test whether the effects of presenting the risks of air pollution in a narrative vs. statistical format on pro-environmental intentions vary depending on the individuals' stage of behavioural change (Study 2). Study 1 (N = 263) is based on a survey measuring individuals' perceived psychological distance of the environmental risks of air pollution, and the perceived effectiveness of different pro-environmental behaviours. Results suggest that perceived distance and perceived effectiveness vary across different stages of behavioural change. Study 2 (N = 258) presents a 2(Format: narrative vs. statistical) × 3(Stages of change) protocol, testing the effectiveness of a narrative format depending on individuals' stage of behavioural change. Results suggest that proximising a threat through a narrative format of communication is more effective especially for individuals in the pre-action stage of change. We also present a moderated mediation model explaining the influence of the interaction between the message format and the stage of behavioural change on behavioural intentions and on efficacy appraisal via narrative engagement. Findings are discussed with regards to the stage model and narrative persuasion.

KEYWORDS

air pollution, psychological distance, narrative persuasion, stages of behavioural change, efficacy appraisal

1. Introduction

The air pollution levels that we observe today are the consequence of increased global industrialisation and urbanisation. The large-scale industries that introduce the majority of pollutants into the air are transportation, industrial machinery, energy production and modern agriculture (World Health Organization, 2019). There is also some personal

accountability for individuals who use personal motorised vehicles, household energy, waste disposal and the excessive consumption of luxury goods. These personal behaviours are increasingly contributing to air pollution as the scale of this behaviour increases in both developed and developing countries (Carlsten et al., 2020), which has negative effects for the climate, ecosystems, and citizens' health. Air pollution is defined by the World Health Organisation as "the contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere." Six major pollutants have been identified: ground-level ozone, carbon monoxide, particle pollution, sulphur oxides, nitrogen oxides, and lead. Although the main effects of these pollutants concern the health of individuals as well as all living organisms and the ecosystems in general (through the acidification of water and soil; Manisalidis et al., 2020), air pollution is also strongly linked to climate change. Some minor air pollutants, such as methane and black carbon, are powerful short-lived climate pollutants (SLCPs), which have notable global warming potential even if they persist in the atmosphere for short lifetimes. Moreover, the main sources of air pollution, such as the use of fossil fuels (e.g., in the field of transportation), are also sources of high CO_2 emissions, which are strictly linked to increasing temperature and extreme weather events (NASA Vital Signs; Crowley and Berner, 2001; Amirkhani et al., 2022). The WHO thus explains how "reducing ambient and household air pollution can also reduce emissions of carbon dioxide (CO_2) and short-lived climate pollutants, therefore contributing to the near- and long-term mitigation of climate change."

Although levels of air pollution density have peaked and started to decline following air quality initiatives in developed countries, many developing countries are heading toward higher levels, adding strain to already dangerous climate conditions (Ritchie and Roser, 2019). There has been some progress, with the proportion of the European population exposed to ground-level ozone reducing from 54% in 2007, to 7% in 2014; however, following increased temperatures in 2018, an estimated 30% of the population was exposed to levels above targets (European Environment Agency, 2018). In 2018 15% of urban citizens were also exposed to values of Particulate Matter above targets and 4% to limit-exceeding levels of NO_2 (European Environment Agency, 2018). Therefore, despite progress to reduce emissions in European countries, air quality still needs to be effectively and consistently reduced to safe levels.

Public perceptions of air pollution and the associated risks are thus crucial for meeting the emissions targets of countries worldwide, particularly those of Western countries where targets are challengingly low. It is therefore important that we understand how people perceive air pollution, in order to identify effective communication strategies to use in information and education programmes and campaigns to motivate citizens to change their behaviour in order to improve air quality.

The present research has two main objectives. The first one (pursued in Study 1) is to explore the public perception of the environmental risks of air pollution, and whether this might drive individuals through the different stages of behavioural change. The second objective (pursued in Study 2) is to test whether presenting the risks of air pollution in a narrative format is more effective than a statistical format when promoting pro-environmental behaviours to improve air quality, depending on individuals' stage of behavioural change.

1.1. Social perception of air pollution through the stages of behavioural change

The majority of the studies exploring the public perception of air pollution focus on individuals' subjective evaluations of the pollution levels where they live, and the risks that this can have with regards to their health (Bickerstaff and Walker, 1999, 2001; Bush et al., 2001a,b; Howel et al., 2003). Although there are no studies specifically concerning individuals' perception of the environmental risks of air pollution, it has been demonstrated that individuals generally tend to represent environmental risks such as climate change (Brulle et al., 2012; Spence et al., 2012; Kohut and Pew Research Center, 2013; Leiserowitz et al., 2013; Stoknes, 2014) and biodiversity loss (Bosone and Bertoldo, 2022) as distant threats. These phenomena are indeed perceived as psychologically distant (Trope and Liberman, 2010; Spence et al., 2012), something happening in a distant future (a sub-dimension defined as temporal distance), to other people (social distance), in faraway geographical areas (geographical distance) and with a relative degree of uncertainty (uncertainty).

Distantiating risks on these dimensions is a process that individuals adopt to protect themselves as this allows them, on the one hand, to feel more secure and, on the other hand, to avoid changing their behaviours which are contributing to the issue they are distantiating from. However, such a process is problematic as it entails a lesser concern for important issues (Brügger et al., 2015) and as a consequence, a weaker engagement in behavioural change in favour of the environment (Creutzig et al., 2018). It is thus possible to suppose that different degrees of perceived psychological distance would characterise individuals' different positions with regards to behavioural change, also definable as different stages of the process of behavioural change.

Indeed, behavioural change should not be considered as an on-off switch, but rather as a dynamic process based on several stages of change, where individuals can advance but also retrocede. The process of change has been described by the *trans*-theoretical model (TTM; Prochaska and DiClemente, 1994), which considered behavioural change as a transition through five stages. Individuals in the first stage of "pre-contemplation" do not intend to take action and change their behaviour in the foreseeable future. Individuals in the second "contemplation" stage become aware of the necessity for a change in their behaviour. Individuals in the third "preparation" stage form the intention to change their behaviour in the foreseeable future, and when they actually initiate the new behaviour they pass in the fourth "action" stage. The fifth and final "maintenance" stage includes individuals who are already engaged in the new behaviour and work to prevent relapse. Past research in the field of health-promotion has demonstrated how different strategies are more or less effective in pushing individuals through different phases; for instance, while risk vulnerability and severity seems to increase intention to engage in the targetted behaviour for individuals in the pre-contemplation and contemplation stages, perceived efficacy of the targetted behaviour and self-efficacy increase behavioural intentions for individuals in the action stage (Horowitz, 2003; Martin et al., 2007; Bočkarjova et al., 2009;

Lopes et al., 2016; Mohebbi et al., 2021). It is possible to suppose that this is due to the fact that individuals perceive risks and behavioural effectiveness differently in the different stages. Several studies in the field of health-promotion have for instance demonstrated that the different stages of the *trans*-theoretical model are characterised by different combinations of the threat- and coping-appraisal processes described by the Protection Motivation Theory (e.g., Maddux and Rogers, 1983). Threat-appraisal refers to individuals' perception of the vulnerability and severity of the risk they are facing, whereas coping-appraisal refers to their perception of the effectiveness of the possible behavioural alternatives available to cope with such a threat and of their own ability to adopt them (i.e., self-efficacy). In the meta-analysis carried out by Marshall and Biddle (2001) on the stages of behavioural change with regards to dietary issues, individuals in a stage of pre-contemplation perceived substantially lower scores for both threat appraisal (perceived vulnerability and severity) and coping-appraisal. While a linear increase of coping-appraisal (specifically, self-efficacy) was observed between the preparation, action and maintenance stages, threat appraisal constructs showed a non-linear association with stage progression. More precisely, individuals in pre-contemplation had significantly lower levels of consciousness than did individuals in all other stages, which increased slightly for individuals in the contemplation stage, and did not differ between the action and maintenance stages. The most recent research on the TTM commonly consider risk perception and awareness as levers in the field of health promotion to increase the intention of individuals' in the pre-contemplation stage to adopt a new behaviour (e.g., de Freitas et al., 2020; de Carvalho et al., 2021), without measuring the actual risk perception or efficacy perception of individuals in the different stages. More importantly, while the stage model of behavioural change has been validated and tested in the field of health-promotion, it is still relatively new in the field of pro-environmental behaviour (Bamberg, 2013; Andersson, 2020). We argue that individuals in different behavioural change stages with regards to pro-environmental behaviours will report different degrees of the perception of the risk of the environmental consequences of air pollution. More precisely, we expect individuals in the pre-action stages (pre-contemplation and contemplation) to perceive the environmental consequences of air pollution to be at a higher psychological distance, than individuals in the following stages. Similarly, we expect them to also report lower perceived effectiveness of possible behaviours to cope with air pollution than individuals in the following stages. The goal of our first study is thus to explore whether individuals' perceived psychological distance of the environmental risks of air pollution, as well as their perception of the effectiveness of possible pro-environmental behaviours to reduce air pollution, varies according to the individuals' stage of behavioural change.

The fact that perceived risk and perceived effectiveness are key elements pushing individuals through the phases of behavioural change is particularly important for its practical implication, as it would confirm that one of the levers that educational and communication programmes could use to push individuals to advance in the process of behavioural change is "proximising" the risks of air pollution while at the same time increasing individuals' perception of the effectiveness of behavioural changes improving air quality.

1.2. "Proximising" the risks by narrative persuasion

A few studies have tried to use different communication techniques to "proximise" the risks of climate change, by describing it as an issue that is geographically close to the targetted individuals and as particularly concerning the social group to which they belong (Shwom et al., 2008; Spence and Pidgeon, 2010; Schuldt et al., 2018; Loy and Spence, 2020). However, these studies showed that such a technique did not have a significant effect on behavioural intentions, or behavioural change (Brügger et al., 2015, 2016).

We argue that this depends on the strategy that is used to proximise psychological distance. Indeed, within the studies that did not find a significant influence of proximising psychological distance in persuasive messages, the environmental risks are presented through scientific data on climate change, thus adopting a numerical approach of presentation of risks. Indeed, past research has demonstrated that presenting information in a narrative format is more effective than presenting information in a statistical format (Rothman and Kiviniemi, 1999; de Wit et al., 2008; Miller-Day and Hecht, 2013), especially in areas such as health, advertising, and education (Hornikx, 2005; De Graaf et al., 2016).

Narrative evidence has been studied with regards to its effects on support for controversial political policies (Igartua, 2010), health behaviours (Hinyard and Kreuter, 2007; Shen, 2015), and recruitment into extremist groups (Casebeer and Russell, 2005; Braddock, 2015). A few studies, however, reported non-significant effects of narratives on intentions and behaviours (e.g., Cheney et al., 2006; Prati et al., 2012), or even opposite effects to those expected (e.g., Gesser-Edelsburg and Endevelt, 2011). In two recent meta-analyses, a positive association between narrative evidence and intentions and behaviours emerged both in the specific field of health communication (Shen, 2015), and more in general in persuasive communication (Braddock and Dillard, 2016). Although the use of narratives in environmental education interventions is rather frequent (such as the use of movies and documentaries in what is defined as entertainment education; see Bahk, 2010; Topp et al., 2019), little research has tested the persuasive effects of narrative evidence compared to other types of evidence format. In a recent experimental study by Nakano and Hondo (2023), where participants received either narrative or logical information about climate change and completed several measures related to behavioural intentions, interest, and emotions, results indicated that a narrative format triggers stronger negative emotions and behavioural intentions, especially for individuals who reported having a low interest in the issue. Based on this literature review, we argue that narrative evidence is more effective than statistical evidence in reducing the perceived psychological distance of the environmental risks, and in increasing pro-environmental behavioural intentions, but only for individuals in the pre-action stage of behavioural change.

> Hypothesis 1 (HP1; tested in Study 2) is thus the following: presenting the environmental risks of air pollution in a

> narrative format will increase individuals' intentions to engage in pro-environmental behaviours as compared to presenting them in a statistical format, but only for individuals in the first stage of behavioural change (pre-action). Indeed, since in this stage individuals are less interested and worried about the targetted issue, a narrative message will be more effective than a statistical one. On the contrary, we expect individuals in the action and post-actrion stages to be already concerned by the environmental risks of air pollution, and thus to be less sensitive to the influence of the information format.

But why will narrative evidence be more persuasive than statistics? A narrative message engages individuals through the message being reported and transports them into the story (Busselle and Bilandzic, 2008; Sestir and Green, 2010), creating what can be defined as "narrative engagement" (De Graaf et al., 2009). Once immersed in a narrative, it is argued that mental-processes are focussed upon the narrative being presented, resulting in less counter-argument and attention to the message's potential faults (Slater and Rouner, 2002). By forming vivid mental simulations of events, narrative information can enable the formation of an alignment with the protagonist persuading greater levels of acceptance of the message's intended response (Green and Clark, 2013), and thus mediating the effectiveness of message adoption and behavioural change (Lee et al., 2011). We argue that the effectiveness of presenting the risks of air pollution in a narrative format will partly depend on the influence such a format has on individuals' efficacy appraisal, including self-efficacy and response-efficacy (Bosone et al., 2015). Self-efficacy refers to a person's belief about their ability to engage in a behaviour and is often associated with response efficacy, which is the perceived effectiveness of one's behavioural change (Witte and Allen, 2000). As Bandura (1982) posits, a greater awareness and knowledge of risks is an important precursor to changing behaviour yet it is not sufficient. There need to be means, resources and social support to mitigate unwanted behaviours. He determines that successful changes require a strong belief in one's ability to use self-regulatory skills effectively. The use of narrative information is predicted to improve the self-efficacy experienced by the subject, as Bandura (1982) determines that vicarious experiences, such as those from an engaging narrative, are a potential source of self-efficacy. It is also possible to argue that narrative messages will increase perceived response-efficacy, as individuals transported into a narrative engage in mental simulations of how they would behave in a situation like the one described (Escalas, 2004; Nielsen et al., 2018).

Based on past research on the effects of narrative evidence on individuals' engagement, we expect the persuasiveness of a narrative vs. statistical format, moderated by the stages of behavioural change, to be mediated by individuals' engagement with the message, influencing efficacy appraisal as well as perceived psychological distance and behavioural intentions. Hypothesis 2 (HP2; tested in Study 2) is thus the following: the effects of narrative vs. statistical format on behavioural intentions is mediated by individuals' engagement with the message, and this mediation is moderated by the stages of behavioural change.

1.3. Objectives

The present research has two main objectives. The first one is to explore the public perception of the environmental risks of air pollution, and whether this might push individuals through the different stages of behavioural change.

To this purpose, by means of a survey, Study 1 explored individuals' perceived psychological distance of the environmental risks of air pollution, as well as their perception of the effectiveness of several behaviours in improving air quality, with particular attention to the possible differences according to the participants' stage in the process of behavioural change.

The second objective is to test whether presenting the risks of air pollution in a narrative format is more effective than a statistical format in boosting individuals' intentions to engage in pro-environmental behaviours to improve air quality, depending on individuals' stage of behavioural change. To this purpose, Study 2 tested whether the effectiveness of a narrative message depends on individuals' stage of behavioural change.

The data that supports the findings of the two studies is available from the corresponding author upon reasonable request. All data was collected and analysed according to the latest General Regulation on Data Protection.

2. Study 1

2.1. Method

2.1.1. Participants

A total of 263 people took part in the study (58.3% women and 41.3% men). Participants ranged in age from 18 to 71 years ($M = 44.1$; $SD = 12.5$), and 93.1% were licenced drivers. Participants were recruited online, by publishing a post on several social network groups. Data was collected between March and April 2021, participants answered the questionnaire on Qualtrics. Participation was voluntary and free, all participants gave their consent to the analysis of their answers.

2.1.2. Materials and procedure

The measures were presented in the order in which they are described below (the questionnaire is reported in the **Supplementary material**). After the completion of the questionnaire, participants were thanked and fully debriefed.

2.1.2.1. Psychological distance

Individuals' perception of the psychological distance of the environmental risks of air pollution was measured by adapting the scale of climate change psychological distance [Spence et al., 2012; α ($N = 8$) = 0.78], asking individuals to rate their agreement with 8 items, measuring the geographical (e.g., "The environmental risks of air pollution are more likely to affect far away countries"), temporal (e.g., "are an important issue right now"), social (e.g., "The environmental problems caused by air pollution will certainly affect me and my family") and uncertainty (e.g., "I am sure that air pollution has negative environmental consequences") sub-dimensions of psychological distance, on a seven-point scale from *1- Strongly disagree* to *7- Strongly agree*.

2.1.2.2. Behavioural effectiveness

Participants were asked to rate, on a seven-point scale from *1-Not at all effective* to *7-Completely effective*, the extent to which they believed a list of twelve pro-environmental behaviours to be effective in improving air quality [α (N = 12) = 0.77].

2.1.2.3. Socio-demographic details and behavioural change stage

In the final section of the questionnaire, individuals were asked to indicate their gender, their age, and whether they had a driving licence or not. Moreover, following the method used by Godin et al. (2004) and by Andersson (2020), we measured the behavioural change stage of individuals by asking them to choose what they thought would happen in the 6 months following the survey, among the following items:

- "I do not intend to change my lifestyle in order to help reduce air pollution within the next 6 months" (pre-contemplation).
- "I can imagine myself changing certain habits in order to help reduce air pollution within the next 6 months" (contemplation).
- "I have started trying to change certain parts of my lifestyle in order to help reduce air pollution over the last 6 months" (preparation).
- "During the past 6 months, I have changed my lifestyle in order to help reduce air pollution" (action).
- "For the past 6 months, I have maintained a lifestyle that helps reduce air pollution" (maintenance).

Following their answers, 7.6% of participants were classed in the pre-contemplation stage, 6.5% in the contemplation stage, 28.5% in the preparation stage, 20.9% in the action stage, and 36.5% in the maintenance stage.

2.2. Results

To analyse the influence of the stages of behavioural change and considering the uneven distribution of the sample across stages, we decided to consider individuals in the pre-contemplation and in the contemplation stage together, as in a "pre-action" stage, as individuals in both stages are ambivalent about their current behaviour (following the same procedure as in Forward, 2014 and in Andersson, 2020). Participants were thus divided into four groups according to their behavioural change stage: pre-action (N = 37), preparation/intention (N = 75), action (N = 55), and maintenance (N = 96). As the sample sizes were still not equally distributed, a Levene's test was conducted to determine whether the data met the homogeneity of variance assumption. The test infirmed the null hypothesis ($p < 0.005$) that all the stages have similar population variances; consequently, Welch's ANOVAs were carried out to test the influence of the stages on the continuous dimensions of psychological distance and perceived effectiveness of behaviours.

2.2.1. Perceived psychological distance according to behavioural change stages

The Welch's ANOVA showed that the general psychological distance of the environmental risks of air pollution varied significantly depending on the stage of behavioural change, $F_{(3,105)} = 5.40$, $p = 0.002$. More precisely, Games-Howell *Post hoc* test indicated that individuals in the stage of pre-action (M = 5.75; SD = 1.07) perceived environmental risks of air pollution as less close than individuals in stages of maintenance (M = 6.42; SD = 0.59, $p = 0.004$).

2.2.2. Perceived behavioural effectiveness according to behavioural change stages

Welch's ANOVA showed that the perceived effectiveness of actions varied with participants' stage of change [$F_{(3,107)} = 10.74$, $p < 0.001$].

Indeed, perceived effectiveness were lower for individuals in the stage of pre-action (M = 4.67; SD = 1.12) than individuals in the stage of preparation (M = 5.50; SD = 0.70, $p < 0.001$), action (M = 5.73; SD = 0.80, $p < 0.001$) and maintenance (M = 5.73; SD = 0.65, $p < 0.001$) (see **Table 1**).

2.3. Summary of key findings of study 1

Findings from Study 1 demonstrated that individuals' perception of risk and effectiveness varies depending on the stage of behavioural change they find themselves in.

More precisely, the more individuals are advanced on the process of behavioural change, the closer they perceive the risks of air pollution to be, and the more effective they consider behavioural change to be. Hence, perceived risk and effectiveness are two key dimensions pushing individuals through phases, and should be effective levers to use in persuasive communication to promote behavioural change. We argue that a message focussing on the risks of air pollution in a narrative format will be effective in proximising the threat and at the same time improve efficacy appraisal, as compared to a message presenting them in a statistical format, especially for individuals in the first stages of behavioural change. To test this, we carried out Study 2.

TABLE 1 Means , standard deviations and Games-Howell test (Study 1).

Measure	Pre-action (a) N = 37	Preparation (b) N = 75	Action (c) N = 55	Maintenance (d) N = 96
	M (SD)	M (SD)	M (SD)	M (SD)
Psychological distance of the risks of air pollution	5.75^{a**} (1.07)	6.16 (0.81)	6.27 (0.80)	6.42^{b**} (0.59)
Perceived efficacy of behaviours for improving air quality	4.67^{abc***} (1.12)	5.50^{d***} (0.70)	5.73^{d***} (0.80)	5.73^{d***} (0.65)

Mean score with different letters are Games-Howell pairwise comparisons. $^{**}p < 0.01$. $^{***}p < 0.001$.

3. Study 2

Based on the results of Study 1 suggesting that perceived risk and effectiveness are two levers for advancing in the stages of behavioural change, as well as on past literature on the effectiveness of narrative evidence especially for people who are less interested in an issue (e.g., Nakano and Hondo, 2023), we decided to test whether the persuasiveness of a narrative vs. statistical format varies depending on the stage of behavioural change individuals are at. Study 2 thus aims to test whether a narrative format increases pro-environmental intentions more effectively than a statistical one especially for individuals in the pre-action stage (HP1). Furthermore, Study 2 aims to understand the reason behind the persuasiveness of a narrative format, testing a mediation hypothesis arguing that the effects of a narrative vs. statistical format is mediated by its effects on individuals' engagement with a message (HP2).

3.1. Method

3.1.1. Participants

To estimate the sample size needed for this study, we used the average effect size published in social psychology (d = 0.43; Richard et al., 2003). Based on this effect size, the results obtained with G*Power indicates a sample size of at least 252 participants to achieve 80% power for an ANOVA analysis with 8 groups and 2 predictors (Format × Stage).[1] Participants were a total of 269 adults. Data was collected via online distribution of the digitised survey (on Qualtrics). After a preliminary examination of participants' responses, 11 participants were eliminated from further analyses. This was due to failure to correctly respond to the question "what colour is the blue sky," leaving 258 responses for analysis.

The final sample was composed of 38% men and 62% women, aged from 14 to 69 (M = 30.7; SD = 10.49). The distribution of the participants across stages was asymmetrical, with only 11.6% of the sample in the pre-contemplation stage, 32.9% in the contemplation stage, 27.1% in the preparation stage, 8.9% in the initiation stage and 19.4% in the maintenance stage. Following the example of past research in this field (e.g., Andersson, 2020), a decision was made to combine individuals in different stages according to their position with regards to the creation of behavioural intention (in the preparation stage), which brought us to divide the sample into three groups. The pre-action group included individuals from the stages of pre-contemplation and contemplation stage (N = 59 exposed to a narrative message, N = 56 exposed to a statistical one). The preparation/intention group included individuals from the preparation stage (N = 33 exposed to a narrative message, N = 37 exposed to a statistical one). The post-action group included individuals from the initiation and maintenance stages (N = 35 exposed to a narrative message, N = 38 exposed to a statistical one).

1 In order to correspond to Study 1, we initially decided to consider participants as distributed over four–and not five–stages of behavioural change. Finally, they were categorised into three distinct change groups (see explanations below).

3.1.2. Procedure

Participants were recruited online, via a post published on social network groups not directly concerned with environmental protection. Data was collected between June and October 2021. After establishing informed consent, individuals were asked to indicate to which stage of behavioural change they were at with regards to pro-environmental behaviours (following the same procedure used in Study 1). Participants were randomly assigned to one of the two experimental message conditions. They were prompted to read their respective message and continue to answer a questionnaire. The measures were presented in the questionnaire the order in which they are described below (the questionnaire is reported in the section "**Supplementary material**"). Finally, participants were thanked and fully debriefed.

3.1.3. Materials

3.1.3.1. Experimental manipulation

Two experimental persuasive messages of approximately 310 words were constructed to raise awareness of the risks that air pollution presents for the environment in terms of its impact on climate change. Messages varied the type of Format (narrative vs. statistical)used to describe the evidence about the environmental risks of air pollution. The narrative evidence messages then went on to present a gender-neutral first-person account by what was designed to be a typical Western individual, "Sacha," who described an experience of living in a city subject to a natural catastrophe in the environmental condition (e.g., "*As Sacha recounts: Shortly after the rain started the city lost power, no TV, no internet and the mobile networks weren't working either.*"). The statistical evidence messages continued with percentages and figures of the levels of displacements and structural damages caused by the environmental consequences of air pollution (e.g., "*In 2019, 24.9 million people were displaced due to climate disasters, the highest figure recorded since 2012 and three times the number of displacements caused by conflict and violence.*"), describing the consequences of extreme climatic events (flooding) for people in general (e.g., "*The agglomeration of housing and economic activity makes people living in cities particularly vulnerable to property loss, power cuts, water contamination and sewer damage caused by flooding.*"). Both messages ended with instructions for choosing activities that can reduce one's contribution to air pollution.

3.1.3.2. Engagement

Individuals' engagement with the message was assessed using a scale developed from previous studies' factor analyses on narrative engagement (Busselle and Bilandzic, 2009; De Graaf et al., 2009), and was adapted for message-type stimuli. Eight items were chosen [α (N = 8) = 0.89], reflecting the identification and transportation types of engagement as described in the literature, measuring on a seven-point scale from *1-Strongly disagree* to *7-Strongly agree* whether they felt transported in the message (e.g., "While reading the message I found myself thinking of other things," reversed scored) and whether they felt engaged with the individual, or the people, described in the narrative or statistical message, respectively, (e.g., "I could easily imagine myself in the situation of the [people/person] affected by air pollution described in the message"). The stimuli on identification differed slightly for participants exposed to the narrative vs. statistical message, as they

asked whether they identified with "the person" described in the narrative message, or "the people" described in the statistical one.

3.1.3.3. Efficacy appraisal

Efficacy Appraisal was assessed by 4 items [α (N = 4) = 0.91] measuring self-efficacy with two items (e.g., "I believe that I can act to reduce the air pollution in my city"), and response-efficacy with two items (e.g., "Reducing individual emissions would prevent the negative consequences of air pollution"), on a seven-point scale from *1-Strongly disagree to 7-Strongly agree*.

3.1.3.4. Psychological distance of perceived risk

Psychological distance of perceived risk was measured using 8 items [α (N = 8) = 0.91] designed as in Study 1 to assess geographical, temporal, social distance and uncertainty in regards to the general risks of air pollution, on a seven-point scale going from *1-Strongly disagree to 7-Strongly agree*. A higher score represents greater psychological distance of the risk, lower values represent smaller distance.

3.1.3.5. Behavioural intention

Behavioural intention was measured using eight items [α (N = 8) = 0.92] on a seven-point scale, going from *1- Not at all* to *7- Completely*, questioning participants' intentions to engage in activities that reduce air pollution such as reducing food waste, buying local, considering different methods of personal transportation, participating in public meetings about reducing individual use of cars/motorbikes, supporting the increase of a carbon tax for individuals.

3.2. Results

One two-way MANOVA was carried out to analyse the influence of Format (narrative vs. statistical) and Stage (pre-action vs. preparation/intention vs. post-action) on behavioural intentions, psychological distance, engagement and efficacy appraisal. All F and p-values are reported in **Table 2**. Finally, a moderated mediation analysis (model 8 according to Hayes, 2012) has been carried out through the SEM programme of JASP to test whether the effect of Format on Behavioural intention, Psychological distance and Efficacy appraisal is mediated by Engagement, and whether this mediation is moderated by Stage.

3.2.1. Behavioural intentions

Format had a significant effect on participants' intention to engage in pro-environmental actions. More precisely, individuals exposed to a narrative message reported higher intentions (M = 5.17; SD = 1.18) than individuals exposed to a statistical message (M = 4.81; SD = 1.47).

Stage of change had a significant effect on participants intentions to engage in pro-environmental actions. The Tukey's *post-hoc* tests confirmed that individuals in stage 3 (post-action) reported higher individual intentions (M = 5.65, SD = 0.78) than individuals in stage 1 (pre-action; M = 4.53, SD = 1.67; Tukey's p = 0.001) and individuals in stage 2 (preparation/intention; M = 5.08, SD = 0.79; Tukey's p = 0.02), and that individuals in stage 2 reported higher intentions than individuals in stage 1 (Tukey's p = 0.01).

The interaction Format × Stage did not have a significant effect.

3.2.2. Psychological distance

Format had a significant effect on the general dimension of psychological distance: individuals in the narrative condition perceived the risks of air pollution as a closer threat (M = 3.07; SD = 1.49) than individuals in the statistical condition (M = 2.61; SD = 1.11).

Stage had a significant effect on psychological distance: individuals in the post-action stage reported the risks of air pollution as closer (M = 2.25; SD = 1.15) than individuals in the preparation/intention stage (M = 2.87; SD = 0.82; Tukey's p = 0.01) and individuals in the post-action stage (M = 3.21; SD = 1.55; Tukey's $p < 0.001$). The difference between individuals in the pre-action and preparation/intention stage was not significant (Tukey's $p > 0.1$).

Format × Stage did not have a significant effect.

3.2.3. Engagement

Format had a significant effect on engagement: individuals in the narrative condition felt more engaged (M = 5.18; SD = 1.03) than individuals in the statistical condition (M = 4.69; SD = 1.27).

Stage did not have a significant effect on engagement.

Format × Stage had a significant effect. More precisely, individuals in the pre-action stage reported higher transportation when exposed to a narrative message (M = 5.27; SD = 1.28) than when exposed to a statistical one (M = 4.33; SD = 1.65; $t(113)$ = 3.43, p = 0.001, 95% CI = [0.39; 1.49]). This difference was not significant (all $t < 1$) for individuals in the preparation/intention stage (narrative: M = 5.01, SD = 0.72; statistical: M = 4.89, SD = 0.76) or in the post-action stage (narrative: M = 5.19, SD = 0.81; statistical: M = 5.03, SD = 0.84).

3.2.4. Efficacy appraisal

Format did not have a significant effect on efficacy appraisal.

Stage significantly influenced efficacy appraisal: individuals in the pre-action stage reported lower perceived efficacy (M = 4.76; SD = 1.67) than individuals in the preparation/intention stage (M = 5.38; SD = 0.71; Tukey's p = 0.003) and in the post-action stage (M = 6.11, SD = 0.75; Tukey's $p < 0.001$). The difference between preparation/intention and post-action stages was also significant (Tukey's p = 0.001).

Format × Stage also significantly affected efficacy appraisal. More precisely, individuals in the pre-action stage exposed to a narrative message reported higher perceived efficacy (M = 5.16; SD = 1.48) than those exposed to a statistical one (M = 4.34, SD = 1.77; $t(113)$ = 2.71, p = 0.008, 95% CI = [0.22; 1.42]). This difference was not significant (all $t < 1$) for individuals in the preparation/intention stage (narrative: M = 5.42, SD = 0.64; statistical: M = 5.34, SD = 0.78) or in the post-action stage (narrative: M = 6.04, SD = 0.75; statistical: M = 6.18, SD = 0.75).

3.2.5. Moderated mediation

We conducted structural equation modelling using JASP; we tested model 8 (see Igartua and Hayes, 2021), with Format as the independent variable, Stage as the moderating variable, Engagement as the mediating variable, and Behavioural intention, Efficacy appraisal and Psychological distance as dependent variables. The model is presented in **Figure 1**.

TABLE 2 MANOVA–influence of format and stage of behavioural change (Study 2).

	F	*p*	η^2	95% CI
Behavioural intentions				
Format	4.06*	0.04	0.02	[−0.57; 0.59]
Stage	18.46***	0.001	0.13	[−1.99; −0.95]
Format*Stage	1.78	0.17	0.01	[−0.05; 1.42]
Psychological distance				
Format	6.42*	0.01	0.03	[−0.73; 0.44]
Stage	12.88***	0.001	0.09	[0.76; 1.81]
Format × Stage	1.81	0.17	0.01	[−1.41; 0.09]
Engagement				
Format	7.71**	0.006	0.03	[−0.37; 0.69]
Stage	1.63	0.19	0.01	[−1.18; −0.22]
Format × Stage	3.91*	0.02	0.03	[0.11; 1.46]
Efficacy appraisal				
Format	2.64	0.11	0.01	[−0.71; 0.43]
Stage	27.55***	0.001	0.18	[−2.35; −1.33]
Format × Stage	4.03*	0.02	0.03	[0.24; 1.68]

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

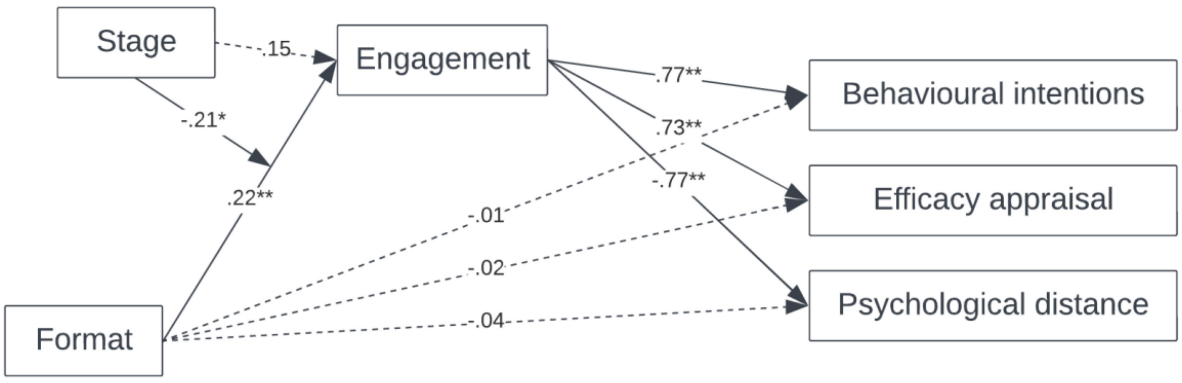

FIGURE 1
Standardised structural relations; moderated mediation model (Study 2). *$p < 0.05$. **$p < 0.01$.

The direct effect of Format on Engagement is significant (β = 0.22, SE = 0.07, p = 0.002, 95% CI [0.078, 0.361]), as the interactive effect of Format × Stage (β = −0.21, SE = 0.08, p = 0.02, 95% CI [−0.368, −0.038]), while the direct effect of Stage on Engagement is not significant (β = 0.15, SE = 0.08, p = 0.08, 95% CI [−0.02, 0.311]). The direct effect of Engagement on Behavioural intentions is significant (β = 0.77, SE = 0.05, $p < 0.001$, 95% CI [0.667, 0.875]), as well as its direct effect on Efficacy appraisal (β = 0.73, SE = 0.06, $p < 0.001$, 95% CI [0.613, 0.837]) and on Psychological distance (β = −0.77, SE = 0.05, $p < 0.001$, 95% CI [−0.873, −0.669]). The indirect effect of Format through Engagement on Behavioural Intentions is not significant (β = −0.01, SE = 0.06, p = 0.87, 95% CI [−0.133, 0.113]), as the indirect effect of Format through Engagement on Efficacy Appraisal (β = −0.02, SE = 0.07, p = 0.83, 95% CI [−0.147, 0.117]) and on Psychological distance (β = −0.04, SE = 0.06, p = 0.51, 95% CI [−0.160, 0.080]).

3.3. Summary of key findings of study 2

Findings from Study 2 demonstrate that individuals have different risk and effectiveness perceptions depending on the stage of behavioural change that they are at, with people already engaged in behavioural change being more sensitive to environmental issues and more motivated to engage in further environmental efforts.

The data also suggests that while the influence of the format of evidence on behavioural intentions does not vary depending on the stage of change of individuals, only individuals who are not yet engaged in changing their behaviours in favour of the environment are highly sensitive to the effect that format has on

their efficacy appraisal. The theoretical and practical implications of these findings are further discussed in the general discussion.

4. General discussion

Findings from the research presented in this paper demonstrate that individuals in different stages of the process of behavioural change have different risk and efficacy appraisals when it comes to air pollution, and are thus affected differently by narrative persuasion. Indeed, data from Study 1 confirms that the more individuals are advanced on the process of behavioural change, and are engaging or have already engaged in pro-environmental behaviours, the closer they perceive the environmental risks of air pollution to be, and the more effective they consider pro-environmental actions to be in improving air quality. This is in line with past research and models in the field of behavioural change explaining how individuals' decision to engage in specific new behaviours when facing a threat directly depends on individuals' appraisal of the threat but also of the effectiveness of alternative behaviour to deal with such a threat (Witte and Allen, 2000; Kothe et al., 2019; Shafiei and Maleksaeidi, 2020). Indeed, according to these models, individuals who do not perceive a threat as close and severe, and/or do not consider the alternative behaviour as effective to deal with the threat, do not engage in behavioural change. By confirming that individuals who are engaging or have engaged in behavioural change perceive higher threat and higher efficacy than individuals who have not yet engaged in behavioural change, our data confirms that these two dimensions are fundamental to push people to advance through the different stages of behavioural change.

Data from Study 1 confirm that perceived risk and perceived efficacy are two key dimensions differentiating the different phases of behavioural change, suggesting that they could be used as levers to push individuals to advance through phases, via narrative persuasion. The findings of Study 2 demonstrated in fact that the stage of behavioural change determines the sensibility of citizens to the influence of the evidence format used in a communication about the environmental risks of air pollution. Indeed, individuals in a phase of pre-contemplation and contemplation reported closer psychological distance and higher efficacy appraisal when receiving a narrative communication rather than a statistical one, but this difference was not significant for individuals in the action and post-action stages. This is in line with past research demonstrating that individuals in these stages are ambivalent about their current behaviour, which makes them more sensitive to external influences (Forward, 2014; Andersson, 2020). This could also explain why past research has found heterogeneous results with regards to the effectiveness of narrative vs. factual communications in promoting pro-environmental behaviour, with some studies finding no significant difference with regards to transportation and behavioural intention (e.g., Jones, 2014).

A question remains concerning the reason why statistical format seems to not be effective in any of the stages of behavioural change. Indeed, presenting scientific evidence is important to explain how certain conclusions have been reached through data, although past empirical research has demonstrated that the ability to understand statistics and numbers varies greatly among individuals (Reyna et al., 2009; Peters, 2012; Hopp, 2015), which could explain the lack of persuasiveness when exposing a general sample to a statistical format of evidence. The research presented in this paper does not allow us to draw a conclusion on the non-persuasiveness of the statistical format, because individuals' numeracy and/or mathematical expertise was not measured, nor was the understanding of the statistics presented in general. Further research should thus focus not only on the reasons why narrative format is persuasive, but also on the reasons why statistical format is not, and whether this depend on the expertise and knowledge of the population exposed to the messages.

Our findings about the effectiveness of narrative persuasion are however less explicit when considering behavioural intentions, as no interactive effect is obtained. Given the limited overall sample of Study 2 (especially considering the sub-samples in each stage of behavioural change), modelling analyses could not be carried out (Jackson, 2003); future research on this topic should aim at collecting data from a larger sample in order to allow for structural equation modelling guided by hypotheses well-grounded in theory and past research. A narrative message seems more effective than a statistical one boosting participants' intention to engage in pro-environmental behaviours, regardless of the stage of behavioural change individuals are in. This could be due to the «habitual» nature of the targetted behaviour, driving. indeed, it has been argued that one of the conditions to modify habits is that individuals perceive the positive benefits of behavioural change in a short-term perspective (Jager, 2003), and that procrastination of behavioural change is reduced when individuals can imagine concretely the new behaviour or task (McCrea et al., 2008). It is thus possible to suppose that a narrative format would improve the ability of individuals to imagine short term benefits in a concrete way, thus influencing behavioural intentions for all individuals regardless of the stage of behavioural change they are in. Future research should explore further the reasons why a narrative message is more effective even for people who are in the process of changing their behaviour or have changed it already.

One further limitation of Study 2 concerns the influence of format on individuals' engagement with a message. This effect could have been biassed by the way the two formats (statistical and narrative) have been phrased in the messages, specifically when considering narrative identification. Indeed, if the narrative message presented a specific character and his experience with flooding, mentioning the character six times and thus giving several opportunities to participants to identify with the character, the statistical message only mentioned "people" and their experience a couple of times. This incongruence could have resulted in further identification with the narrative than with the statistical format. The two messages were not pre-tested, and this is one of the main methodological limitations of Study 2. Future studies need to further analyse whether a statistical message offering the same opportunities to identify with the people described as a narrative message also results in higher narrative engagement.

It is important to consider that the generalisation of our data could be limited by the fact that the participants in Study 1 and Study 2 were not equally distributed across the five stages identified by the TTM (Prochaska and DiClemente, 1984; Prochaska et al., 2015). The difficulty of finding individuals in the pre-contemplation stage, which also features in past studies (e.g., Forward, 2014; Andersson, 2020) might depend on a general

increase of environmental awareness that developed in the last decades (Special Eurobarometer 468, 2017; Bandura and Cherry, 2020). This difficulty brings us to question the pertinence of dividing the process of behavioural change in favour of the environment in five stages based on "arbitrary time periods" (Sutton, 2000), which has been previously criticised (Weinstein et al., 1998; Sutton, 2000; Littell and Girvin, 2002; Wilson and Schlam, 2004). Further research could rather focus on the original three phases of behavioural change as described by Lewin (1951): unfreezing, changing and refreezing. Further research should thus explore whether the increase of environmental awareness in Western societies calls for the development of a new model of the stages of behavioural change to be adopted in experimental work as well as in interventions to promote pro-environmental behaviours.

Overall, the present research addresses two main gaps in the literature with regards, on one hand, to the understanding of how risk- and efficacy-perceptions vary across stages of behavioural change, and on the other hand to the study of the persuasiveness of narrative evidence. Indeed, findings from study 1 demonstrate that individuals in the first stages of behavioural change perceive the environmental consequences of air pollution to be psychologically distant (which triggers low perception of risk and vulnerability) and the behaviours to improve air quality to be less effective than individuals in the more advanced stages of behavioural change. This in line with past research in the field of health promotion (e.g., Marshall and Biddle, 2001), confirming that also in the field of pro-environmental behaviour, perceived risk and perceived effectiveness are two levers that could push individual to advance through stages of behavioural change. Furthermore, findings from study 2 advance the research on narrative persuasion in the field of pro-environmental behavioural change, suggesting that the effectiveness of narrative vs. statistical formats of risk information depends on the way individuals are positioned with regards to the process of engaging in pro-environmental behavioural change. This offers practical advice for the development of education and communication programmes, contributing to research demonstrating that different communication strategies might be more or less effective in promoting environmental awareness and behavioural change depending on the segment of the targetted population.

Data availability statement

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

Author contributions

LB was in charge of the concept and design of the studies, data analysis, and writing of the article. MC has made a substantial contribution for the development of the methods and as well as data collection and analysis. FM revised the article critically for important intellectual content as well as data analysis and interpretation. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

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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.2023.1072187/full#supplementary-material

References

Amirkhani, M., Ghaemimood, S., von Schreeb, J., El-Khatib, Z., and Yaya, S. (2022). Extreme weather events and death based on temperature and CO2 emission–a global retrospective study in 77 low-, middle-and high-income countries from 1999-2018. *Prev. Med. Rep.* 28:101846. doi: 10.1016/j.pmedr.2022.101846

Andersson, A. (2020). Is climate morality the answer? Preconditions affecting the motivation to decrease private car use. *Trans. Res. Part D Trans. Environ.* 78:102198. doi: 10.1016/j.trd.2019.11.027

Bahk, C. M. (2010). Environmental education through narrative films: Impact of medicine man on attitudes toward forest preservation. *J. Environ. Educ.* 42, 1–13. doi: 10.1080/00958960903479811

Bamberg, S. (2013). Applying the stage model of self-regulated behavioral change in a car use reduction intervention. *J. Environ. Psychol.* 33, 68–75.

Bandura, A. (1982). The assessment and predictive generality of self-percepts of ef?cacy. *J. Behav. Ther. Exp. Psychiatry* 13, 195–199. doi: 10.1016/0005-7916(82)90004-0

Bandura, A., and Cherry, L. (2020). Enlisting the power of youth for climate change. *Am. Psychol.* 75:945. doi: 10.1037/amp0000512

Bickerstaff, K., and Walker, G. (1999). Clearing the smog? Public responses to air-quality information. *Local Environ.* 4, 279–294. doi: 10.1080/13549839908725600

Bickerstaff, K., and Walker, G. (2001). Public understandings of air pollution: The 'localisation'of environmental risk. *Glob. Environ. Change* 11, 133–145. doi: 10.1016/S0959-3780(00)00063-7

Bočkarjova, M., Van der Veen, A., and Geurts, P. A. T. M. (2009). "A PMT-TTM model of protective motivation for flood danger in the Netherlands," in *Paper presented at the ITC working papers series* (International Institute for Geo-Information Science and Earth Observation).

Bosone, L., and Bertoldo, R. (2022). The greater the contact, the closer the threat: The influence of contact with nature on the social perception of biodiversity loss and the effectiveness of conservation behaviours. *Sustainability* 14:16490. doi: 10.3390/su142416490

Bosone, L., Martinez, F., and Kalampalikis, N. (2015). When the model fits the frame: The impact of regulatory fit on efficacy appraisal and persuasion in health communication. *Pers. Soc. Psychol. Bull.* 41, 526–539. doi: 10.1177/0146167215571089

Braddock, K. (2015). The utility of narratives for promoting radicalization: The case of the Animal Liberation Front. *Dyn. Asymmetric Confl.* 8, 38–59. doi: 10.1080/17467586.2014.968794

Braddock, K., and Dillard, J. P. (2016). Meta-analytic evidence for the persuasive effect of narratives on beliefs, attitudes, intentions, and behaviors. *Commun. Monogr.* 83, 446–467. doi: 10.1080/03637751.2015.1128555

Brügger, A., Dessai, S., Devine-Wright, P., Morton, T. A., and Pidgeon, N. F. (2015). Psychological responses to the proximity of climate change. *Nat. Clim. Change* 5, 1031–1037. doi: 10.1038/nclimate2760

Brügger, A., Morton, T. A., and Dessai, S. (2016). "Proximising" climate change reconsidered: A construal level theory perspective. *J. Environ. Psychol.* 46, 125–142. doi: 10.1016/j.jenvp.2016.04.004

Brulle, R. J., Carmichael, J., and Jenkins, J. C. (2012). Shifting public opinion on climate change: An empirical assessment of factors influencing concern over climate change in the US, 2002–2010. *Clim. Change* 114, 169–188. doi: 10.1007/s10584-012-0403-y

Bush, J., Moffatt, S., and Dunn, C. (2001a). 'Even the birds round here cough': Stigma, air pollution and health in Teesside. *Health Place* 7, 47–56. doi: 10.1016/s1353-8292(00)00037-x

Bush, J., Moffatt, S., and Dunn, C. E. (2001b). Keeping the public informed? Public negotiation of air quality information. *Public Understand. Sci.* 10:213. doi: 10.1088/0963-6625/10/2/304

Busselle, R., and Bilandzic, H. (2008). Fictionality and perceived realism in experiencing stories: A model of narrative comprehension and engagement. *Commun. Theory* 18, 255–280. doi: 10.1111/j.1468-2885.2008.00322.x

Busselle, R., and Bilandzic, H. (2009). Measuring narrative engagement. *Media Psychol.* 12, 321–347.

Carlsten, C., Salvi, S., Wong, G., and Chung, K. (2020). Personal strategies to minimise effects of air pollution on respiratory health: Advice for providers, patients and the public. *Eur. Respir. J.* 55:1902056. doi: 10.1183/13993003.02056-2019

Casebeer, W. D., and Russell, J. A. (2005). Storytelling and terrorism: Towards a comprehensive counter-narrative strategy. *Strat. Insights* 6, 1–16.

Cheney, L. C., Kohler, C., and Muilenburg, J. (2006). A woman in transition: Can drama deliver a cancer awareness message? *J. Cancer Educ.* 21, 129–132. doi: 10.1207/s15430154jce2103_7

Creutzig, F., Roy, J., Lamb, W. F., Azevedo, I. M., De Bruin, W. B., Dalkmann, H., et al. (2018). Towards demand-side solutions for mitigating climate change. *Nat. Clim. Change* 8, 260–263.

Crowley, T. J., and Berner, R. A. (2001). CO2 and climate change. *Science* 292, 870–872. doi: 10.1038/s41558-018-0121-1

de Carvalho, M. C. R., de Menezes, M. C., Toral, N., and Lopes, A. C. S. (2021). Effect of a Transtheoretical Model-based intervention on fruit and vegetable intake according to perception of intake adequacy: A randomized controlled community trial. *Appetite* 161:105159. doi: 10.1016/j.appet.2021.105159

de Freitas, P. P., de Menezes, M. C., Dos Santos, L. C., Pimenta, A. M., Ferreira, A. V. M., and Lopes, A. C. S. (2020). The transtheoretical model is an effective weight management intervention: A randomized controlled trial. *BMC Public Health* 20:652. doi: 10.1186/s12889-020-08796-1

De Graaf, A., Hoeken, H., Sanders, J., and Beentjes, H. (2009). The role of dimensions of narrative engagement in narrative persuasion. *Communications* 34, 385–405. doi: 10.1515/COMM.2009.024

De Graaf, A., Sanders, J., and Hoeken, H. (2016). Characteristics of narrative interventions and health effects: A review of the content, form, and context of narratives in health-related narrative persuasion research. *Rev. Commun. Res.* 4, 88–131. doi: 10.12840/issn.2255-4165.2016.04.01.011

de Wit, J., Das, E., and Vet, R. (2008). What works best: Objective statistics or a personal testimonial? An assessment of the persuasive effects of different types of message evidence on risk perception. *Health Psychol.* 27, 110–115. doi: 10.1037/0278-6133.27.1.110

Escalas, J. E. (2004). Imagine yourself in the product: Mental simulation, narrative transportation, and persuasion. *J. Advert.* 33, 37–48. doi: 10.1080/00913367.2004.10639163

European Environment Agency (2018). *Exceedance of air quality standards in Europe*. Copenhagen: European Environment Agency.

Forward, S. E. (2014). Exploring people's willingness to bike using a combination of the theory of planned behavioural and the transtheoretical model. *Eur. Rev. Appl. Psychol.* 64, 151–159. doi: 10.1016/j.erap.2014.04.002

Gesser-Edelsburg, A., and Endevelt, R. (2011). An entertainment–education study of stereotypes and prejudice against fat women: an evaluation of Fat Pig. *Health Educ. J.* 70, 374–382.

Godin, G., Lambert, L. D., Owen, N., Nolin, B., and Prud'homme, D. (2004). Stages of motivational readiness for physical activity: A comparison of different algorithms of classification. *Br. J. Health Psychol.* 9, 253–267. doi: 10.1348/135910704773891087

Green, M., and Clark, J. (2013). Immersion into narrative worlds: Implications for entertainment media influences on tobacco use. *Addiction* 108, 477–484. doi: 10.1111/j.1360-0443.2012.04088.x

Hayes, J. R. (2012). Modeling and remodeling writing. *Writ. Commun.* 29, 369–388.

Hinyard, L. J., and Kreuter, M. W. (2007). Using narrative communication as a tool for health behavior change: A conceptual, theoretical, and empirical overview. *Health Educ. Behav.* 34, 777–792. doi: 10.1177/1090198106291963

Hopp, T. (2015). The effect of numeracy on the relationship between state reactance and message evaluations. *Commun. Res. Rep.* 32, 314–321. doi: 10.1080/08824096.2015.1089855

Hornikx, J. (2005). A review of experimental research on the relative persuasiveness of anecdotal, statistical, causal, and expert evidence. *Stud. Commun. Sci.* 5, 205–216.

Horowitz, S. M. (2003). Applying the transtheoretical model to pregnancy and STD prevention: A review of the literature. *Am. J. Health Promot.* 17, 304–328. doi: 10.4278/0890-1171-17.5.304

Howel, D., Moffatt, S., Bush, J., Dunn, C. E., and Prince, H. (2003). Public views on the links between air pollution and health in Northeast England. *Environ. Res.* 91, 163–171. doi: 10.1016/S0013-9351(02)00037-3

Igartua, J. J. (2010). Identification with characters and narrative persuasion through fictional feature films. *Commun. Eur. J. Commun. Res.* 35, 347–373. doi: 10.1515/comm.2010.019

Igartua, J. J., and Hayes, A. F. (2021). Mediation, moderation, and conditional process analysis: Concepts, computations, and some common confusions. *Span. J. Psychol.* 24:e49.

Jackson, D. L. (2003). Revisiting sample size and number of parameter estimates: Some support for the N:q hypothesis. *Struct. Equ. Model.* 10, 128–141. doi: 10.1207/S15328007SEM1001_6

Jager, W. (2003). *Breaking bad habits: A dynamical perspective on habit formation and change. Human decision-making and environmental perception–understanding and assisting human decision-making in real life settings*. Groningen: University of Groningen.

Jones, M. D. (2014). Communicating climate change: Are stories better than "just the facts"? *Policy Stud. J.* 42, 644–673. doi: 10.1111/psj.12072

Kohut, A., and Pew Research Center (2013). *Climate change and financial instability seen as top global threats*. Washington, DC: Pew Research Center.

Kothe, E. J., Ling, M., North, M., Klas, A., Mullan, B. A., and Novoradovskaya, L. (2019). Protection motivation theory and pro-environmental behaviour: A systematic mapping review. *Aust. J. Psychol.* 71, 411–432. doi: 10.1111/ajpy.12271

Lee, J. K., Hecht, M. L., Miller-Day, M., and Elek, E. (2011). Evaluating mediated perception of narrative health messages: The perception of narrative performance scale. *Commun. Methods Meas.* 5, 126–145. doi: 10.1080/19312458.2011.568374

Leiserowitz, A., Maibach, E. W., Roser-Renouf, C., Feinberg, G., and Howe, P. (2013). *Climate change in the American mind: Americans' global warming beliefs and attitudes in April 2013*. New Haven, CT: Yale University.doi: 10.2139/ssrn.2298705

Lewin, K. (1951). *Field theory in social science*. New York, NY: Harper and Row.

Littell, J. H., and Girvin, H. (2002). Stages of change: A critique. *Behav. Modif.* 26, 223–273. doi: 10.1177/0145445502026002006

Lopes, A. C. S., Bedeschi, L. B., Dos Santos, L. C., and de Menezes, M. C. (2016). Interventions directed at eating habits and physical activity using the transtheoretical model: A systematic review. *Nutr. Hosp.* 33, 1194–1204. doi: 10.20960/nh.586

Loy, L. S., and Spence, A. (2020). Reducing, and bridging, the psychological distance of climate change. *J. Environ. Psychol.* 67:101388. doi: 10.1016/j.jenvp.2020.101388

Maddux, J. E., and Rogers, R. W. (1983). Protection motivation and self-efficacy: A revised theory of fear appeals and attitude change. *J. Exp. Soc. Psychol.* 19, 469–479. doi: 10.1016/0022-1031(83)90023-9

Manisalidis, I., Stavropoulou, E., Stavropoulos, A., and Bezirtzoglou, E. (2020). Environmental and health impacts of air pollution: A review. *Front. Public Health* 8:14. doi: 10.3389/fpubh.2020.00014

Marshall, S. J., and Biddle, S. J. (2001). The transtheoretical model of behavior change: A meta-analysis of applications to physical activity and exercise. *Ann. Behav. Med.* 23, 229–246. doi: 10.1207/S15324796ABM2304_2

Martin, I. M., Bender, H., and Raish, C. (2007). What motivates individuals to protect themselves from risks: The case of wildland fires. *Risk Anal Int. J.* 27, 887–900. doi: 10.1111/j.1539-6924.2007.00930.x

McCrea, S. M., Liberman, N., Trope, Y., and Sherman, S. J. (2008). Construal level and procrastination. *Psychol. Sci.* 19, 1308–1314. doi: 10.1111/j.1467-9280.2008.02240.x

Miller-Day, M., and Hecht, M. (2013). Narrative means to preventative ends: A narrative engagement framework for designing prevention interventions. *Health Commun.* 28, 657–670. doi: 10.1080/10410236.2012.762861

Mohebbi, B., Sabouri, M., and Tol, A. (2021). Application of health education and promotion theory-based interventions on patients with cardiovascular disease: A systematic review. *J. Educ. Health Promot.* 10:236. doi: 10.4103/jehp.jehp_899_20

Nakano, Y., and Hondo, H. (2023). Narrative or logical? The effects of information format on pro-environmental behavior. *Sustainability* 15:1354. doi: 10.3390/su15021354

Nielsen, J. H., Escalas, J. E., and Hoeffler, S. (2018). Mental simulation and category knowledge affect really new product evaluation through transportation. *J. Exp. Psychol. Appl.* 24:145. doi: 10.1037/xap0000169

Peters, E. (2012). Beyond comprehension: The role of numeracy in judgments and decisions. *Curr. Direct. Psychol. Sci.* 21, 31–35. doi: 10.1177/0963721411429960

Prati, G., Pietrantoni, L., and Zani, B. (2012). Influenza vaccination: The persuasiveness of messages among people aged 65 years and older. *Health Commun.* 27, 413–420.

Prochaska, J. O., and DiClemente, C. C. (1994). *The transtheoretical approach: Crossing traditional boundaries of therapy*. Malabar, FL: Krieger Publishing Company. doi: 10.1080/10410236.2011.606523

Prochaska, J. O., and DiClemente, C. C. (1984). *The transtheoretical approach: Crossing traditional boundaries of therapy*. Homewood, IL: Dow Jones Irwin.

Prochaska, J. O., Redding, C. A., and Evers, K. E. (2015). "The transtheoretical model and stages of change," in *Health behavior: Theory, research, and practice*, Vol. 97, eds K. Glanz, B. K. Rimer, and K. Viswanath (San Francisco, CA: Jossey-Bass).

Reyna, V. F., Nelson, W. L., Han, P. K., and Dieckmann, N. F. (2009). How numeracy influences risk comprehension and medical decision making. *Psychol. Bull.* 135:943. doi: 10.1037/a0017327

Richard, F. D., Bond, C. F. Jr., and Stokes-Zoota, J. J. (2003). One hundred years of social psychology quantitatively described. *Rev. Gen. Psychol.* 7, 331–363. doi: 10.1037/1089-2680.7.4.331

Ritchie, H., and Roser, M. (2019). *"Outdoor air pollution"*. Available online at: 'https://ourworldindata.org/outdoor-air-pollution' (accessed October 2022).

Rothman, A. J., and Kiviniemi, M. T. (1999). Treating people with information: An analysis and review of approaches to communicating health risk information. *JNCI Monogr.* 1999, 44–51. doi: 10.1093/oxfordjournals.jncimonographs.a024207

Schuldt, J. P., Rickard, L. N., and Yang, Z. J. (2018). Does reduced psychological distance increase climate engagement? On the limits of localizing climate change. *J. Environ. Psychol.* 55, 147–153. doi: 10.1016/j.jenvp.2018.02.001

Sestir, M., and Green, M. C. (2010). You are who you watch: Identification and transportation effects on temporary self-concept. *Soc. Influence* 5, 272–288. doi: 10.1080/15534510.2010.490672

Shafiei, A., and Maleksaeidi, H. (2020). Pro-environmental behavior of university students: Application of protection motivation theory. *Glob. Ecol. Conserv.* 22:e00908. doi: 10.1016/j.gecco.2020.e00908

Shen, D. (2015). Dual textual dynamics and dual readerly dynamics: Double narrative movements in Mansfield's "psychology". *Style* 49, 411–438. doi: 10.5325/style.49.4.0411

Shwom, R., Dan, A., and Dietz, T. (2008). The effects of information and state of residence on climate change policy preferences. *Clim. Change* 90, 343–358. doi: 10.1007/s10584-008-9428-7

Slater, M., and Rouner, D. (2002). Entertainment-education and elaboration likelihood: Understanding the processing of narrative persuasion. *Commun. Theory* 12, 173–191. doi: 10.1111/j.1468-2885.2002.tb00265.x

Special Eurobarometer 468, (2017). *Attitudes of European citizens towards the environment*. Luxembourg: European Commission. doi: 10.2779/84809

Spence, A., and Pidgeon, N. (2010). Framing and communicating climate change: The effects of distance and outcome frame manipulations. *Glob. Environ. Change* 20, 656–667. doi: 10.1016/j.gloenvcha.2010.07.002

Spence, A., Poortinga, W., and Pidgeon, N. (2012). The psychological distance of climate change. *Risk Anal. Int. J.* 32, 957–972. doi: 10.1111/j.1539-6924.2011.01695.x

Stoknes, P. E. (2014). Rethinking climate communications and the "psychological climate paradox". *Energy Res. Soc. Sci.* 1, 161–170. doi: 10.1016/j.erss.2014.03.007

Sutton, S. (2000). *Transtheoretical model applied to smoking cessation. Understanding and changing health behaviour: From health beliefs to self-regulation*. Amsterdam: Harwood Academic Publishers, 207–225.

Topp, K., Thai, M., and Hryciw, D. H. (2019). The role of entertainment in engagement with climate change. *Environ. Educ. Res.* 25, 691–700. doi: 10.1080/13504622.2019.1572072

Trope, Y., and Liberman, N. (2010). Construal-level theory of psychological distance. *Psychol. Rev.* 117:440. doi: 10.1037/a0018963

Weinstein, N. D., Rothman, A. J., and Sutton, S. R. (1998). Stage theories of health behavior: Conceptual and methodological issues. *Health Psychol.* 17:290. doi: 10.1037/0278-6133.17.3.290

Wilson, G. T., and Schlam, T. R. (2004). The transtheoretical model and motivational interviewing in the treatment of eating and weight disorders. *Clin. Psychol. Rev.* 24, 361–378. doi: 10.1016/j.cpr.2004.03.003

Witte, K., and Allen, M. (2000). A meta-analysis of fear appeals: Implications for effective public health campaigns. *Health Educ. Behav.* 27, 591–615. doi: 10.1177/109019810002700506

World Health Organization (2019). *Ten threats to global health in 2019*. Geneva: World Health Organization.

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Explanatory model of the psychosocial variables related to the social acceptance of a uranium mine project in northwest Spain

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Introduction: The demographic growth and the development of the welfare system have been accompanied by an important social dilemma between preserving nature or promoting energy development by assuming the benefits and risks of both proposals. This research attempts to address this social dilemma by analyzing the psychosocial factors that influence the acceptance or rejection of a new uranium mining development and exploitation project. The main objective was to test an explanatory theoretical model of uranium mining project acceptance, based on the interrelation of sociodemographic variables (e.g., age, gender, economic and educational situation, and level of knowledge about uranium energy) and cognitive variables (e.g., environmental beliefs, risk, and benefit perceptions), along with the activation of an emotional balance in response to the proposal of constructing a uranium mine.

Method: Three hundred seventy-one individuals responded to the questionnaire about the variables included in the model.

Results: The results showed that older participants showed lower levels of agreement with the mining proposal people, while women and those with greater knowledge of nuclear energy perceived greater risks and had a more negative emotional balance. The proposed explanatory model based on sociodemographic, cognitive, and affective variables showed good fit indices for explaining the assessment of the uranium mine. Thus, age, level of knowledge, risks and benefits, and emotional balance had a direct effect on the acceptance of the mine. Likewise, emotional balance showed a partial mediation effect between the relationships existing between the perception of benefits and risks and the acceptance of the mining proposal.

Discussion: The results are discussed based on the consideration of analyzing sociodemographic, cognitive, and affective variables to understand potential conflicts in communities affected by energy projects.

KEYWORDS

social conflict, uranium mine, acceptance or rejection, explanatory model, environmental beliefs, risk perception

1. Introduction

The concept of sustainability encompasses different dimensions and aims to find the appropriate balance between preserving the natural environment and the development of human activity, thus considering a balance between biodiversity, economy, culture, heritage, and identity roots (Teerikangas et al., 2021). The growth of the population, combined with the development of the welfare society, has led to an increase in investment in research, development, and eco-innovation in order to ensure the necessary resources to meet the population's various needs, including energy. However, in the face of this approach, Smil's (2018) asserts that the negative aspects of advances in the development of new energy sources must also be valued, including the deterioration of air quality, inequality in access to energy or energy poverty, or the development of large monopolies that can corrupt governments. Faced with this social dilemma of development versus conservation, it is worth mentioning Sustainable Development Goal 7, which values the importance of a clean, affordable, and modern energy system worldwide (Wang et al., 2022). Thus, in recent decades, numerous alternative energy sources have been explored in an attempt to minimize the negative consequences of pollution, deforestation, and the exploitation of fossil fuels (Afshan et al., 2022).

Therefore, the exploration of new sources of energy has always been accompanied by a debate between development and conservation (Lindahl et al., 2018); for Smil (2018), it is a debate between the positive and negative aspects of development. In this sense, Firestone and Kempton (2007) argued that technological interventions in the environment require a confrontation between local communities, developers, and authorities who support technological intervention. In an attempt to avoid such confrontation, other sources of energy have recently been explored that are further away from densely populated areas. For example, there has been progress in extracting oil and gas in coastal areas (known as offshore drilling). However, in some cases, these interventions also provoke social rejection, as happened in the drilling project off the coasts of the Canary Islands, where, despite having the support of the central administration, the social rejection of the local population ultimately forced the drilling company to abandon the project (Ruiz et al., 2018). Thus, proposals for intervention in nature in search of new sources of energy have often been accompanied by the rejection of the population most directly affected by the construction of such infrastructure (Batel and Rudolph, 2021).

The weight of negative attitudes from the population towards some energy interventions, such as offshore oil and gas drilling, which lead to the effective rejection of different energy projects, has been pointed out in recent research works (Chen and Martens, 2021). In fact, numerous studies (see Upham et al., 2015) have highlighted the role of community acceptance of a proposed energy project as a key factor for the successful execution of such projects by governments. Upham et al. (2015) pointed out that public opinion, perceptions, acceptance, attitudes, behaviors, values, and related practices have become relevant factors for governments, the energy industry, and researchers in environmental and behavioral disciplines. Thus, some research studies (Upham et al., 2015; Chen and Martens, 2021) show that some projects are executed with the approval of affected local communities, while others generate greater rejection, all without knowing the crucial psychosocial factors involved in acceptance. These results highlight the role that populations play in the acceptance or rejection of different energy proposals, hence the emergence of a new concept called "energy citizenship," based on the democratic right of citizens to engage and participate in decision-making (Devine-Wright, 2007; Brondi et al., 2016).

As mentioned, in the field of energy, social acceptance of technology or innovations in renewable energy is increasingly considered one of the many issues that determine the success of the implementation of new developments and policies (Wüstenhagen et al., 2007). But before advancing with the aim of this research, it seems necessary to emphasize the concept of social acceptance, as Dessi et al. (2022) state, "acceptability" refers to the characteristics that favor a behavioral response for or against; "acceptance" is the behavior that accepts and promotes the use of technology, while "adoption" is the decision-making process (analysis, selection, purchase, and commitment to use) until the technology is used. Social acceptance is one of the key aspects of policy development in the field of energy technologies and, for this reason, a considerable number of sociological and psychological studies focus on analyzing the determinants of social acceptance of a wide variety of energy interventions (Cohen et al., 2014; Batel, 2020). For Devine-Wright and Wiersma (2020), social acceptance is a multidimensional concept in which political, social, economic, and community aspects are interrelated. Thus, acceptance has been defined as a positive attitude towards a specific fact that manifests itself in the form of a supportive, consenting, or authoritative opinion or behavior (Kraeusel and Möst, 2012). Therefore, following Wolsink (2018), the term acceptance aims to encompass both opinions and actions that are relevant to the degree to which the energy innovation project would be accepted or not by the community.

Using a social cognitive theoretical framework, Mendoza-Denton et al. (2020) elaborated a dynamic system of interaction between cognitive and affective variables to explain the processing of information and the behavior of individuals or communities in specific situations. In this line, Baran et al. (2023) use a social cognitive theoretical framework from which the individual processes information, activates an emotional state that explains decision-making or behavior towards an energy innovation. Similarly, Carlson et al. (2020) explain how environmental dispositions are associated with both environmental attitudes and beliefs and the emotional activation that occurs in response to images of climate change with positive or negative valence. Based on the interrelationship between social, cognitive, and affective variables, Huijts et al. (2012) developed a theoretical model to explain the acceptance of energy projects. According to Huijts et al. (2012), some of the population might focus on perceived risks (both environmental and economic, weighing the impact on the current socio-economic system or tourism in the area), and the other part might mainly value the social and economic benefits for the affected area (increased job opportunities, improvements in the communication network and infrastructure, or increased population). Although Huijts et al. (2012) limited the model to psychological variables, they acknowledge that sociodemographic variables could be determinants to explain acceptance. In the present research, a socio-cognitive-affective theoretical framework is used as a starting point to analyze the interrelationship of sociodemographic, cognitive, and affective variables in relation to the acceptance of an energy proposal.

Although *sociodemographic variables* have been shown to have a rather modest explanatory weight in some behaviors, some studies have found a direct relationship between educational and socioeconomic level and acceptance of technological proposals (Devine-Wright and Batel, 2013). For example, education and economic level were related to the acceptance of wind farm implementation (Devine-Wright and Batel, 2013) and technological intervention projects (Brannstrom et al., 2022). Thus, Brannstrom et al. (2022) found that in local communities with low education levels and few employment opportunities, acceptance of an energy proposal increases as the perception of greater economic benefits for the area increases, and therefore, perceived risk decreases. Regarding contextual characteristics, Perko et al. (2015) found that the level of knowledge about nuclear energy is related to negative emotions and attitudes towards this type of energy, and therefore greater perception of risk, such as radiological risks. In relation to the acceptance of the construction of uranium mines, Bjørst (2016) analyzed the role of personal variables that affect the debate between "saving" or "destroying" the local community. In contrast to other types of energy projects, Pedersen and Johansson (2012) compared emotional reactions to a wind farm and a uranium mine, and while they did not find gender differences in acceptance of a wind farm, they did find differences in acceptance of a uranium mine, with a more negative emotional state in women than in men. In addition, older citizens also perceived the uranium mine more negatively and threateningly than younger ones. Therefore, based on these results, a relationship is expected to be found between sociodemographic variables and the level of knowledge, both with environmental beliefs and perceived risks/benefits, as well as with the generated emotional state and acceptance of the energy proposal.

According to the theory of planned behavior proposed by Ajzen (2001), beliefs about specific people or objects influence attitudes, which in turn influence behavioral intention. In this sense, research has shown that *pro-environmental beliefs* are associated with positive public attitudes towards renewable energies and the resulting acceptance or rejection of energy projects (Eurobarometer, 2005; Tendero, 2021). In fact, citizens' attitudes can differ depending on the type of energy; for example, with regard to oil drilling, several studies have found that most local communities have clearly negative attitudes because they consider drilling to be harmful to the environment and health (Binder and Boldero, 2012). Regarding nuclear energy (Jones et al., 2016), clear differences have been observed in attitudes between different countries. While de Groot et al. (2020) compared the level of risk perception between two types of energy, gas and nuclear, and in both cases, they found that perceived risk leads to rejection of the proposed energy. Beliefs are directly associated with risk perception (or gain perception), which is an essential process for the acceptance of a particular technological project. Thus, perceived benefits and risks have a powerful effect on emotional reactions and the level of acceptance (de Groot et al., 2020). In this sense, in the present research, we find it interesting to analyze the relationship between environmental beliefs, risk and benefit perception associated with the development of the uranium mine, both with the emotional state it generates in citizens and with the possible acceptance of the mining project.

In general, changes in the natural environment can provoke different *affective reactions* that influence social conflict over the impact on nature caused by the exploitation of different energy sources (Ruiz et al., 2018). Previous studies have found that the emotions triggered by energy technologies depend on the personal assessment of the level of threat or opportunity they pose for daily life. In the case of nuclear energy, some studies have shown how the perception of risk and threat posed by this type of energy is associated with rejection of both the creation of nuclear power plants and the radioactive waste associated with uranium (Pidgeon et al., 2008), so opposition to this type of energy is driven by fear and threat. Automatic emotional responses of fear or anxiety can be triggered by knowledge of risks or accidents in other facilities, leading to a greater perception of risk (Venables et al., 2012). Thus, the relationship between perceived risk and the benefit of constructing a uranium mine can determine acceptance or rejection based on the emotional balance activated in the affected population, so emotional balance would play a mediating role in the relationship between perceived risk or benefit and mine acceptance.

After reviewing the interrelationships between sociodemographic variables (i.e., Devine-Wright and Batel, 2013; Bjørst, 2016), cognitive variables (i.e., Devine-Wright, 2009, 2011; Bronfman et al., 2012; Upham et al., 2015), and emotional variables (i.e., Van der Horst, 2007; Devine-Wright, 2011; Huijts et al., 2012; Ruiz et al., 2018) regarding the acceptance or rejection of energy projects from a cognitive, emotional, and personality dynamics approach (Mendoza-Denton et al., 2020), Figure 1 presents a theoretical explanatory model of energy project acceptance or rejection. Thus, the main objective of this study was to analyze the explanatory role of some sociodemographic, cognitive, and emotional variables on the level of acceptance of a uranium mine development project. The specific hypotheses to be tested are as follows:

> *Hypothesis 1.* Sociodemographic characteristics and level of knowledge about uranium energy will be related to both perceived risks and benefits, as well as to the emotions triggered and acceptance of the proposal. Thus, older people and those with lower socioeconomic and educational levels will perceive greater risks and fewer benefits and, therefore, show lower acceptance of the energy proposal. Likewise, based on the aforementioned studies, we expect to find gender differences whereby women will have stronger environmental beliefs and perceive greater risk regarding the construction of uranium mines than men, leading to greater emotional balance activation and consequent rejection of the mining proposal.

> *Hypothesis 2.* Pro-environmental beliefs and constructed beliefs about the risks and benefits associated with the construction of a uranium mine will influence the activation of emotional balance and subsequent acceptance of the mining proposal.

> *Hypothesis 3.* The emotional balance activated by the proposal to construct a uranium mine will have a direct impact on the acceptance of the mining proposal while also mediating the relationships between perceived risks or benefits and the acceptance of the energy project.

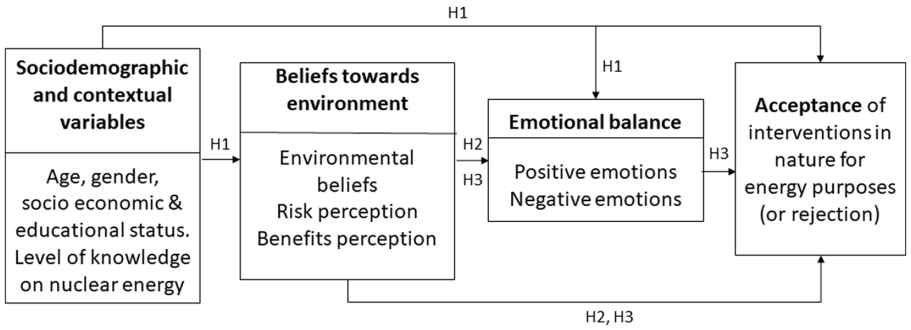

FIGURE 1
Theoretical explanatory model proposed for the acceptance or rejection of proposals for intervention in nature for energy purposes.

2. Materials and methods

2.1. Nuclear energy project characteristics

The uranium mine development and exploitation project, called the "Salamanca Project," was planned to be carried out by an international private mining company in the province of Salamanca, in northwestern Spain (see Figure 2 for the exact geographic location of the uranium mine). Details of the Salamanca Project prepared by the mining company can be found on their website.[1] The mining company began field studies in 2007 and intensified them in 2010, and from 2011 onward also began the social conflict and struggle against the project in the face of the approaches and actions in the mining field, creating different protest platforms, such as Stop Uranio.[2] The project, which began in 2013, included a Retortillo-Santidad uranium mine, a uranium concentrates plant, and a radioactive waste storage facility. The concentrates plant is a radioactive facility and is subject to several authorizations, to be granted by the Ministry for Ecological Transition and Demographic Challenge, in accordance with a report from the Spanish Nuclear Safety Council. These authorizations are required for site selection, plant construction, commissioning, decommissioning, and dismantling. In July 2021, the project was rejected by the Spanish Nuclear Safety Council (CSN report, July 2021). However, the company appealed the decision and, at the time of this writing is awaiting the outcome of the appeal. Given the current energy crisis in Europe and the need to resort to energy from nuclear power plants, the debate has been reopened in the affected populations with conflicting opinions on the possible opening of the uranium mine to supply European and Spanish nuclear power plants.

2.2. Participants and procedure

By calculating an *a priori* power analysis with G*power software for correlation tests, analyses of variance (ANOVAs) for mean comparisons, and linear multiple regression as statistical tests, asking for a small to medium expected effect size, the optimal total sample size was 348 participants, with a power of 0.95.

A total of 371 people responded to the questionnaire we sent out. A portion of the sample (202 participants) was found by distributing the questionnaire to various places near the mine location using a snowball sampling method (Baltar and Brunet, 2012). The questionnaire was developed on the Google Forms platform, which could be accessed through a link and a QR code. To do this, we distributed the questionnaire in the affected area by placing posters with QR codes in different locations (bars, town hall, parks, and portals). To complete the sample to an optimal size, 169 university students from the University of Salamanca participated through a classroom activity in which participants could voluntarily access the questionnaire while respecting their anonymity. The ethical committee of the University of Salamanca approved the research design of this study (ref. 0000822, approved on November 24, 2022).

Regarding the sociodemographic characteristics of the sample, the 371 participants in the study had a mean age of 33.5 years (SD = 15.87, ranging in age from 18 to 80 years) with 63.1% women and 36.9% men. In terms of employment status, 43.7% reported working full-time, 50.1% were students, 3% were retired, 2.7% were unemployed, and 0.5% were in another situation. In terms of education level, 57.4% reported having university education, 13.7% had doctoral studies, 24% had high school studies, 4% had vocational training, and 0.8% had basic or elementary education. Regarding the monthly income level of the family unit, 31% reported earning more than 2,500 euros, 15.1% between 2001 and 2,500 euros, 15.1% between 1,501 and 2000 euros, 16.4% between 1,001 and 1,500 euros, 5.9% less than 1,000 euros, and 16.4% did not answer this question. They were also asked how far their place of residence was from the area affected by the uranium mine, with 59% reporting living less than 100 kilometers away, compared to 41% who reported living further away. 75.2% reported not having done tourism in the area affected by the mine, while 24.8% had. Finally, 17.5% claimed to have participated in some kind of protest activity against the mine, with only 1.3% saying they had participated in any action in defense of the mine's construction. Descriptive analyses of the socio-demographic characteristics based on the origin of both samples can be found in the supplementary material (see Supplementary Material S1).

The questionnaire presented the following introduction:

> We are a research group of the University of Salamanca that is conducting a survey on the social assessment of the uranium

1 www.berkeleyenergia.com/salamanca-project-overview/
2 https://twitter.com/stopuranio?lang=es

FIGURE 2
Geographical location of the uranium mine project called the "Salamanca Project" in Spain, which would become the largest open pit uranium mine in Europe. **(A)** The "Salamanca Project" is located in northwestern Spain, **(B)** it is located 70 kilometers from the city of Salamanca and 45 kilometers from the border with Portugal. It is an eminently agricultural area with a low population density in the nearby towns (Retortillo and Villavieja de Yeltes with 200 and 850 inhabitants, respectively); **(C)** The location of the mine is less than 2 kilometers from a thermal spa used by the Romans, in the area runs the Yeltes river. The image shows both the location of the tailings pond and the deforestation that has taken place in the area (the company claims to have already cut down more than 2,000 oak trees). Images extracted from google maps (for more information see https://bit.ly/3VlfRUA). Maps data: Google, ©2023 CNES/Airbus, IGP/DGRF, Maxar Technologies, Inst. Geogr. Nacional.

> extraction and processing project for energy purposes in the province of Salamanca, specifically in the towns of Retortillo, Santidad and Villavieja de Yeltes. The participation in this survey is voluntary, so we would be grateful if you could answer the questions honestly, bearing in mind that we are interested in your assessment. There being no right or wrong answers. The information collected will be anonymous and will be used strictly for research purposes, so we understand that the completion of the test implies your consent to use the data for such purposes. The estimated response time is less than 15 min.

2.3. Measures

Immediately after the presentation, the questions related to sociodemographic variables, environmental beliefs, emotions about the mine, and personal assessment of acceptance were presented:

- *Sociodemographic and contextual measures.* Participants responded to questions related to age and sex; in addition, employment situation, socioeconomic status and educational level were assessed from a range with the five different options previously mentioned (5 being the highest level). Next, we asked about place of birth, place of residence, level of knowledge of the affected area and whether it was used as a tourist destination. The distance to the area affected by the mine project was calculated by asking whether the usual place of residence was located more or less than 100 km from the mine. Finally, we asked whether they had participated in actions to defend or reject the mining project.
- *Level of knowledge about the uranium mine exploitation project.* To assess whether individual perceived that they were sufficiently informed about the energy project (Ruiz et al., 2018), the level of knowledge of the population about both the uranium energy and the uranium mine project was evaluated with the next six specific items: In what measure do you think you have knowledge

about… "the benefits of nuclear energy," "the risks of nuclear energy," "alternatives to nuclear energy," "the project for the construction and operation of the uranium mine in Salamanca," "benefits for the area of uranium mining as a nuclear energy source," "the risks that the extraction of uranium as a source of nuclear energy would have for the region of Salamanca." The questions were rated by participants using a 10-point Likert scale, with 1 = *no knowledge* and 10 = *high knowledge*. An exploratory factorial analysis with the six items showed one main factor which explained a 79.49% of variance. The scale had adequate reliability ($\alpha = 0.94$).

- *Environmental beliefs.* The scale developed by Corral-Verdugo et al. (2008) and adapted to Spanish language by Ruiz et al. (2018) was used to assess the environmental beliefs of the population, including questions that consider both that *nature is at the service of humans* (e.g., "Caring for nature now means securing the future for humans") and that *humans should take care of nature* (e.g., "Human beings can progress only by conserving nature's resources"). The scale is composed of five items to which participants responded using a 10-point Likert scale, with 1 = *completely disagree* and 10 = *completely agree*. An exploratory factorial analysis with the five items showed one main factor which explained a 61.09% of variance. The scale had adequate reliability in both the original ($\alpha = 0.78$), and the present study ($\alpha = 0.84$).
- *Perception of the benefits of the development of the uranium mine exploitation project*. We used an adaptation of the scale developed by Ruiz et al. (2018) to assess the extent to which participants perceived a benefit from the construction and exploitation project of the area-specific energy proposal. The scale consists of four items (e.g., "Uranium mining will help create new employment opportunities in Retortillo and the western part of the province of Salamanca") to which participants are asked to respond on a 10-point Likert scale, with 1 = *completely disagree* and 10 = *completely agree*. The four items had referred to job opportunities, economic and political influence, economic investments, and social development. An exploratory factorial analysis with the four items showed one main factor which explained an 83.82% of variance. The scale had adequate reliability in both the original ($\alpha = 0.94$) and the present study ($\alpha = 0.94$).
- *Risk perception of the uranium mine development project*. We used an adaptation of the scale developed by Bronfman et al. (2012), which consists of four items (e.g., "Uranium mine developments pose a risk to human health") to which participants are asked to respond on a 10-point Likert scale, with 1 = *strongly disagree* and 10 = *strongly agree*. The four items refer to health risk, a traditional economy, tourism activities, and environmental risk in the form of deforestation and water contamination. An exploratory factorial analysis with the four items showed one main factor which explained a 79.22% of variance The scale had adequate reliability in both the original ($\alpha = 0.92$) and the present study ($\alpha = 0.91$).
- *Emotional balance toward the uranium mine development project*. We used the reduced version of the Positive Affect and Negative Affect scale (Watson et al., 1988; used by Cuadrado and Tabernero, 2015), composed of eight items that are rated on a 10-point scale on which 1 = *strongly disagree* to 10 = *strongly agree*. Six items assessed negative emotional states activated by knowledge of the development a uranium mine project (annoyed, hostile, ashamed, fearful, nervous, and alert) and two items assess positive emotional states (confident and happy). An exploratory factorial analysis showed two main factors which explained a 76% of variance (55.63% for the 6 negative emotions and 21.71% for two positive emotions). The eight items showed an adequate reliability ($\alpha = 0.86$). A global measure of emotional balance was created from the person's mean negative affect was subtracted from the person's mean positive affect (Wiese et al., 2000).
- *Level of acceptance of the development a uranium mine.* Acceptance was assessed by measuring the degree to which the participants agree with the proposed energy intervention, along the same lines as the work of Ruiz et al. (2018); specifically, they were expressly asked, in four items, about "To what extent do you accept a uranium mine development … in the Retortillo-Santidad area, your residence area, Spain, or other countries?." Responses were made on a 10-point Likert-type scale (1 = *strongly disagree*, 10 = *strongly agree*). An exploratory factorial analysis with the four items showed one main factor which explained a 73.55% of variance. The scale had adequate reliability ($\alpha = 0.88$).

2.4. Statistical analysis

We conducted descriptive and correlational analyses to test the relationships between the variables. Several ANOVAs were performed to test gender differences in the psychosocial variables incorporated. To test an exploratory model of the acceptance of a project of a uranium mine with all of the study's variables, we performed structural equation modeling (SEM). A multigroup SEM analysis was conducted to test for the equivalence of the theoretical explanatory model structure among both samples. This was performed with IBM SPSS Statistics Amos (Version 25) by following the manual multistep proposed by Byrne (2009). The model fit was evaluated using the following statistics: χ^2, χ^2/df ratio, root-mean-square error of approximation (RMSEA), goodness-of-fit Index (GFI), adjusted GFI (AGFI), normed fit index (NFI), and comparative fit index (CFI). For model evaluation, Schermelleh-Engel et al.'s (2003) recommendations were followed: acceptable model fit is indicated by $\chi^2/df \leq 3$; RMSEA <0.08, with a confidence interval (CI) close to RMSEA; GFI and NFI ≥ 0.90; AGFI between 0.85 and 0.90; CFI and Tucker–Lewis Index (TLI) ≥ 0.95; and Incremental Fit Index (IFI). Good model fit is indicated by $\chi^2/df \leq 2$; RMSEA between 0 and 0.05, with CI close to RMSEA; GFI and NFI ≥ 0.95; AGFI higher than 0.90; CFI and TLI ≥ 0.97, and IFI. Finally, mediational analyses in IBM SPSS Amos (Version 25) were performed (Collier, 2020).

3. Results

3.1. Relationships between all studied variables

As a first step, Pearson correlation analyses was performed with the sociodemographic variables and the rest of variables evaluated in

the questionnaire to test Hypothesis 1. The level of studies ($M = 3.79$, SD = 0.76) and income ($M = 3.53$, SD = 1.42) presented a significant and positive level of correlation with each other ($r = 0.33$, $p < 0.001$); in addition, both variables showed a significant level of correlation with age ($r = 0.33$, $p < 0.001$; $r = 0.38$, $p < 0.001$, respectively) and with the level of knowledge ($r = 0.19$, $p < 0.001$; $r = 0.16$, $p = 0.008$, respectively). On the other hand, education level showed a significant and negative relationship with both level of perceived benefits and level of acceptance with the proposed uranium mine construction (see Table 1).

In regard to the role of gender, women presented significantly stronger environmental beliefs, $F(1,369) = 8.23$, $p = 0.004$; $\eta^2 = 0.022$; observed power (OP) = 0.816; $M = 9.21$, SD = 0.88, than men ($M = 8.88$, SD = 1.36), according with that difference women perceived a higher level of risk associated with the construction of the uranium mine, $F(1, 369) = 6.59$, $p = 0.011$; $\eta^2 = 0.018$; OP = 0.726; $M = 8.01$, SD = 1.85, than the level of risks perceived by men ($M = 7.43$, SD = 2.45), and therefore experienced stronger negative emotions, $F(1,369) = 5.89$, $p = 0.016$; $\eta^2 = 0.016$; OP = 0.678; $M = 4.36$, $SD = 2.37$; than the negative emotions experienced by men ($M = 3.75$, SD = 2.20). The emotional balance is significatively higher for women ($M = -1.60$, $SD = 3.05$; $F(1,369) = 5.14$, $p = 0.024$; $\eta^2 = 0.014$; OP = 0.619) than for male ($M = -0.87$, SD = 2.84), However, women reported having a lower level of knowledge about the uranium mine project, $F(1,369) = 14.54$, $p = 0.001$; $\eta^2 = 0$ 0.038; OP = 0.967; $M = 3.64$, $SD = 2.16$, than the level of knowledge reported by men ($M = 4.56$, SD = 2.42). No significant differences were found with the rest of the variables analyzed, the level of agreement with the uranium mine was not significatively different between women and male ($F(1,369) = 1.23$, $p = 0.267$).

Regarding the differences related to access to the sample, the different ANOVAs performed between the overall sample and the student sample revealed significant differences in the following variables: environmental beliefs, $F(1,369) = 10.56$, $p < 0.001$; $\eta^2 = 0.028$; OP = 0.90; level of knowledge, $F(1,369) = 50.40$, $p < 0.001$; $\eta^2 = 0.12$; OP = 1.0; perception of benefits, $F(1,369) = 53.68$, $p < 0.001$; $\eta^2 = 0.127$; OP = 1.0; negative emotions, $F(1,369) = 4.62$, $p < 0.05$; $\eta^2 = 0.012$; OP = 0.57; and level of acceptance, $F(1,369) = 43.74$, $p < 0.001$; $\eta^2 = 0.106$; OP = 1.0. However, there were no significant differences in perceived level of risk, $F(1,369) = 0.17$, $p = 0.68$; $\eta^2 = 0.00$, OP = 0.069; and level of positive emotions activated against the construction of the uranium mine, $F(1,369) = 0.10$, $p = 0.76$; $\eta^2 = 0.00$; OP = 0.061. It should be noted that a significant difference was also found between the two samples with respect to age, $F(1,369) = 26.77$, $p < 0.001$; $\eta^2 = 0.068$; OP = 0.99, so the differences found may be due to this factor.

To evaluate the relationship between the other variables studied, we performed several correlation analyses. As can be seen in Table 1, all the relationships followed the expected direction (Hypotheses 1–3). Older participants showed a higher level of knowledge and academic level, and the more knowledge they claimed to have about energy from uranium mines, the lower level of the perception of benefits and the emotional balance towards uranium mining development. Environmental beliefs were shown to have a significant positive relationship with risk perception, although the relationship with perceived benefits, emotional balance, and level of acceptance of the project was significant and negative. Participants who reported a higher level of risk perception showed significantly and negatively fewer benefits, less emotional balance, and a lower level of acceptance of the uranium mine. Finally, the level of project acceptance showed negative significant correlations with environmental beliefs and risk perception, and positive significant correlations with benefit perception and emotional balance. These results allow us to test the theoretical model presented in Figure 1. The correlation table based on the origin of both samples can be found in the supplementary material (see Supplementary Material S2). The correlation analyses for both samples (general population and students) showed similar values between acceptance of the mining project and each of the analyzed psychosocial variables: environmental beliefs [−0.23/−0.29, respectively], risk perception [0.41/0.36, respectively], perception of benefits [−0.50/−0.43, respectively], positive emotions [0.36/0.34, respectively], and negative emotions [−0.17/−0.31, respectively]. Despite the differences in the sociodemographic characteristics of the participants according to the data collection carried out (general population versus university students), the values found in the correlation analyses and the significance levels were very similar, and therefore the statistical analyses were performed with the entire sample.

TABLE 1 Means, standard deviations, and correlations between all the variables studied (bivariate Pearson correlations).

Variables	1	2	3	4	5	6	7	8
1. Age	–							
2. Academic level	0.34**	–						
3. Knowledge level	0.36**	0.19**	–					
4. Environmental beliefs	0.19**	0.10	0.12*	–				
5. Risk perception	−0.05	−0.01	0.11*	0.38**	–			
6. Benefits perception	−0.38**	−0.16**	−0.33**	−0.26**	−0.44**	–		
7. Emotional balance	−0.13*	0.04	−0.29**	−0.35**	−0.48**	0.48**	–	
8. Project acceptance	**−0.26****	**−0.11***	−0.09	**−0.29****	**−0.37****	**0.54****	**0.39***	–
M	35.53	3.79	3.98	9.09	7.80	5.41	−1.33	2.94
SD	15.87	0.76	2.30	2.47	2.10	2.43	2.99	1.94

*$p < 0.05$, **$p < 0.01$.
The values in bold highlight the significant correlations between the variables studied and the dependent variable (project acceptance).

3.2. Structural equation model for the psychosocial variables explaining the level of acceptance of a uranium mine construction project

To test all our hypotheses and the hypothesized theoretical model of the acceptance of the uranium mine (see Figure 1), we performed a SEM analysis, testing for the adequacy of the theoretical explanatory model structure. Figure 3 represents the validity of the theoretical model for the entire sample. The goodness-of-fit tests revealed that the model was well fitted, $\chi^2(9) = 7.022$, $p = 0.635$; CMIN/df = 0.780; RMSEA = 0.000 (95% CI [0.00, 0.049]); CFI = 1.00; NFI = 0.991; IFI = 1.00; NFI = 0.991.

To test Hypothesis 3, two simple mediational models had been created based on the emotional balance relationships tested in the path analysis and agreed with the theoretical model shown in Figure 3. The emotional balanced aroused by the creation of the uranium mine had mediated the relationship between the perceived of benefits (see Figure 4A) and risk of the mine (see Figure 4B). To test mediation, 3 pathways were examined: (1) the main chain leading from the level of perceived benefits or risks (Figures 4A,B) of mine construction (as independent variables, IV) to the level of acceptance of the uranium mine project (as dependent variable, DV); (2) the simple mediation pathway through emotional balance (mediator, M) to mine acceptance (DV); and (3) the simple mediation pathway from the level of perceived benefits or risks of mine construction (IV) through emotional balance (M) to mine acceptance (DV). Confidence intervals (95%) were generated by bootstrapping with 5,000 resamples. Bootstrapping is a nonparametric resampling procedure that allows confidence intervals (CI) to be generated for statistical inference when normality assumptions about the sample distribution are not required.

The study assessed the mediational role of emotional balance on the relationship between benefits perception (and risk perception) and the level of acceptance of the uranium mine. The results revealed a significant indirect effect of impact of emotional balance on the relationship between benefits and level of uranium mine acceptance was positive and significant (indirect effect = 0.219; $p < 0.001$, [lower confident Interval = 0.037; bound confident Interval = 0.099]), the indirect effect of the impact of emotional balance on the relationship to risk was also significant, supporting H3. Furthermore, the direct effect of benefits perception on uranium mine acceptance in presence of the mediator was also found significant (both when considering benefits $\beta' = 0.45^{**}$; and considering risks $\beta' = -0.24^{**}$). Therefore, emotional balance partially mediated both the relationship between benefits and level of acceptance and the relationship between risks and level of acceptance of the uranium mine.

4. Discussion and conclusions

The rejection of mine construction is not something new in the history of mineral extraction; being aware of this, Ey et al. (2017) stated that acceptance by or rejection of a community in response to the construction of a mine is far from being a rational decision but obeys other factors that have gone relatively unnoticed, such as psychosocial variables. Devine-Wright and Wiersma (2020) stated that acceptance is a multidimensional concept that integrates social, psychological, affective, historical, demographic, economic, and political variables. The result of our research has aimed to show this evidence through an explanatory model of the acceptance of the proposal of a uranium mine after taking into consideration the interrelation of sociodemographic and contextual variables (e.g., age, gender, economic and education level, perceived level of knowledge), cognitive variables (e.g., pro-environmental beliefs, perception of risks and benefits), together with emotional balance (as an equilibrium between the positive and negative emotions), that are activated by the proposal of the mine construction.

In line with previous research results (Devine-Wright and Batel, 2013; Bjørst, 2016), sociodemographic characteristics played an important role in explaining the acceptance or rejection of the uranium mine. As expected, participants with higher education levels had greater knowledge of the project. Our study confirmed that older participants were less accepting of the uranium mine project, although they had more knowledge about it and nuclear energy, consistent with

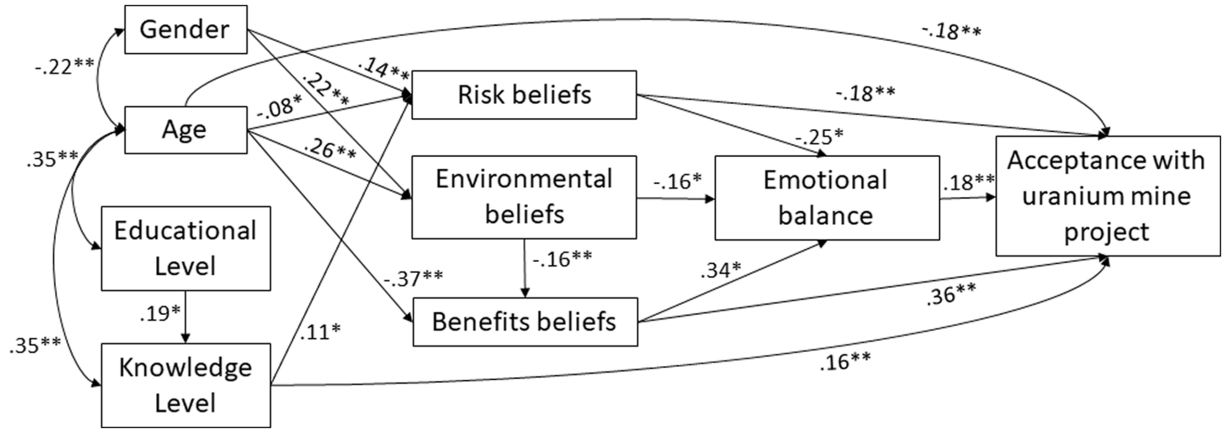

FIGURE 3
Structural equation modeling analysis to explain the level of acceptance of a uranium mine from sociodemographic, cognitive, and emotional variables involved in the personal assessment. Numeric values indicated the strength of the standardized estimates (β). All relationships signed between variables were significative at least at the 0.05 level.

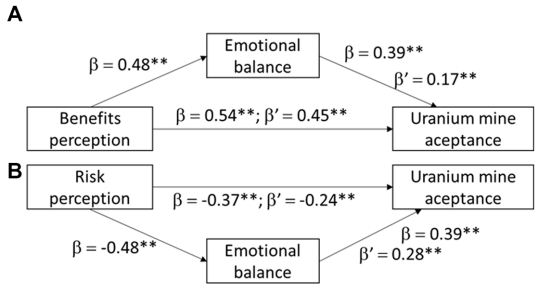

FIGURE 4
Mediational analysis of emotional balance activated before the construction project of a uranium mine in the relationships between **(A)** benefits perception of the mine with acceptance of the mine and between **(B)** risk perception with acceptance of the mine (**p<0.01).

the findings of Pedersen and Johansson (2012). In contrast, Pedersen and Johansson (2012) found a positive relationship between age and acceptance of a wind farm, but a negative and significant relationship between environmental beliefs and uranium drilling. Our study highlights the relevance of environmental beliefs and emotions towards a uranium extraction project associated with nuclear power and its potential acceptance. We found that older people perceived greater risks and fewer benefits from the development of the mining project, which was consistent with pro-environmental beliefs. Our results also support the findings of other research (Flynn et al., 1994; Gao et al., 2022) that women held stronger pro-environmental beliefs, perceived greater risks towards the mining project, and expressed more negative emotions. Flynn et al. (1994) found that differences regarding perceived risk decrease when considering the interaction of gender with the racial origin of the sample (white or non-white). Based on our data, we found that gender differences in perceived risk became non-significant when we analyzed only the sample of those under 30 years of age (60% of the sample, from $F(1,369) = 6.59$, $p < 0.01$ to $F(1,230) = 3.01$, $p = 0.08$). This result suggests the need to address gender differences in interaction with age when analyzing the valuation of new energy projects, whether they are renewable energy projects, such as wind energy, or based on nuclear energy development.

Furthermore, the results showed that individuals with higher education levels perceive fewer benefits from the development of the uranium mine construction project and, therefore, have lower acceptance of the project. This result is consistent with Brannstrom et al.'s (2022) proposal that, in isolated communities with few development opportunities, the perception of benefits of the mining project and the consequent acceptance grow in people with low education levels and low job expectations. Along these lines, Corner et al. (2011) created a sociodemographic profile of people who would presumably be in favor of nuclear energy as male, older, and of a high social class, whereas pro-environmental values and beliefs would act as more stable predictors of nuclear energy rejection. Thus, individuals with strong pro-environmental beliefs or values were less likely to approve uranium mining or nuclear power projects as a way to combat climate change, although acceptance or rejection was mediated by the perceived risk of the project (Corner et al., 2011). In contrast to Corner et al.'s (2011) results on the greater acceptance of the mine as a function of age, the explanatory model presented found that older people hold both greater pro-environmental beliefs and higher levels of information but fewer perceived benefits and less acceptance. Thus, according to the results found by Devine-Wright (2009), the analysis of the acceptance of a proposal for the construction of a mine should always take into account the characteristics of the sample, so that the theoretical model of interrelation between variables should consider the sociodemographic characteristics of the population in the explanatory model, such as age, gender, educational level, or level of knowledge on the subject. By taking these factors into account, it may be possible to increase the likelihood of acceptance and reduce potential conflicts in the communities affected by energy projects.

According to the path analysis created, the emotional balance would have a partial mediation role both between the perception of risk and the level of acceptance of the uranium mine proposal, as well as with the perception of benefit and the level of acceptance of the uranium mine. These results are in line with those found by Ransan-Cooper et al. (2018), who stated that in the face of fear of an energy project, negative emotions are activated that explain rejection and, in many cases, it is these emotions that agglutinate the rejection of the citizens that make up the affected populations (Johansson et al., 2022). Therefore, in the proposed theoretical model we present the emotional balance as a mediator in the acceptance or rejection of a proposal in such a way that when the perceived risk is high, negative emotions increase, therefore the emotional balance becomes negative and the impact of the perceived risk on the probability of accepting the mining proposal decreases. When the perception of a possible benefit from the mine increases and therefore increases the probability of acceptance, the emotional balance would act as a mediator, reducing the direct impact of this relationship.

Our results are in line with the hypothesis proposed by Bronfman et al. (2012), according to which the perception of risks and benefits of the proposed renewable energy sources explained social acceptance by a local community, where the perception of benefits had the greatest influence on acceptance. Thus, in the results shown in the path analysis, the variable with the greatest explanatory power for acceptance was the perceived benefits of uranium mine construction. However, this impact was mediated by the activation of emotional balance in reaction to the development of the uranium mine. Overall, the present study highlights the importance of considering emotional responses when examining the acceptance or rejection of proposed energy projects. It suggests that emotional balance plays a crucial role in mediating the relationship between perceived risks and benefits and the level of acceptance. Therefore, it is essential to address the emotional responses of affected populations and take into account their concerns and fears when proposing new energy projects. This approach can help foster greater understanding and collaboration between local communities, policymakers, and energy companies, leading to more sustainable and socially acceptable energy projects.

This research has some limitations. One is centered on the methodological approach we adopted; a micro sociopsychological vision was used to analyze how the psychosocial variables influence acceptance of a new energy proposal, but the interrelation with more macro-level variables associated with policies, institutions, or economic markets was left aside, as Devine-Wright and Wiersma (2020) suggested. On the other hand, another limitation comes from the procedure used to access the sample, a part of the participants in the study came from a data collection based on a snowball system distributed in the area affected by the construction of the mine, while another part of the sample were students from a university close to the area affected by the mine. Another limitation was that participants' attachment to place, affinity or identity with the affected area was not assessed, which would have allowed us to analyze

differentiation in beliefs about risks and benefits, as well as emotional balance and acceptance level. Nor did we evaluate trust or mistrust of the project development and institutions, another variable that has been found to be relevant in other studies on mine construction (Lehtonen et al., 2022). On the other hand, the data were collected at a single point in time without considering the evolution of the conflict in the area. As mentioned previously, the proposal for the construction of the mine started years ago and is currently under appeal by the company. It would have been interesting to conduct a longitudinal follow-up of the social construction created toward the project, both in terms of attitudes, the level of information, the balance between risks and benefits and between positive and negative emotions activated by the mining project over time.

As implications for environmental management, the results of this study highlight the need to analyze the emotions citizens feel when faced with energy project proposals, especially for people with ties to the affected area. The emotional balance moderates the possible benefits or intensifies the perceived risks. Given the interrelationships among the variables, the greater the perception of the benefits associated with the development of the uranium mine, the greater the positive emotions generated and the greater the probability of acceptance of the project. Although the perception of risk intensifies negative emotions, we believe that this relationship will be determinant of a low acceptance of the proposed construction of the uranium mine, especially among citizens related to the affected area. Furthermore, the results have shown the relevance of environmental beliefs, which were negatively related to perceived benefits, emotional balance and acceptance of the mine construction while presenting a positive relationship with perceived risks; therefore, the preservation of nature seems to be present before making the decision to accept or reject a uranium mining project. The results should be considered to manage and prevent the social conflicts generated among the populations affected by the construction of new mining projects. When dealing with a uranium mine construction project, the evaluation of the activation of negative emotions takes on special attention for the management of conflicts both between communities and between citizens. Furthermore, the communication media should be appealed by this issue since they have the responsibility to provide rigorous information to their audience. When dealing with this kind of interventions, the media, local stakeholders, and municipalities should cover in an objective way the implications of the projects in all the different levels, without aiming to bias the perceptions of citizens by favoring dialogue rather than conflict over the diversity of perceived risks and benefits.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by the ethical committee of the University of Salamanca approved the research design for this study (ref. 0000822, approved on November 24, 2022). Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

GS-T, AH, JG, and CT contributed to conception and design of the study, and wrote sections of the manuscript. GS-T organized the database. GS-T, AH-M, and CT performed the statistical analysis. GS-T and CT wrote the first draft of the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1134499/full#supplementary-material

References

Afshan, S., Ozturk, I., and Yaqoob, T. (2022). Facilitating renewable energy transition, ecological innovations and stringent environmental policies to improve ecological sustainability: evidence from MM-QR method. *Renew. Energy* 196, 151–160. doi: 10.1016/j.renene.2022.06.125

Ajzen, I. (2001). Nature and operation of attitudes. *Annu. Rev. Psychol.* 52, 27–58. doi: 10.1146/annurev.psych.52.1.27

Baltar, F., and Brunet, I. (2012). Social research 2.0: virtual snowball sampling method using Facebook. *Internet Res.* 22, 57–74. doi: 10.1108/10662241211199960

Baran, M., Hazenberg, R., Iwinska, K., Kasianiuk, K., Perifanos, I., da Maria Ferreira Silva, J., et al. (2023). Between innovative and habitual behavior. Evidence from a study on sustainability in Greece, Poland, Portugal, Sweden, and the United Kingdom. *Front. Energy Res.* 10:2. doi: 10.3389/fenrg.2022.1030418

Batel, S. (2020). Research on the social acceptance of renewable energy technologies: past, present and future. *Energy Res. Soc. Sci.* 68:101544. doi: 10.1016/j.erss.2020.101544

Batel, S., and Rudolph, D. (2021). "Contributions, tensions and future avenues of a critical approach to the social acceptance of renewable energy infrastructures" in *A critical approach to the social acceptance of renewable energy infrastructures* eds. S. Batel and D. Rudolph (Cham: Palgrave Macmillan), 237–257.

Binder, G., and Boldero, J. M. (2012). Planning for change: the roles of habitual practice and habitus in planning practice. *Urban Policy Res.* 30, 175–188. doi: 10.1080/08111146.2012.672059

Bjørst, L. R. (2016). Saving or destroying the local community? Conflicting spatial storylines in the Greenlandic debate on uranium. *Ext. Ind. Soc.* 3, 34–40. doi: 10.1016/j.exis.2015.11.006

Brannstrom, C., Leite, N. S., Lavoie, A., and Gorayeb, A. (2022). What explains the community acceptance of wind energy? Exploring benefits, consultation, and livelihoods in coastal Brazil. *Energy Res. Soc. Sci.* 83:102344. doi: 10.1016/j.erss.2021.102344

Brondi, S., Sarrica, M., Caramis, A., Piccolo, C., and Mazzara, B. M. (2016). Italian parliamentary debates on energy sustainability: how argumentative'short-circuits affect public engagement. *Public Underst. Sci.* 25, 737–753. doi: 10.1177/0963662515580067

Bronfman, N. C., Jiménez, R. B., Arévalo, P. C., and Cifuentes, L. A. (2012). Understanding social acceptance of electricity generation sources. *Energy Policy* 46, 246–252. doi: 10.1016/j.enpol.2012.03.057

Byrne, B. M. (2009). *Structural equation modeling with AMOS: basic concepts, programming, and applications*. London, England: LEA.

Carlson, J. M., Kaull, H., Steinhauer, M., Zigarac, A., and Cammarata, J. (2020). Paying attention to climate change: positive images of climate change solutions capture attention. *J. Environ. Psychol.* 71:101477. doi: 10.1016/j.jenvp.2020.101477

Chen, M., and Martens, P. (2021). Coastal residents' attitudes toward offshore oil and gas drilling in China. *Ext. Ind. Soc.* 8:100942. doi: 10.1016/j.exis.2021.100942

Cohen, J. J., Reichl, J., and Schmidthaler, M. (2014). Re-focussing research efforts on the public acceptance of energy infrastructure: a critical review. *Energy* 76, 4–9. doi: 10.1016/j.energy.2013.12.056

Collier, J. E. (2020). *Applied structural equation modeling using AMOS: basic to advanced techniques*. New York: Routledge.

Corner, A., Venables, D., Spence, A., Poortinga, W., Demski, C., and Pidgeon, N. (2011). Nuclear power, climate change and energy security: exploring British public attitudes. *Energy Policy* 39, 4823–4833. doi: 10.1016/j.enpol.2011.06.037

Corral-Verdugo, V., Carrus, G., Bonnes, M., Moser, G., and Sinha, J. (2008). Environmental beliefs and endorsement of sustainable development principles in water conservation: towards a new human interdependence paradigm scale. *Environ. Behav.* 40, 703–725. doi: 10.1177/0013916507308786

Cuadrado, E., and Tabernero, C. (2015). Affective balance, team prosocial efficacy and team trust: a multilevel analysis of prosocial behavior in small groups. *PLoS One* 10:e0136874. doi: 10.1371/journal.pone.0136874

de Groot, J. I., Schweiger, E., and Schubert, I. (2020). Social influence, risk and benefit perceptions, and the acceptability of risky energy technologies: an explanatory model of nuclear power versus shale gas. *Risk Anal.* 40, 1226–1243. doi: 10.1111/risa.13457

Dessi, F., Ariccio, S., Albers, T., Alves, S., Ludovico, N., and Bonaiuto, M. (2022). Sustainable technology acceptability: mapping technological, contextual, and social-psychological determinants of EU stakeholders' biofuel acceptance. *Renew. Sust. Energ. Rev.* 158:112114. doi: 10.1016/j.rser.2022.112114

Devine-Wright, P. (2007). "Energy citizenship: psychological aspects of evolution in sustainable energy technologies" in *Governing technology for sustainability*. ed. J. Murphy (London: Earthscan), 63–86.

Devine-Wright, P. (2009). Rethinking NIMBYism: the role of place attachment and place identity in explaining place-protective action. *J. Community Appl. Soc. Psychol.* 19, 426–441. doi: 10.1002/casp.1004

Devine-Wright, P. (2011). Place attachment and public acceptance of renewable energy: a tidal energy case study. *J. Environ. Psychol.* 31, 336–343. doi: 10.1016/j.jenvp.2011.07.001

Devine-Wright, P., and Batel, S. (2013). Explaining public preferences for high voltage pylon designs: an empirical study of perceived fit in a rural landscape. *Land Use Policy* 31, 640–649. doi: 10.1016/j.landusepol.2012.09.011

Devine-Wright, P., and Wiersma, B. (2020). Understanding community acceptance of a potential offshore wind energy project in different locations: an island-based analysis of 'place-technology fit'. *Energy Policy* 137:111086. doi: 10.1016/j.enpol.2019.111086

Eurobarometer, S. (2005). Social values, science and technology. Special Report, 225.

Ey, M., Sherval, M., and Hodge, P. (2017). Value, identity and place: unearthing the emotional geographies of the extractive sector. *Aust. Geogr.* 48, 153–168. doi: 10.1080/00049182.2016.1251297

Firestone, J., and Kempton, W. (2007). Public opinion about large offshore wind power: underlying factors. *Energy Policy* 35, 1584–1598. doi: 10.1016/j.enpol.2006.04.010

Flynn, J., Slovic, P., and Mertz, C. K. (1994). Gender, race, and perception of environmental health risks. *Risk Anal.* 14, 1101–1108. doi: 10.1111/j.1539-6924.1994.tb00082.x

Gao, Z., Guo, L., Zhang, H., Deng, S., Zhang, Y., and Gao, Y. (2022). Study on public acceptance of decommissioning of a uranium mining and metallurgy facility in Hunan Province. *J. Environ. Radioact.* 251–252:106987. doi: 10.1016/j.jenvrad.2022.106987

Huijts, N. M., Molin, E. J., and Steg, L. (2012). Psychological factors influencing sustainable energy technology acceptance: a review-based comprehensive framework. *Renew. Sust. Energ. Rev.* 16, 525–531. doi: 10.1016/j.rser.2011.08.018

Johansson, A., Lindahl, K. B., and Zachrisson, A. (2022). Exploring prospects of deliberation in intractable natural resource management conflicts. *J. Environ. Manag.* 315:115205. doi: 10.1016/j.jenvman.2022.115205

Jones, C. R., Elgueta, H., and Eiser, J. R. (2016). Reconciling nuclear risk: the impact of the Fukushima accident on comparative preferences for nuclear power in UK electricity generation. *J. Appl. Soc. Psychol.* 46, 242–256. doi: 10.1111/jasp.12359

Kraeusel, J., and Möst, D. (2012). Carbon capture and storage on its way to large-scale deployment: social acceptance and willingness to pay in Germany. *Energy Policy* 49, 642–651. doi: 10.1016/j.enpol.2012.07.006

Lehtonen, M., Kojo, M., Kari, M., Jartti, T., and Litmanen, T. (2022). Trust, mistrust and distrust as blind spots of social licence to operate: illustration via three forerunner countries in nuclear waste management. *J. Risk Res.* 25, 577–593. doi: 10.1080/13669877.2021.1957987

Lindahl, K. B., Johansson, A., Zachrisson, A., and Viklund, R. (2018). Competing pathways to sustainability? Exploring conflicts over mine establishments in the Swedish mountain region. *J. Environ. Manag.* 218, 402–415. doi: 10.1016/j.jenvman.2018.04.063

Mendoza-Denton, R., Shoda, Y., Ayduk, O., and Mischel, W. (2020). "Applying cognitive-affective processing system (CAPS) theory to cultural differences in social behavior" in *Merging past, present, and future in cross-cultural psychology*, eds. D. L. Dinne, D. K. Forkays, S. A. Hayes, and W. J. Lonner (New York City: Garland Science), 205–217.

Pedersen, E., and Johansson, M. (2012). Wind power or uranium mine: appraisal of two energy-related environmental changes in a local context. *Energy Policy* 44, 312–319. doi: 10.1016/j.enpol.2012.01.058

Perko, T., Adam, B., and Stassen, K. R. (2015). The differences in perception of radiological risks: lay people versus new and experienced employees in the nuclear sector. *J. Risk Res.* 18, 40–54. doi: 10.1080/13669877.2013.879488

Pidgeon, N. F., Lorenzoni, I., and Poortinga, W. (2008). Climate change or nuclear power—no thanks! A quantitative study of public perceptions and risk framing in Britain. *Glob. Environ. Chang.* 18, 69–85. doi: 10.1016/j.gloenvcha.2007.09.005

Ransan-Cooper, H., Ercan, S. A., and Duus, S. (2018). When anger meets joy: how emotions mobilise and sustain the anti-coal seam gas movement in regional Australia. *Soc. Mov. Stud.* 17, 635–657. doi: 10.1080/14742837.2018.1515624

Ruiz, C., Marrero, R., and Hernández, B. (2018). Influence of emotions on the acceptance of an oil drilling project. *Environ. Behav.* 50, 324–349. doi: 10.1177/0013916517701795

Schermelleh-Engel, K., Moosbrugger, H., and Müller, H. (2003). Evaluating the fit of structural equation models: tests of significance and descriptive goodness-of-fit measures. *Methods Psychol. Res. Online* 8, 23–74.

Smil, V. (2018). *Energy and civilization: a history* Cambridge, MA: MIT Press.

Teerikangas, S., Koistinen, K., Onkila, T., and Mäkelä, M. (2021). "Synthesis and future research directions" in *Research handbook of sustainability agency*, eds. S. Teerikangas, T. Onkila, K. Koistinen and M. Mäkelä (Cheltenham: Edward Elgar Publishing), 404–434.

Tendero, M. (2021). "The time has come! The development of the European environmental conscience: evidence from the Eurobarometer surveys from 1974 to 2020" in *The European environmental conscience in EU politics*, eds. T. Hoerber and G. Weber (New York: Routledge), 156–184.

Upham, P., Oltra, C., and Boso, À. (2015). Towards a cross-paradigmatic framework of the social acceptance of energy systems. *Energy Res. Soc. Sci.* 8, 100–112. doi: 10.1016/j.erss.2015.05.003

Van der Horst, D. (2007). NIMBY or not? Exploring the relevance of location and the politics of voiced opinions in renewable energy siting controversies. *Energy Policy* 35, 2705–2714. doi: 10.1016/j.enpol.2006.12.012

Venables, D., Pidgeon, N. F., Parkhill, K. A., Henwood, K. L., and Simmons, P. (2012). Living with nuclear power: sense of place, proximity, and risk perceptions in local host communities. *J. Environ. Psychol.* 32, 371–383. doi: 10.1016/j.jenvp.2012.06.003

Wang, G., Sadiq, M., Bashir, T., Jain, V., Ali, S. A., and Shabbir, M. S. (2022). The dynamic association between different strategies of renewable energy sources and sustainable economic growth under SDGs. *Energ. Strat. Rev.* 42:100886. doi: 10.1016/j.esr.2022.100886

Watson, D., Clark, L. A., and Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *J. Pers. Soc. Psychol.* 54, 1063–1070. doi: 10.1037/0022-3514.54.6.1063

Wiese, B. S., Freund, A. M., and Baltes, P. B. (2000). Selection, optimization, and compensation: an action-related approach to work and partnership. *J. Vocat. Behav.* 57, 273–300. doi: 10.1006/jvbe.2000.1752

Wolsink, M. (2018). Co-production in distributed generation: renewable energy and creating space for fitting infrastructure within landscapes. *Landsc. Res.* 43, 542–561. doi: 10.1080/01426397.2017.1358360

Wüstenhagen, R., Wolsink, M., and Bürer, M. J. (2007). Social acceptance of renewable energy innovation: an introduction to the concept. *Energy Policy* 35, 2683–2691. doi: 10.1016/j.enpol.2006.12.001

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Children's independent mobility during dark hours: a scoping review

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Introduction: Independent mobility is every child's right and has implications for their health, wellbeing, and development. This scoping review addresses children's needs and experiences of light conditions in their everyday outdoor life. The review examines peer-reviewed scientific literature that analyses associations between different light conditions and children's independent mobility (CIM) during dark hours.

Methods: By formulating a Boolean search string, including terms related to children independent mobility, light and outdoor environment, five scientific databases were searched. The search resulted in 67 eligible papers that were analyzed through an inductive, thematic analysis.

Results: Four overarching themes representing the researched topics of the effects of light conditions with importance for CIM during dark hours were identified: (1) physical activity (PA) and active travel, (2) outdoor activities and place use, (3) safety perception, and (4) outdoor risks. The findings highlight that darkness constitutes a major obstacle for CIM, and that fear of darkness is common among children. It restricts the degree of CIM and influences children's safety perception as well as how they navigate through public places outdoors. The findings show that the type and design of outdoor settings during dark hours and children's familiarity with places during daytime could play a role in the degree of CIM after dark. The presence of outdoor lighting is related to children's increased PA and active travel, and outdoor lighting seems to also influence children's place use and interaction with the environment. The presence and extent of outdoor lighting and lighting quality may play a role in children's safety perception, which in turn can influence CIM.

Discussion: The findings suggest that promoting CIM during dark hours might not only contribute to the accumulation of children's PA, confidence, and skills, but also support mental health. The understanding of children's perspectives on the quality of outdoor lighting needs to be deepened to support CIM. Highlighting the child perspective would aid the development of current recommendations for outdoor lighting and the implementation of the Agenda 2030 of ensuring healthy lives and promoting wellbeing for all at all ages, and making cities inclusive, safe, resilient and sustainable throughout the day and seasons.

KEYWORDS

children, independent mobility, after dark, darkness, outdoor lighting, street lighting

1. Introduction

The United Nations Agenda 2030 states that cities should provide access to safe, affordable, accessible and sustainable transport systems to all citizens, including children (1). Children's independent mobility (CIM), i.e., the degree to which children of different ages have the freedom for independent action, exploration, play and socializing with friends

in their local environments without adult supervision (2), has an intrinsic value for children and is something that they have the right to enjoy (3). This right is formulated in the United Nations' Convention on the Rights of the Child, enshrining that every child has the right to rest and leisure, to engage in play and recreational activities appropriate to the age of the child (Article 31) and to a standard of living that is good enough to meet their physical and social needs and support their development (Article 27) (4). A prerequisite for this is a safe outdoor environment (3).

Light and darkness affect how places are used and perceived (5, 6). It influences our behavior, such as how we interact with others, position ourselves and navigate through public places (7–9). Well-lit outdoor environments are, among adults, associated with perceived visual accessibility, safety, and walking (10). Little research has focused on children's needs and experiences of light and darkness in their everyday outdoor life, implying that lighting recommendations and standards are informed by research based on adults' perceptions and needs (11).

In the history of studying CIM, the permission to go out after dark has been included in measures of mobility licenses that children obtain from their parents. In the seminal study by Hillman et al. (12), the question "Is your child usually allowed to go out alone after dark?" was asked. Today, this question is one of six core questions typically included in questionnaires used to assess CIM (13). Yet, constrains and facilitators of CIM during dark hours seem to be an overlooked topic. A study of CIM in 16 countries[1] across the world consistently showed that darkness constitutes a significant barrier to CIM (3). Going out alone after dark was the most withheld independent mobility (IM), and only 22% of the children were granted permission by their parents to go out alone after dark. The authors recommended "Single Double Summertime"[2] resulting in lighter evenings to support CIM and reduce road causalities, but neither potential benefits of CIM during dark hours nor outdoor lighting to support CIM was discussed.

Though CIM during daylight has received considerable attention [e.g., Marzi and Reimers (13), Malone (14), Schoeppe et al. (15)], less focus has been placed on the dark hours and how artificial outdoor lighting may support children's needs for IM in their neighborhood. The impetus for exploring this issue is the past 40 years research showing that CIM is declining, with significant implications for children's health and physical, social and mental development (3). This also applies to the Nordic countries (16–18), where the dark season constitutes a particular challenge for children as it entails extended hours of darkness. Children's perceptions of place differ from adults, highlighting the necessity for research focused on children's perspectives (19). To counter the decline in CIM, there is a need to peer into the darkness to fully understand the complex interdependencies between qualities of urban environments, parental concerns and CIM (20–22).

1.1. Aim

This scoping review aims to identify and map the available scientific knowledge about CIM during dark hours and further identify knowledge gaps for future studies. We investigate differences of CIM between natural light and darkness. Furthermore, we consider how artificial outdoor lighting may support CIM on foot or by bicycle within neighborhoods during dark hours. The review is based on three overarching research questions:

RQ 1: How and under which circumstances has CIM during dark hours been studied up until now?

RQ 2: What are the effects of light conditions on CIM, and for whom and where are the effects reported?

RQ 3: How are the light conditions defined and operationalized in relation to CIM in previous studies?

The overall goal with the review is to provide knowledge that could make cities more accessible for children throughout the day and seasons.

2. Method

2.1. The search protocol

The design of the review procedure was based on literature on scoping reviews (23, 24) and on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (25). The procedure was initially defined by a review protocol expressing the purpose, search terms and eligibility criteria. The purpose of the review was expressed as follows: to identify, analyze, and describe the available research on children's perspectives, experiences, behaviors and responses to light condition. Search terms were defined in four groups to facilitate the development of a Boolean search string (1) related to the individual (e.g., child, pupil), (2) the activity (e.g., mobility, travel), (3) light conditions (e.g., street lighting, dark*) and (4) the setting (e.g., outdoor*, neighborhood). To avoid the scope being too narrow, both variations in natural light and artificial outdoor lighting were considered. After initial searches that combined the search terms in different ways, a final Boolean search string was created. The protocol stated that to be included in the review, papers had to (a) be published in a peer-reviewed scientific journal, (b) be retrievable from internationally available electronic databases, (c) be written in English, (d) include an empirical study regarding children within school age (from the age of six up to 18 years old), (e) focus on urban outdoor settings and (f) include light conditions in the result section. No exclusion criteria were applied regarding date of publication or geographical origin.

2.2. The search process

In order to cover a wide range of disciplines, the search was conducted within several electronic databases. To get a second opinion on the search strategies and choice of databases before initiating the searches, Lund University library staff was consulted. The searches were then conducted in the following databases:

1 Australia, Brazil, Denmark, England, Finland, France, Germany, Ireland, Israel, Italy, Japan, Norway, Portugal, South Africa, Sri Lanka and Sweden.

2 Meaning that the clocks would be one hour ahead of Greenwich Mean Time (GMT) in the winter and two hours ahead of GMT in the summer.

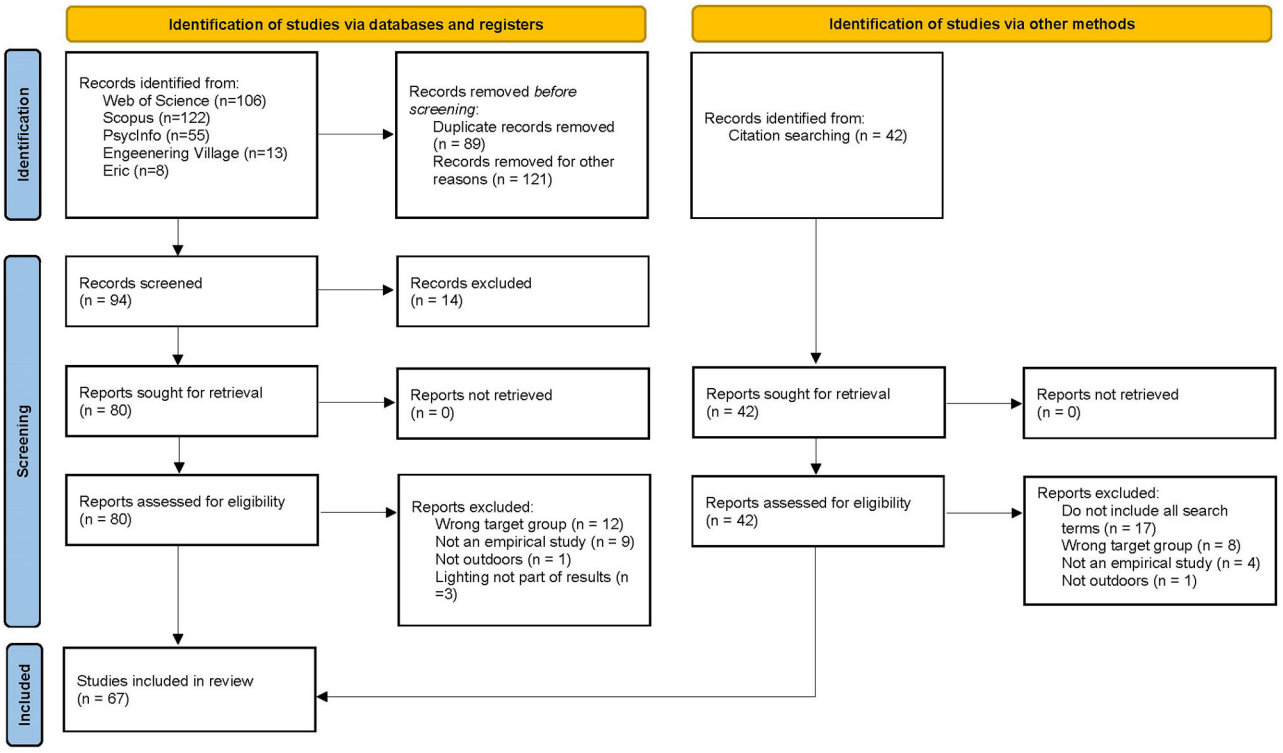

FIGURE 1
PRISMA 2020 flow diagram for the review. Figure adapted from Page et al. (25).

Scopus, Web of Science (ISI), PsycInfo, Eric and Engineering Village up until April 2021. The search string functioned as a template and was adapted to the different databases (See Supplementary Table 1). Relevant papers were identified by the title and, if needed, by reading the abstract. The search resulted in 304 relevant hits out of a total of 3,348. Eighty-nine duplicates were eliminated, and 121 papers were excluded because they did not include all four groups of the search terms. The remaining 94 papers were screened in detail by reading the abstract and, if necessary, screening the full-text to assure that the search terms were fulfilled. Fourteen of the papers were excluded because the search hits referred to something other than what was intended (e.g., *light* physical activity instead of artificial light). The 80 papers were read by four researchers who independently screened whether the abstracts in addition to the inclusion criteria contained all four aspects of the search terms: individual, activity, light conditions and outdoor environment (setting). The researchers agreed that 55 of the 80 papers were relevant for the present study. The remaining papers' full-text versions were retrieved and read. Twelve additional papers were identified in the reference lists of the selected papers. These were retrieved and assessed for eligibility by full-text reading. The final number of papers eligible for further analysis were 67 (See Figure 1).

To capture the intended scope of RQ 1, a descriptive analysis of the included papers' origin and methodological standpoints was made. The analysis focused on year of publication, type of journal, country, and continent of origin, how CIM was defined and studied, whose perspective the findings were based on, the age of the studied children, in which setting the studies has been carried out, how the light conditions were defined, and methods and theories used.

To answer RQ 2 and RQ 3, the papers were then analyzed with an inductive, thematic approach inspired by Braun and Clarke (26). First, the papers were read, and initial ideas were noted down (step 1). Then, initial codes based on the issues of CIM they explored in relation to light conditions were generated (step 2). Thereafter, the coded papers were organized into potential themes (step 3). The themes were reviewed by checking if they worked in relation to the codes generated in step 2 and if they were representative of the entire set of papers collated in step 3. Categories defining the studied light conditions were then identified within each theme. Lastly, themes and categories were defined and named.

3. Results

3.1. How and under which circumstances CIM during dark hours has been studied

The 67 identified papers, dated from 1999 to 2021, were published in 45 different journals, primarily within the fields of public health, medicine, and transportation research. Most of the papers were based on research in Europe ($N = 26$) and North America ($N = 21$). The remaining papers were based on research in Oceania ($N = 12$), Asia ($N = 3$), South America ($N = 2$) and Africa ($N = 1$). Two papers included data from several continents. In the following sections, it is described how CIM was defined

and studied in the identified papers, whose perspective the findings were based on, the age of the studied children, in which setting the studies were carried out, how the light conditions were defined, and the methods and theories used (see Figure 2 for a summary and Supplementary Table 2 for further details).

CIM has been defined and studied in different ways in the papers. About half of them ($N = 31$) studied children's physical activity (PA) and sedentary time in relation to environmental features, e.g., season, day length or dark streets, or in relation to the perception of an area, e.g., perceived safety. Twenty-one of the papers studied children's or parents' perspectives on public spaces and transportation modes to different destinations and explicitly expressed a focus on children's everyday IM. Other papers are more implicit in their definition of CIM but studied the access and visits to different places ($N = 4$), or the interaction and perception of places from a broader perspective (e.g., in relation to transitioning toward adulthood or place connectivity) ($N = 6$). A small number of the papers ($N = 4$) focused on child pedestrian-vehicle crashes during different environmental conditions (e.g., after sunset). One paper studied the associations between environmental neighborhood features and adolescent homicide.

Most of the papers based their findings on self-reports by children, e.g., through questionnaires, interviews or focus group discussions ($N = 28$), or on measurements on children (e.g., daily step counts (DSC), heartrate (HR), global positioning systems (GPS) monitoring) ($N = 10$). Six papers based their findings on data from databases (e.g., data on pedestrian-vehicle crashes, adolescent-homicides, physical activity). Few were based on parents' self-reports, e.g., through questionnaires or interviews ($N = 2$). Other papers based their findings on both parents' and children's self-reports ($N = 13$), children's self-reports and measurements (DSC, HR, GPS monitoring or body mass index (BMI) ($N = 6$) or parents' self-reports and measurements on children (BMI) ($N = 2$).

The children in the papers were 0–20 years old, where the most common age group was children aged 13 ($N = 38$). Overarchingly, the children could be divided into two age-groups considering this review's focus on school-aged children: middle childhood (age 6–12, $N = 48$) and late childhood/adolescence (age 13–18, $N = 51$). Thirty-five papers included ages from both groups or children younger than six and/or older than eighteen. This means that some of the children's ages fall outside the specified age in the eligibility criteria, but also that some of the children were older than what is defined as a child according to the United Nations Convention on the Rights of the Child (i.e., every human being below the age of eighteen years) (4).

The studied settings ranged from children's local neighborhoods to a focus on e.g., park features or road environment design. Most common were built environments situated in urban areas, e.g., public open spaces, road environments, recreational facilities, parks, the way to school or activity spaces for children ($N = 48$). Some papers focused on a broader setting (e.g., made comparisons between countries or seasons) ($N = 7$).

The light conditions considered in the papers were described in a variety of terms (see Supplementary Table 2 for details), but can be divided into two major groups: (1) natural light ($N = 33$), including the shifting of daylight outdoors over the day or seasons, e.g., evening and night-time hours, day length differences over the year, after dark or darkness, and (2) artificial outdoor lighting ($N = 34$), comprising studies of outdoor lighting and the lit environment, e.g., the presence of outdoor lighting in an environment or the perception of outdoor lighting or the lit environment. Hereafter we will use the terminology *natural light* and *outdoor lighting* to distinguish between the two groups and use *light conditions* as an overarching concept to describe both.

Considering how the relationships between children and the environments were framed, most papers were unclear in their theoretical standpoint when studying associations between CIM and characteristics in the physical environment ($N = 51$). A small number of the papers explicitly applied a socio-ecological framework considering the interplay between children and their physical and/or sociocultural environments ($N = 9$) [e.g., Sallis et al. (27), Lang and Rayner (28)]. Some papers relied on cultural geographical frameworks [e.g., Holloway and Valentine (29), Kato (30), Vanderstede (31)], looking into the cultural dimensions of space and place of adolescents' everyday life ($N = 4$), while three papers applied social-psychological theories (32–35) to explore parents' attitudes and beliefs toward active school travel, outdoor play or to understand associations between environmental features and adolescent homicide. Quantitative methods and analyses ($N = 50$) were most common for studying associations between child behavior and environmental factors. Ten papers used a qualitative methodology and seven used mixed-method approaches ($N = 7$).

3.2. Operationalization of light conditions and effects on CIM

The thematic analysis generated four overarching themes related to the effects of light conditions on CIM: (1) *physical activity and active travel,* (2) *outdoor activities and place use,* (3) *safety perception* and (4) *outdoor risks.* The first three themes were further divided into two categories, related to the identification of effects of (1) variation in *natural light* or (2) presence of artificial *outdoor lighting*, focusing on e.g., quality. The fourth theme only included results regarding artificial lighting. For some categories, influencing factors were identified. These factors are indicated in italics in the text and constitute key aspects in relation to physical or social environmental factors, influencing the effects of light conditions on CIM. The themes, categories and influencing factors are outlined in Figure 3.

3.2.1. Physical activity and active travel

The first theme, including 34 papers, regards how light conditions influence children's physical activity (PA) (e.g., daily steps) and active travel (traveling by bike or by foot), and is divided into two different categories with regard to the studied light conditions: one focusing on natural light including seasonality, day length and darkness and the other focusing on artificial outdoor lighting, including the presence, density and perception of outdoor lighting. In both categories, children's behaviors primarily were studied through measurements of daily step counts, heart rate, BMI, or GPS, while in some papers, the behaviors were captured through self-reports. Children's perceptions of outdoor

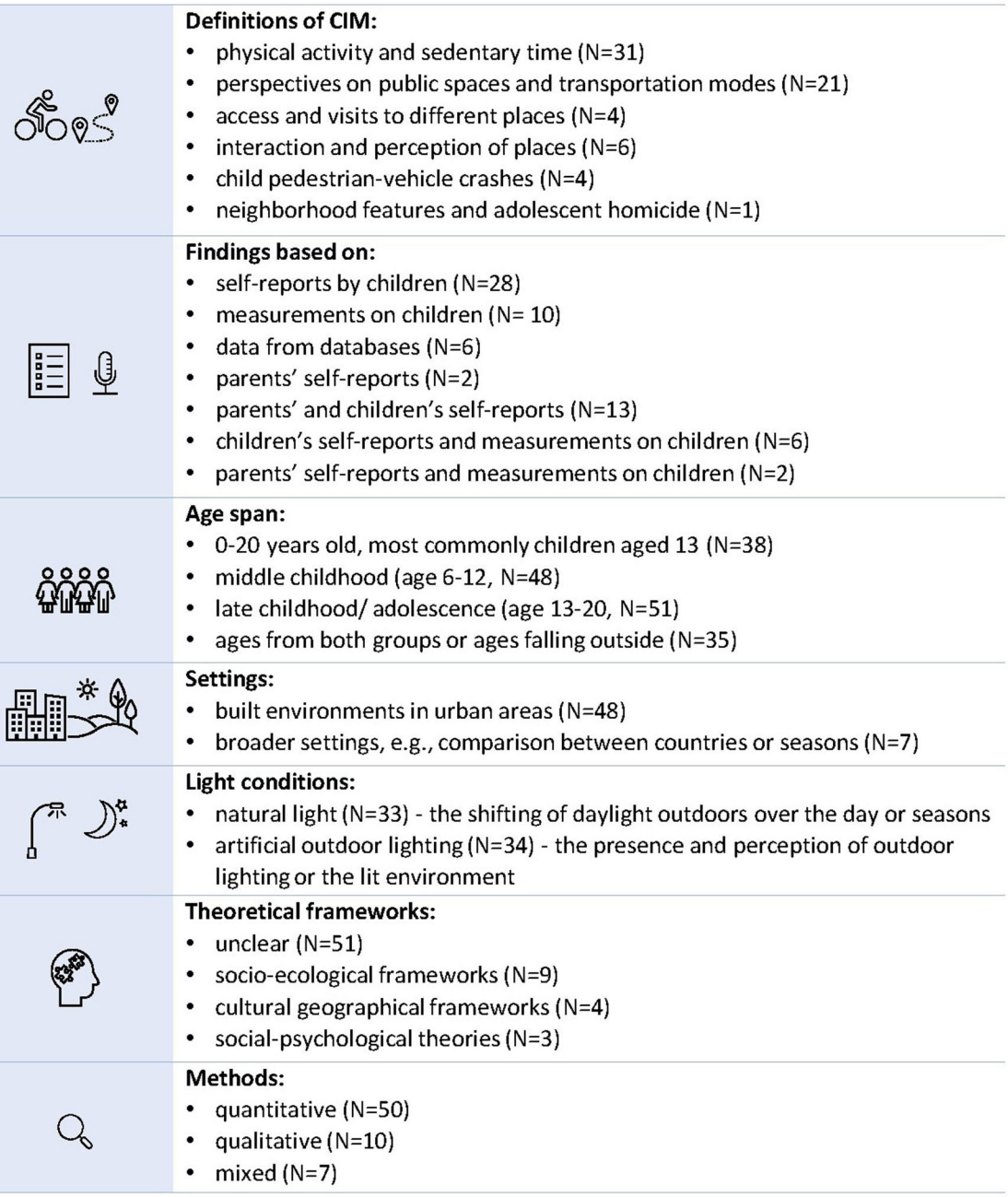

FIGURE 2
Summary of how CIM during dark hours has been studied.

lighting were investigated, and some papers also captured children's perspectives on outdoor lighting for supporting their outdoor PA.

3.2.1.1. Natural light: seasonality, day length and darkness

Seventeen papers considered natural light in relation to children's PA and active travel. The findings are somewhat inconsistent, but most findings suggest that darkness with regard to day length and seasonality is a barrier to children's PA and active travel. Children seem to be more physically active when the day length is longer, i.e., during summer months.

Five of the papers have found associations between seasonality and children's PA (36–39) or active travel (40). In three of the papers, there are differences depending on *gender* and *latitude*. Among European children (age 12–17), a stronger relationship between seasonality, PA and sedentary time were found among children in Central-North of Europe compared to South of Europe (37). Associations were only significant for girls' sedentary time. More extreme winter conditions (i.e., darker and colder) were suggested as an explanation for the geographical differences in activity/sedentary behaviors. In the US, there was a clear seasonal

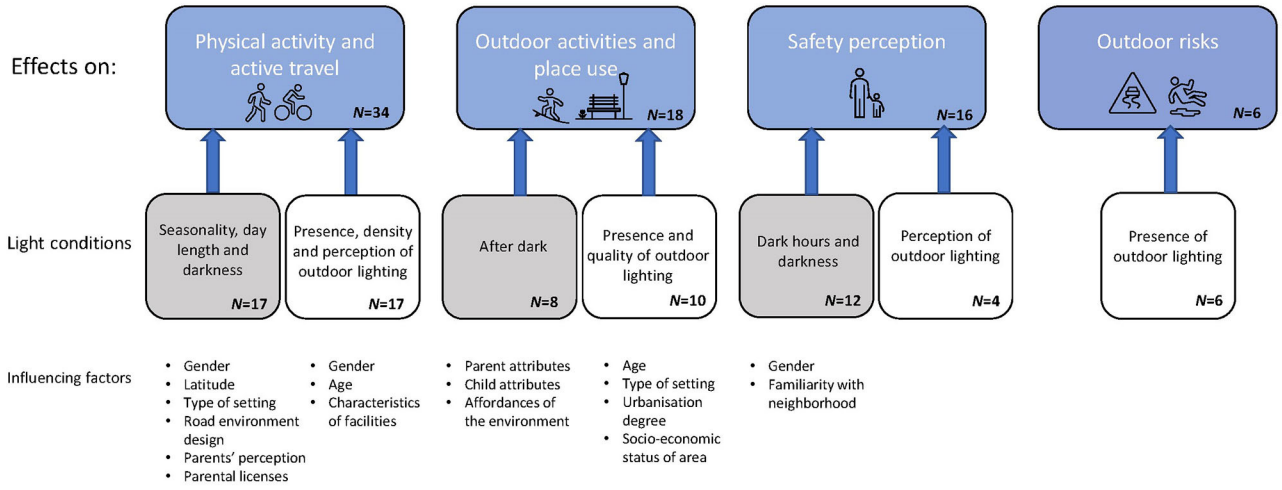

FIGURE 3
Identified themes that light conditions have an effect on. Some papers are included in more than one theme. Light conditions constitute identified categories and their main characteristics. Gray boxes regard findings in relation to natural light and white boxes regard artificial outdoor lighting. Influencing factors includes identified key aspects connected to each theme and category.

pattern of children's active trips, with high levels during summer months and low levels during winter months (age 5–17). Also, children were more sensitive to seasonality than adults and older adults (40).

Six papers found associations between different months, hours of daylight, day length or exposure to natural light and children's PA (41–46) relating to gender and latitude. Children (age 9–13) living in the UK engaged in significantly less PA minutes during winter/spring months compared to autumn months (45). Among children (age 3–18) from Australia, Europe and the US, more daylight hours and better visibility were related to increased PA (43). Day length was associated with children's PA, but the association varied between the included countries. One Southern European country (Portugal) had an opposite trend, i.e., decreased hours of daylight was associated with increased PA (43). Children in Northern Europe and Australia remained more active given the weather conditions than children in the US and Western Europe (43). In the US, each additional hour of day length was associated with more PA among children (age 12–14) (44). On days with 14 h of daylight or more, British children's PA (age 8–11) was higher, but there was no difference between short and medium days (<9.5 h/10.2–12.6 h) (46). The effect of long day length was largest between 5 p.m. and 8 p.m. and remained so after adjusting for the effects of different weather (e.g., rainfall, wind). This effect was explained by greater duration and intensity of play outside home on long days. Active travel and structured sports were less influenced by the day length (46). Among children (age 5–16) in Australia, Brazil, Europe and the US, longer evening daylight was independently related to a small increase in daily PA, with largest associations in the late afternoon and early evenings (41). However, these associations were inconsistent, with stronger associations between day length and PA among boys in some countries (i.e., Denmark and England) (41). In another paper, British children's (age 5–15) average daily light exposure was positively associated with time physically active and negatively associated with sedentary time (42). The associations seemed to have an independent nature, suggesting that exposure to light may be associated with PA and sedentary behavior separately, thus not simply displacing each other.

In three papers, *urban and rural areas* were studied in relation to associations between season, PA and active travel (36, 38, 39). Children (age 11–12) from both urban and rural areas in Cyprus spent significantly more time active outside during summer than winter (36). Compared to the children in urban schools, children in rural schools spent significantly more time outside over the two seasons (36). Interestingly, urban school children were more active in the winter and rural school children were more active in the summer. In Scotland, levels of PA were highest among both urban and rural children (age 10–11) during the summer months, and lowest in the autumn months (39). In Canada, children (age 9–10) reported lower PA during winter (38). Winter months had lower odds of children engaging in active school travel compared to the fall, and were greater among boys compared to girls, and children living in urban vs. rural areas.

Associations between evenings or hours after dark, PA and active travel have been found regarding *gender, road environment design, parents' perception* and *parental licenses* (47–51). Beyond daylight hours, few girls (age 15) were physically active outside (51). Several of them wanted to keep their recreational activities after dark, but were constrained by fear, parental concerns, lack of supervision and suitable transport. During evenings, boys' (age 13–15) PA were positively associated with the presence of speed humps (47). However, Carver et al. (52) found no clear difference in children's (age 8–9, 13–15) PA before school, after school or in the evening. Comparisons between parental licenses and active transport by sex revealed that boys (age 12–14) were 1.9 times more likely than girls to be allowed out after dark in New Zeeland (49). In Sweden, parents drove their children (age 7–13) to school by car during the winter, due to cold weather and bad conditions for cycling (50). Good outdoor lighting was perceived by parents

as important to enable children's travel to school during the long period of darkness that the winter entails (50). When parents viewed their neighborhood as unsafe for their children (age 3–10) to walk after dark, the children were more likely to be obese (48).

3.2.1.2. Outdoor lighting: presence, density, and perception of outdoor lighting

Seventeen of the papers within the theme studied outdoor lighting in relation to children's PA and active travel. The papers show that outdoor lighting has an influence on children's PA and active travel, but that it varies depending on factors such as *gender*, *age,* and *characteristics of facilities*.

In papers where the influence of presence or density of outdoor lighting on PA has been studied, the findings are contradicting. Two papers showed that the presence of outdoor lighting was related to increased PA among boys (age 10–14) (53) and active travel for both boys and girls (age 6–16) (54). Papers also showed that a higher density of outdoor lighting was positively associated with children's objectively measured PA (age 16–20) and with increased self-reported walking (age 0–18) (55), and that children (age 11–12) living in areas with more outdoor lighting engaged in more PA (56).

Two papers found no association between the presence of outdoor lighting and PA among children (age 9–14) of both genders (57, 58). Among boys (age 8–9), public spaces with no lighting along paths were inversely associated with PA during weekends (59). Even though presence of outdoor lighting could be viewed as a safety feature, other *characteristics of facilities* in public places might matter as well (59). The places with outdoor lighting could, for example, be "trouble spots" or formal recreation places, thus being spaces that the boys are not allowed to visit or that they are not interested in visiting (59).

Ten papers focused on children's perception of outdoor lighting and how it influences PA and active travel (60–69). The findings indicate that children's perception of well-lit environments support PA and active travel. Having no outdoor lighting on the street were seen as a physical environmental barrier among children (age 8–13) from underserved neighborhoods, and dark streets were mentioned as barriers to their ability to be physically active (65). Children (age 12 and 18) agreed somewhat with a statement that poor outdoor lighting was a constraint on the choice to walk (67).

Eight of these papers highlighted effects of the perception of outdoor lighting and PA or active travel with regard to *gender*. For both genders (age 15–16), the perception of well-lit streets was positively correlated with active commuting to school (63) and the convergent validity for children's (age 10–12) transportation to school was fair regarding the statement "The route does not have good lighting" (68). Sufficient outdoor lighting was perceived as a PA-facilitator among children (age 10–11) of both genders (66). For girls, the perception of good outdoor lighting at night were found to predict active transport (age 15–17) (64) and higher non-school PA (age 11–12) (60). Additionally, girls' (age 15–17) perception of poor outdoor lighting was associated with 40% greater probability of not engaging in PA in urban parks (61) and it has been suggested that environments with better outdoor lighting could increase girls' (age 15 and 18) PA (69). On the contrary, girls' (age 13–14) perception of their neighborhood as being well-lit was associated with steeper declines in non-school PA (62). *Age differences* could be a reason why, e.g., well-lit streets might serve as an important venue for non-school activity for girls 11–12 years old, but not for girls 13–14 years old. Another reason given by the authors was that reporting that streets in one's neighborhood are well-lit cannot be interpreted as girls being out at night (62).

3.2.2. Outdoor activities and place use

The second theme, including 18 papers, focuses on the influence of light conditions on children's outdoor activities (e.g., play, being with friends, route choices), place use, interactions with their surroundings and identity development. Children's views and experiences are captured to a various extent, with some of the papers basing their findings on parent's self-reports, while others are based on self-reports by children. The theme is divided into two categories with regard to natural light and artificial outdoor lighting: one focusing on the constraints of darkness on children's outdoor activities and the other on children's place use and identity development in relation to presence and quality of outdoor lighting.

3.2.2.1. Natural light: after dark

Eight of the papers reported how darkness has a great influence on children's possibilities to be outdoors. According to findings, darkness restricted children from being outdoors by influencing parent practices, was associated with children being indoors, and was a signal that it is time to go home for both children and parents. However, darkness was not always associated with restrictions.

Three papers showed that *parent practices* were impacted by darkness and that CIM was restricted after dark (49, 51, 70). In New Zeeland, there was a drastic reduction of children (age 12–14) being permitted out after dark between generations (49). Almost 30% of the parents were permitted out after dark when they were children, while only 15% of the children today were permitted to go out after dark. Children (age 12–14) were subject to *parental constraints* relating to walking alone when it was dark and perceived "no-go" areas which they avoided (70). In line with this, only 31% of girls (age 15) were allowed to be in parks after dark by their parents (51).

Three papers showed that darkness was *associated with being indoors* and a signal that it is time to go home for both children and parents (71–73). Summer was described by children (age 8–10) as a "big, long play time" which only ends when it gets dark, while in winter many retreated from weather and shorter daylight hours to play indoors (71). The weather, shorter days and *limitations of affordances* were seen as barriers to the use of public open spaces in winter (72). Only the families that perceived values in outdoor play during winter had children that felt the urge to play outside (71). Hours of daylight also seemed to influence how children (age 0–15) allocated their time across different activities (73). When daylight durations were longer, children allocated more time to outdoor activities during weekends and spent more time on school-related activities during weekdays.

Two papers indicated that there existed *exceptions of restrictions* of CIM (age 14–16) after dark in Spain (74, 75). Children's possibilities to be outdoors after dark could be encouraged at particular events, such as at neighborhood festivals. Parents let their children stay out longer than usual since there were more people around, thereby being viewed as safer for their children. The

festivals were moments of night-time leisure when both parents and their friends and neighbors were outdoors late.

3.2.2.2. Outdoor lighting: presence and quality of outdoor lighting

Ten of the papers described how outdoor lighting may influence children's place use, but also play a role in their interactions with their surroundings and identity development. The findings indicated that positive effects of outdoor lighting on CIM varies *depending on age* and *where the child lives.*

The presence of outdoor lighting seemed to influence park use among children of different ages (76, 77) and good outdoor lighting was viewed by children (age 13–17) as one of the most important physical characteristics of an activity-friendly environment (78). Parks which children aged 6–8 years old visited had significantly higher chance of having outdoor lighting compared to parks that children aged 3–5 and 9–11 years old visited (77). Lighting around courts was associated with children aged 12–15 years old's park use (76). However, presence of outdoor lighting seemed not to influence children's cycling route choices. Children (age 13–15) chose the shortest possible cycling routes over routes that were covered by lighting (79). In addition, the routes chosen by children (8–12) had less outdoor lighting compared to the shortest routes (80). It is unclear what influenced these children's route choices. Dessing et al. (80) reflected that most of their findings were based on data collected around spring and the beginning of summer, which could have influenced the children's transportation behavior. During dark winter morning trips, outdoor lighting might play a more crucial role in children's walking and cycling route choices. Similar matters were discussed by Verhoeven et al. (79). Bad weather and fewer hours of daylight may impact both children' route choices and transportation mode, even if their findings do not show so. Their data was collected during autumn and winter, but the time for sunrise and sunset was not defined, meaning that it is difficult to get an understanding of the actual light conditions at the studied times.

Outdoor lighting could affect *older children's* interaction with places and support or hinder their sense of identity, belonging, and transition toward adulthood (81). Darkness disrupted children's (age 14–15) micro-sociality of spaces and both outdoor lighting and darkness affected their interactions with their surroundings. It was proposed that children create affective mental maps that guide them where to go and not go depending on light and darkness (81). The night-time was viewed as a forbidden sphere for children while having a strong symbolic value that offers them (age 14–16) the possibility to avoid parental control and develop relationships with peers (74, 75). Public spaces at night could be influential in the creation of youth identity (82) and open up for new possibilities and several "firsts," which could be important experiences in the liminal age that adolescence is. In familiar spaces, such as a child's neighborhood, children could acquire social and spatial skills that are crucial when navigating spaces by themselves (75).

There seemed to be different possibilities for children to be outdoors after dark depending on *urbanization degree* and *socio-economic status* (81, 83, 84). Urbanization led to a decrease of children's (age 10–18) licenses to independently spend time with friends outside after dark (84). Public open spaces in neighborhoods with higher socioeconomic status were more likely to have features supporting place use (e.g., outdoor lighting), compared to public open spaces in lower socioeconomic neighborhoods (83). Children (age 14–16) experienced dimmed, broken, or absent outdoor lighting as a material manifestation of neglect from powerful institutions and class devaluation (81).

3.2.3. Safety perception

The third theme, consisting of 16 papers, highlights how light conditions can influence children's perception of safety in different environments. Unlike above themes, this focuses to a greater extent on children's views and perceptions of light conditions and how it influence everyday outdoor life, including CIM. One category regards natural light focusing on dark hours and darkness, and a second on outdoor lighting with a focus on the presence and quality of outdoor lighting.

3.2.3.1. Natural light: dark hours and darkness

Twelve of the papers had findings related to natural light and children's perception of safety. The papers highlighted that many children were afraid of the dark and that darkness influenced their perception of safety in urban environments. Further, darkness constituted a barrier to CIM in terms of going out after dark and places to be avoided. The perception of fear and safety and coping strategies and avoidance behavior to handle/avoid negative feelings varied between the papers.

Ten papers highlighted *gender differences* for CIM after dark. Gender differences were significant for fear of darkness among children between 11 and 16 years old, with more girls reporting such fear (85, 86). Fear was reported more often by 13-year-old children who believed that their parent's opinion was that children of their age should not be walking in town or riding a bicycle in the evening (86). Girls (age 13–16), regardless of the time of day, felt less safe in public spaces than boys did (87). Boys were more likely than girls to indicate that their local areas were a safe place to walk alone after dark and felt generally safer all the time in their local area compared to girls (85). Children of both genders reporting more traffic and/or car parking on their local streets were less likely to perceive their neighborhood as a safe place to walk alone after dark (85) thereby, suggesting the relation between the number of vehicles and perceived walkability among the children. The fear of darkness also varied among children (age 13–14), depending on factors such as *housing type*, *family characteristics* and *parental licensing* (88). Among girls, mobility was more a reflection of their feelings when moving in their neighborhood, while among boys, housing conditions and the *traffic environment* seemed to be crucial factors influencing their IM (88). For both genders, children's (age 10–18) feelings of safety were lower when traveling on foot than traveling by car or public transport (89). Pursuing activities at night (e.g., eating, shopping, and hanging out) seemed also less safe to children (age 14–18) than during day, and pursuing an activity during the night decreased the perception of safety at the location of the activity, particularly among girls (90). By both genders, the most frequently mentioned reasons for perception of urban threats were a fear of (1) darkness and lack of outdoor lighting, (2) people in general, and (3) locations with negative associations (e.g., cemeteries and dark underpasses). The fear of the dark was

probably the most serious gender difference in the perception of walkability (87).

The location of CIM after dark seemed as well to be affected by gender. Girls (age 13–16) perceived larger areas to be dangerous during the night more than boys did (91). Regardless of the time of the day, the boys' collective walking activity space was also distributed over a larger area compared to that of girls. The biggest difference was found after dark, where girls' distribution of spaces was 4.11 km^2, while boys' distribution reached 6.86 km^2 (91). Moreover, different spatial patterns for children's (age 13–16) location of perception of safety was identified (87). Cemeteries, parks, train stations, side alleys and places with pubs were bound to the greatest perception of fear during the night. Girls stated that they were more afraid in parks mainly due to the dark and insufficient outdoor lighting, lack of people, and threats from passers-by, while cemeteries were more often mentioned by boys (87). Children of both genders (age 10–18) felt less safe in areas where alcohol outlets were overly common (89) and said that dark, lonely places should be avoided (age 15–16) (92). Reasons stated were social threats such as "rapists" and inebriated adults. Among girls, safety strategies such as avoiding being alone in certain places after dark or acting confident (i.e., not scared) when being alone in public spaces after dark were mentioned (92). During daytime, almost all children (age 8–9 and 13–15) believed that it was safe to walk around the block alone, while almost half of them considered it safe to walk home from a bus or train stop at night (93). Among girls, an increased level of concern about road safety impacted their outdoor activities negatively during evenings (93). There were few places outside their homes in which girls (age 15) felt safe after dark (51). A majority of the girls did not perceive natural outdoor environments as safe during dark hours. Surprisingly, however, some of the girls described that if they would feel safe, recreation under the cover of darkness would be beneficial, as darkness was seen as psychologically safe and as a condition under which they could avoid the critical gaze of others (51).

Two papers highlighted a different perspective on safety perception after dark, by mentioning the *familiarity of the location* (75, 94). Familiar neighborhoods providing feelings of safety and confidence supported the conditions for an autonomous experience among children (age 14–16) (75). The neighborhood was described as the primary space where adolescents developed their leisure practices during both day and evening and the spatial knowledge acquired during daytime played an important role in the discovery of nightlife (75). In suburban and rural locations, familiar home areas were seen as less threatening. Compared to urban areas, lone travel after dark was more common among children in these locations (age 13–14) (94).

3.2.3.2. Outdoor lighting: perception of outdoor lighting

There are only four of the papers within this theme with findings related to outdoor lighting and children's perception of safety. All stressed that the presence and quality of outdoor lighting in an area can play a role in children's perception of safety, which in turn can influence CIM.

Outdoor lighting at night was found to be positively associated with perceived safety among children (age 8–10) (95, 96). Based on color information extracted from an image captured from the International Space Station (ISS), it was suggested that children who lived in neighborhoods with greater green or blue hued (compared to red) outdoor lighting at night felt safer and that children felt less safe if they lived in neighborhoods measured to have low-medium compared to medium amount of outdoor lighting (96).

Two papers studied more in-depth children's views on outdoor lighting in relation to perceived safety. An area was described as safe due to the fact that it was perceived as well-lit (age 14–18) (90) and children (age 14–15) explained how inadequate outdoor lighting was an issue with regard to their perception of safety (81). Poorly lit spaces were avoided when it was dark, and evoked fear due to obstructed visibility and recognition. For some of the children, darkness signified danger and poor lighting made them feel anxious or scared. Therefore, they requested more, or brighter outdoor lighting as a way to feel safer (81).

3.2.4. Outdoor risks

The fourth theme, including six papers, focuses on the risks of child injuries and death in urban environments under different light conditions. The papers in this theme predominantly studied risks based on accident reports, hospital discharge or death certificate data, i.e., looking at number of incidents in relation to light conditions in the built environment. One paper included children's views on risks related to absence of outdoor lighting and active school travel. The theme includes only one category focusing on the presence of outdoor lighting.

3.2.4.1. Outdoor lighting: presence of outdoor lighting

Presence of outdoor lighting in an urban environment had an influence on the number of accidents involving children (97–100). Most child pedestrian injuries (age 0–18) seemed to take place at times of optimal conditions for driving (good lighting, dry road, good weather), indicating that optimal driving conditions likely represented optimal play conditions—thereby increasing the exposure of children to traffic (99). In this paper, which studied a total number of 3,823 vehicle crashes involving children, more than three quarters occurred in daylight, 16% of the incidents happened after dark in the presence of outdoor lighting, and <1% in darkness. Spring months (April to June) had the highest occurrence of child pedestrian crashes and January had the lowest. Half of the injuries occurred in the late afternoon/evening (99). Similar diurnal and seasonal patterns were reported by others (97, 98). In the paper by DiMaggio and Durkin (98), the incidences were highest (i.e., 29.3%) for children aged 15–19 years old. For any age group, dark unlighted roads played little role for the risk of injuries. However, children (age 0–15) who were involved in crashes after sunset had a greater risk for more severe injuries or death (100).

Outdoor lighting was significantly associated with decreased risk of homicide among children (age 13–20) (101). The findings were explained by the broken windows theory, suggesting that neglected environments create more disorder and crime, or that outdoor lighting promote increased pedestrian activity and community interaction, i.e., promoting social connections and facilitating social control—thus reducing crime (101).

Only one paper highlighted children's perspectives on risks and injury and the parents' role for CIM in a post disaster community. Inoperative lighting along the way to school led to minor injuries

among children (age 1–18), as they could not detect potholes in the road surface, which in turn induced fear among the children and caused parents to drive them to school during dark hours (102).

4. Discussion

This scoping review aims to identify and map the available scientific knowledge about CIM during dark hours by investigating how outdoor lighting may support CIM. Our definition of CIM has been comprehensive, referring to children's freedom for independent action, exploration, play and socializing with friends in their local environments without adult supervision (2), which agrees with the broad definition and interpretation of CIM in current literature (13). The internationally available, peer-reviewed scientific research identified, strengthens the perspective that darkness constitutes a major obstacle for CIM, and reveals physical activity (PA) and active travel, outdoor activities and place use, safety perception, and outdoor risks, as major research topics of the effects of light conditions with importance for CIM during dark hours. There are, however, an unevenness between the researched topics; most papers concerned effects on PA and active travel, while only a small number addressed effects on outdoor risks. This review also sets the effects of natural light and artificial outdoor lighting in relation to child characteristics and local contexts, likely influencing the impact of light conditions on CIM. The findings point to the need to deepen the understanding of children's perspectives on the quality of outdoor lighting to support CIM during dark hours among both boys and girls of different ages.

In the coming sections, we connect the findings to our research questions, discuss them in relation to previous research, especially stressing aspects that should be addressed in further studies and pointing to specific knowledge gaps. In the final part we critically reflect on our search method and summarize our conclusions.

4.1. Identified effects of CIM during dark hours and knowledge gaps for future studies

In response to RQ 1: *How and under which circumstances has CIM during dark hours been studied up until now?* and RQ 2: *What are the effects of light conditions on CIM, and for whom and where are the effects reported?*, we highlight the findings in relation to light conditions within the two major categories: *natural light* and artificial *outdoor lighting*. In the identified papers, much focus is put on children's PA, active travel, route choices, transportation mode, fear, safety perception and possibilities to be outdoors, whereas some aspects of CIM, in relation to darkness and outdoor lighting (such as exploration, play and socializing), are only mentioned to a limited extent. Hence, such essential aspects of children's lives are overlooked (103–105) with regard to darkness and lighting outdoors, making it difficult to meet the needs of children's right to rest, leisure and play in accordance with the Convention on the Rights of the Child (4). Despite this, the findings illustrated how natural light and outdoor lighting can influence CIM in different ways.

Natural light has an influence on children's PA and active travel. Darkness, with regard to day length and seasonality, comes through as a barrier to children's PA. Children of all ages seem to be more physically active at times when the day length is longer, i.e., during summer months. However, local circumstances in the built environment seem to be a deciding factor when it comes to how light and darkness influence children's PA and active travel. Environmental factors, such as degree of urbanization, the design of the road environment, and factors such as the latitude of the country could play a role. It is widely acknowledged that significant changes in the built environment and urbanization patterns have served to limit children's opportunities for IM within their neighborhoods (16, 106) and that cities are primarily designed with adults and cars in mind, not children (107). PA and active travel in rural settings, sometimes visioned as utopian environments for children to grow up in (108, 109) might also have great impact of winter darkness, where outdoor lighting is sparse or less extensive (39). Colder temperatures, wind and precipitation are presumably also contributing barriers to children's PA and active travel during winter months (38, 40). The geographical differences of PA and active travel due to daylight hours point to the need to also consider light conditions in relation to urban and rural design to understand the barriers of darkness.

Fear of darkness is common among children and influences their safety perception outdoors. This, in turn, leads to darkness constituting a barrier to CIM, both in terms of the consideration of whether to go out or not after dark as well as which places in the built environment should be avoided or not. Therefore, children have developed different coping strategies e.g., not traveling alone, avoiding certain places, or acting confident. There are apparent gender differences in the perception of safety after dark. Girls felt less safe in public spaces than boys, were more afraid of the dark and had denser walking activity spaces after dark compared to that of boys. These findings are in line with research on adults, suggesting that women tend to report more fear than men (86, 110, 111) and that insecurity and fear are factors that can limit IM (112). Also, other factors, such as the type of setting and familiarity with places, could play a role in safety perception and CIM. Hence, it seems that perceptions of safety/fear in the local environment can limit IM, but by familiarizing oneself with the area (at daytime), it could be perceived as safer (88, 113, 114). Places perceived as safe, but also offer children thing to do, can positively support CIM during dark hours (71). This is in line with research showing positive associations between place attachment (i.e., the emotional bonds between people and places) and adults' walking behaviors (115).

For older children (above 14), CIM during night-time can play a role in their identity development and transition into young adulthood, e.g., by offering avoidance of parental control, new possibilities and several "firsts" (74, 75, 82). The night can be viewed as a "second city," with its own geography and group of people (5). Hence, the dark spaces at night might function as a refuge for older children and offer an opening "for trying to be someone the daytime may not let you be, a time for meeting people you should not, for doing things your parents told you not to do" (116). The findings highlight that promoting CIM during dark hours might not only be a contributor to the accumulation of PA, confidence, and skills, but also for their mental health. This behavior, while often negatively interpreted by adults, might fill

an important function for children's self-regulation (117), pointing to the need to develop neighborhood environments in which any child can engage in play and recreational activities independently throughout the year.

The presence of outdoor lighting is related to increased PA and active travel. The perception of outdoor lighting or the lit environment can also influence activity levels, and outdoor lighting is viewed as a physical-activity-facilitator among children. However, findings are inconsistent on how and if outdoor lighting influence children's PA. The findings imply that the relationship is complex, and that child attributes, such as age, gender, and personal interests, as well as parental licenses can be mediating factors when it comes to the relations between outdoor lighting, PA and active travel.

Outdoor lighting seems to also influence children's place use, interaction with the environment and identity development. The presence and quality of outdoor lighting can influence whether children use a place, whether they perceive an area as an activity-friendly environment and affect their interactions with their surroundings and play a role in their navigation and negotiations of public space (74–78, 82). When it comes to children's route choices, however, outdoor lighting did not seem to influence children's cycling routes to an equal extent (79, 80). The reason for this is unclear and should be investigated further.

There are both structural and experienced inequalities in the spaces and places for the children's everyday outdoor life in the identified papers. Some described that there are different possibilities for children to be outdoors after dark depending on where they live (81, 83, 84) and that children experienced dimmed, broken, or absent lighting as a material manifestation of neglect from powerful institutions and class devaluation (81). In previous studies, it has been found that people living in socially vulnerable areas make fewer trips per person and per week than the national average (118, 119). It has been proposed that the way urban spaces are lighted can reinforce inequality, but also challenge them (120). Inequalities in lighting design in relation to CIM and mobility justice should further be addressed in research.

The presence of outdoor lighting and lighting quality may also play a role in children's safety perception, which in turn can influence their IM. Contrary to the literature on adult's responses to outdoor lighting these findings are still limited. Among adults, the relationship between outdoor lighting and perceived safety was by far the most frequently researched topic (121). Moreover, light sources with whiter light seem to have a positive effect on adults' safety perception (121). In our review, one paper suggested that outdoor lighting with greater green or blue hues was related to children feeling safer (96). Findings also showed that areas perceived as well-lit could be perceived as safer and that children requested brighter outdoor lighting as a way to feel safer (81, 90, 96). However, Côté-Lussier et al. (96) relied on lighting data extracted from images taken from an International Space Station rather than photometric on-site measures (e.g., illuminance, luminance, spectral power distribution) or observer-based assessments commonly used to study human perception, evaluation or behavior of the lit environment (8). The assessment of the raw image brightness values using photos from space gives a rough measure of the lighting in an area, but it is uncertain if it can be compared to the actual experience on site. Overall, the restricted number of identified papers and the limited understanding of the lit environment within these papers means that more research is needed to understand the relationship between children's safety perception and the presence and quality of outdoor lighting.

Presence of outdoor lighting might influence outdoor risks for children, but also children's perception of risks. The highest number of accidents occurred when most children were outdoors, e.g., during days with good weather, summer months, and afternoon and evening hours. Overall, the papers (e.g., 97–99) say little about the relative risk of child injuries after dark or in the presence of outdoor lighting. Only two of the papers (100, 102) showed a relationship between greater risk for child injuries and death after sunset, and that parents' perceptions of outdoor risks after dark can limit CIM. Traffic safety issues have been highlighted as a major constraint for children's active travel [e.g., (17, 122)], which emphasizes the importance of untangling the actual and perceived risks of accidents when children are independently mobile during dark hours and the potential of outdoor lighting to influence such risks.

The presence of outdoor lighting is associated with decreased odds of child homicide (101). It has been claimed that outdoor lighting can reduce crime and increase public safety (123), but it has also been disputed (124) and criticized as an approach that elude the deeper socio-economical causes of crime (125–127). The connection between outdoor lighting and crime appears to be sensitive to local conditions and should be context appropriate (128, 129). Since the findings in this review is only based on one paper, no conclusions can be made between the relationship of outdoor lighting and children's risks of being victims of crime.

It should be noted that there are legitimate differences regarding the age when children are allowed by their parents to be independently mobile (e.g., in their neighborhood or commuting), but also that children of different ages have different needs of independence. The focus in this review has been on children within school age (6–18 years old), which brings big differences in the degree of their IM. Despite this, the findings point to how darkness can be a barrier for IM for children of all ages, while also illustrating how this barrier is realized in various ways. For younger children, parental constraints regarding darkness can limit their possibilities to be outdoors and entail e.g., being driven to activities [e.g., Forsberg et al. (50), Nakanishi and Black (102)]. Older children could also be subject to parental constraints, but here it appears that darkness also entails spatial barriers, leading to parental restrictions in the form of "no-go" areas outdoors [e.g., James and Embrey (51), Pooley et al. (70)]. Overall, the findings indicate that outdoor lighting, when perceived as adequate, has an impact on CIM for all children within school age.

4.2. Current limitations in understanding the quality of outdoor lighting from a child perspective

In order to cover a variety of perspectives of CIM during dark hours and the role of outdoor lighting, both natural light and outdoor lighting were considered in this scoping review. In RQ 3 we asked: *How are the light conditions defined and operationalized*

in relation to CIM in previous studies? with the objective to further the understanding of the light conditions *per se*.

A drawback that has emerged in the papers is the lack of details about the studied outdoor lighting. Several of the papers discuss the existence or non-existence of lighting and mention "poor lighting," "well-lit," "sufficient light," "better lighting" or "good lighting" in relation to children's use and experiences of the outdoor environment, but few of them focus in detail on the qualities of outdoor lighting to meet children's needs for IM. What is meant with "well-lit" or "good lighting" from the perspective of children? What type of light source or lighting design could support CIM? Research that includes both observer-based and technical-based environmental assessments of the studied lighting could provide better insights into these matters [cf., (10, 130, 131)]. Côté-Lussier et al. (96) is the only paper that has used technical assessments of the outdoor lighting, but the assessments are arguably too simplified and rough. To better understand the associations between CIM and outdoor lighting, more in-depth research that takes both technical aspects of lighting and the lit environment, together with observer-based assessments from children's perspectives into account, is needed. A good starting point would be to base these assessments on well-established and proven methods within lighting research and child studies.

There are also limitations in the chosen methods and included perspectives in the identified papers with regard to understanding how outdoor lighting could support CIM. Since parental factors, such as parents' perceptions of the neighborhood, parental license and parents previous IM experiences, influence CIM (132), it is of relevance to understand parents' perspectives of light conditions. This is reflected in the identified papers to a limited extent, with parents' views included in 25% of the studies. Nevertheless, children's views of their environments should not be ignored. The basis that IM is every child's right and that they have the right to be heard and to express their views on matters affecting them (Article 12) (4) should be a point of departure. Children's perspectives on light conditions captured through self-reports (e.g., through questionnaires or interviews), were included in 47 of the papers, indicating that their perspectives are considered to a great extent. Additionally, the included children's attributes varied between the papers, representing children of different age groups, genders and countries. However, a predominant part of the papers was based in European or North American contexts, and focused to a great extent on urban environments, indicating that the findings are mostly based on a Western and urban perspective. To better understand CIM during dark hours, research including children from different parts of the world and different kinds of settings is desired.

When studying the methods used for children's self-reports in the papers, it is also apparent that the opportunity for children to express their views on outdoor lighting are limited. Thirty-one of the 47 papers base their findings on questionnaires, but few of these include children's perceptions of lighting or the lit environment, and if they do, the children are asked to answer a statement about how they perceive the lighting (e.g., positive or negative) or if lighting is present or not [e.g., Evenson et al. (57), Kamargianni et al. (67), Onywera et al. (68)]. Instead, most of the papers that include aspects of outdoor lighting have assessed its presence in an area through GIS or so called "objective measures" on site [e.g., Sallis et al. (54), Goon et al. (58), Edwards et al. (76), Flowers et al. (77)]. There are fewer qualitative papers on children's perspectives on outdoor lighting, but these include more detailed descriptions on how children are impacted by light conditions in their outdoor lives [e.g., Mier et al. (65), Mecca (75), Thoma et al. (81)]. Here, however, technical-based environmental assessments are lacking, making it difficult to interpret the findings. As previously concluded, technical-based environmental assessments in combination with methods capturing children's and parents' perspectives [e.g., Derr et al. (133)] could provide better insights into the matter of the effect of outdoor lighting on CIM. Detailed knowledge of the lighting would aid in the understanding of how to promote exploration, play and socializing for children in their local environments in addition to supporting their essential commuting to and from school and other educational activities.

Another drawback in the papers is that the theoretical starting points are rarely explicitly stated, making it difficult to evaluate and interpret the findings. Recent systematic reviews on CIM have shown that it is associated with several attributes, such as socio-demographic, social and physical (134–136). It is therefore motivated to use theories that enable addressing the child-environment relationship. Of the 67 identified papers, only 12 refer to such theories. To better understand the complexity of CIM in relation to light conditions, using a framework considering ways in which parent and child attributes can intersect with neighborhood characteristics, is suggested in future research.

4.3. Methodological reflection

The limited findings about CIM during dark hours and the role of outdoor lighting might depend on shortcomings of the eligibility criteria and search strategy used. Additional themes might have emerged if papers written in other languages than English had been included. Also, the addition of non-peer-reviewed reports could have resulted in greater insights on how different light sources and lighting design might affect children's opportunities and needs. Nevertheless, the peer-review criterion was considered as the best way to identify and map the available scientific knowledge on CIM during dark hours and to identify potential research gaps for future studies. This is motivated by the fact that few studies focus on children's needs and experiences of light conditions in their everyday outdoor life, thereby implying that outdoor lighting recommendations and standards are informed by research based on adult's perceptions.

Due to limited possibilities in conducting full-text searches in all of the selected databases, papers that include aspects of light conditions may have been missed. There are existing papers that could have been relevant to include in the review that were not incorporated since they were not identified through the search process (e.g., found through colleagues, Google searches etc.). To ensure that the findings of this review can be updated and replicated, papers identified through methods other than citation searching was excluded. Despite these limitations, we believe that the most relevant papers have been found and included, when we consider the aim of this review.

5. Conclusion

Both natural light and outdoor lighting seem to play an important role in children's everyday outdoor life by supporting or hindering specific behaviors and needs. Findings that increase the understanding of *the quality* of outdoor lighting to support children's opportunities to move around independently during dark hours is, however, limited. This calls for future research on how different light sources and lighting design might affect CIM during dark hours. In order to develop outdoor lighting that support both children's and parents' perspectives in urban design, more research is needed to fill the gaps:

- Taking technical aspects of outdoor lighting and the lit environment into account (e.g., through photometric on-site measures), to understand the association between CIM and physical properties as well as quality of the lighting would facilitate integration in current lighting standards for urban settings.
- Focusing on specific aspects of CIM in relation to outdoor lighting, such as outdoor risks (actual and perceived), children's safety perception and route- and transportation mode choices to school and extra-curricular activities. CIM also needs to be studied during dark hours in relation to play, exploration and socialization.
- Conducting studies among children of different ages, genders and from different countries and within different kinds of neighborhood settings.

Finally, in order to promote a lighting practice that takes a child perspective into account, research-based strategies including children's perceptions and perspectives are essential. By conducting research with children we can really understand what they think about issues that affect them (137). Our hope is that this scoping review will serve as a starting point for an attempt to create bridges between children's perspectives, urban planning and lighting practice, thereby furthering the understanding of the relationship between built environment characteristics and CIM. This could lead to securing children's perspectives in the rapid development of energy efficient outdoor lighting and creating pathways for CIM over the day and seasons.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

Funding for the study was obtained by JR, PM, and MJ. AL identified and initially analyzed the papers with the support by JR, PM, and MJ, and wrote the first draft of the manuscript. JR, PM, and MJ contributed to revision. All authors contributed to conception and design of the study and contributed to the article and approved the submitted version.

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Conflict of interest

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

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1110224/full#supplementary-material

SUPPLEMENTARY TABLE 1
Date for search and the search string used in each database.

SUPPLEMENTARY TABLE 2
List of papers included in the review. The papers are presented in chronological order of author's/s' name/s and details about how CIM has been studied is presented.

References

1. UN. *Resolution Adopted by the General Assembly on 25 September 2015 70/1. Transforming Our World: The 2030 Agenda for Sustainable Development*. New york: United Nations New York (2015).

2. Johansson M, Mårtensson F, Jansson M, Sternudd C. Urban space for children on the move. *Transport. Children's WellBeing.* (2020) 217–35. doi: 10.1016/B978-0-12-814694-1.00012-9

3. Shaw B, Bicket M, Elliott B, Fagan-Watson B, Mocca E, Hillman M. *Children's Independent Mobility: An International Comparison and Recommendations for Action*. London: University of Westminister, Policy Studies Institute Faculty of Architecture and the Built Environment (2015).

4. UN. Convention on the Rights of the Child. General Assembly resolution 44/25 of 20 November 1989. (1989). (accessed September 15, 2022).

5. Edensor T. Introduction to geographies of darkness. *Cult Geograph.* (2015) 22:559–65. doi: 10.1177/1474474015604807

6. Cele S. "A tale of two trees : how children make space in the city," in *Social, Material and Political Constructs of Arctic Childhoods : An Everyday Life Perspective.).* (2019) 1–15. doi: 10.1007/978-981-13-3161-9_1

7. Morris NJ. Night walking: darkness and sensory perception in a night-time landscape installation. *Cult Geograph.* (2011) 18:315–42. doi: 10.1177/1474474011410277

8. Rahm J. *Urban Outdoor Lighting: Pedestrian Perception, Evaluation and Behavior in the Lit Environment*. Doctoral dissertation. Lund, Sweden: Lund University, Dept of Architecture and Built Environment (2019).

9. Johansson M, Laureshyn A, Nilsson M. Video analysis of pedestrian movement (VAPM) under different lighting conditions—method exploration. *Energies.* (2020) 13:4141. doi: 10.3390/en13164141

10. Johansson M, Pedersen E, Maleetipwan-Mattsson P, Kuhn L, Laike T. Perceived outdoor lighting quality (POLQ): a lighting assessment tool. *J Environ Psychol.* (2014) 39:14–21. doi: 10.1016/j.jenvp.2013.12.002

11. Stafford L, Baldwin C. Planning walkable neighborhoods. *J Plann Liter.* (2018) 33:17–30. doi: 10.1177/0885412217704649

12. Hillman M, Adams J, Whitelegg J. *One False Move*. London: Policy Studies Institute (1990).

13. Marzi I, Reimers AK. Children's independent mobility: current knowledge, future directions, and public health implications. *Int J Environ Res Public Health.* (2018) 15:2441. doi: 10.3390/ijerph15112441

14. Malone K. Changing global childhoods: the impact on children's independent mobility. *Global Stud Childhood.* (2011) 1:161–6. doi: 10.2304/gsch.2011.1.3.161

15. Schoeppe S, Duncan MJ, Badland H, Oliver M, Curtis C. Associations of children's independent mobility and active travel with physical activity, sedentary behaviour and weight status: a systematic review. *J Sci Med Sport.* (2013) 16:312–9. doi: 10.1016/j.jsams.2012.11.001

16. Fyhri A, Hjorthol R, Mackett RL, Fotel TN, Kyttä M. Children's active travel and independent mobility in four countries: Development, social contributing trends and measures. *Transport Policy.* (2011) 18:703–10. doi: 10.1016/j.tranpol.2011.01.005

17. Björklid P, Gummesson M. *Children's Independent Mobility in Sweden*. The Swedish Transport Administration report 2013:113. Borlänge: The Swedish Transport Administration (2013).

18. Nordbakke S. Children's out-of-home leisure activities: changes during the last decade in Norway. *Children's Geograph.* (2018) 17:347–60. doi: 10.1080/14733285.2018.1510114

19. Yarwood R, Tyrrell N. Why children's geographies? *Geography.* (2012) 97:123–8. doi: 10.1080/00167487.2012.12094350

20. Johansson M. Social dangers as constraints for pro-environmental travel modes-the perception of parents in England and Sweden. *Medio Ambiente y Comportamiento Humano*. (2003) 4:49–69. Available online at: https://mach.webs.ull.es/PDFS/VOL4_1/Vol_4_1_e.PDF

21. Johansson M. Environment and parental factors as determinants of mode for children's leisure travel. *J Environ Psychol.* (2006) 26:156–69. doi: 10.1016/j.jenvp.2006.05.005

22. Villanueva K, Badland H, Kvalsvig A, O'Connor M, Christian H, Woolcock G, et al. Can the neighborhood built environment make a difference in children's development? Building the research agenda to create evidence for place-based children's policy. *Acad Pediatr.* (2016) 16:10–9. doi: 10.1016/j.acap.2015.09.006

23. Munn Z, Peters MDJ, Stern C, Tufanaru C, McArthur A, Aromataris E, et al. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Med Res Methodol.* (2018) 18:611. doi: 10.1186/s12874-018-0611-x

24. Booth A, Sutton A, Clowes M, Martyn-St James M. *Systematic Approaches to a Successful Literature Review*. (2021).

25. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Syst Rev.* (2021) 10:1–11. doi: 10.1186/s13643-021-01626-4

26. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol.* (2006) 3:77–101. doi: 10.1191/1478088706qp063oa

27. Sallis JF, Cervero RB, Ascher W, Henderson KA, Kraft MK, Kerr J, et al. An ecological approach to creating active living communities. *Annu Rev Public Health.* (2006) 27:297–322. doi: 10.1146/annurev.publhealth.27.021405.102100

28. Lang T, Rayner G. Ecological public health The 21st century's big idea? *BMJ.* (2012) 345:17–20. doi: 10.1136/bmj.e5466

29. Holloway SL, Valentine G. *Children's Geographies: Playing, Living, Learning*. Abingdon, UK: Routledge. (2004). doi: 10.4324/9780203017524

30. Kato Y. Doing consumption and sitting cars: adolescent bodies in suburban commercial spaces. *Children's Geographies.* (2009) 7:51–66. doi: 10.1080/14733280802630908

31. Vanderstede W. "Chilling"and "hopping" in the "teenage space network": Explorations in teenagers' geographies in the city of Mechelen. *Children's Geographies.* (2011) 9:167–84. doi: 10.1080/14733285.2011.562379

32. Bourdieu P. *Outline of a Theory or Practice. Trans Richard Nice.* Cambridge: Cambridge University Press. (1977) 1989:21–2. doi: 10.1017/CBO9780511812507

33. Gibson JJ. *The Theory of Affordances. The Ecological Approach to Visual Perception. The People, Place and, Space Reader*. New York, NY, USA: Routledge (1979). 56-60.

34. Wilson JQ, Kelling GL. Broken windows. *Atlantic Monthly.* (1982) 249:29–38.

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

36. Loucaides CA, Chedzoy SM, Bennett N. Differences in physical activity levels between urban and rural school children in Cyprus. *Health Educ Res.* (2004) 19:138–47. doi: 10.1093/her/cyg014

37. Gracia-Marco L, Ortega FB, Ruiz JR, Williams CA, Hagstromer M, Manios Y, et al. Seasonal variation in physical activity and sedentary time in different European regions. *The HELENA study J Sports Sci.* (2013) 31:1831–40. doi: 10.1080/02640414.2013.803595

38. Larouche R, Gunnell K, Bélanger M. Seasonal variations and changes in school travel mode from childhood to late adolescence: a prospective study in New Brunswick, Canada. *J Transport Health.* (2019) 12:371–8. doi: 10.1016/j.jth.2018.08.012

39. McCrorie P, Mitchell R, Macdonald L, Jones A, Coombes E, Schipperijn J, et al. The relationship between living in urban and rural areas of Scotland and children's physical activity and sedentary levels: a country-wide cross-sectional analysis. *BMC Public Health.* (2020) 20:8311. doi: 10.1186/s12889-020-8311-y

40. Yang Y, Diez Roux AV, Bingham CR. Variability and seasonality of active transportation in USA: evidence from the 2001 NHTS. *Int J Behav Nutri Phys Act.* (2011) 8:96. doi: 10.1186/1479-5868-8-96

41. Goodman A, Page AS, Cooper AR. Daylight saving time as a potential public health intervention: an observational study of evening daylight and objectively-measured physical activity among 23,000 children from 9 countries. *Int J Behav Nutri Phys Act.* (2014) 11:1–9. doi: 10.1186/1479-5868-11-84

42. Aggio D, Smith L, Fisher A, Hamer M. Association of light exposure on physical activity and sedentary time in young people. *Int J Environ Res Public Health.* (2015) 12:2941–9. doi: 10.3390/ijerph120302941

43. Harrison F, Goodman A, van Sluijs EMF, Andersen LB, Cardon G, Davey R, et al. Weather and children's physical activity; how and why do relationships vary between countries? *Int J Behav Nutr Phys Act.* (2017) 14:74. doi: 10.1186/s12966-017-0526-7

44. Quante M, Wang R, Weng J, Kaplan ER, Rueschman M, Taveras EM, et al. Seasonal and weather variation of sleep and physical activity in 12–14-year-old children. *Behav Sleep Med.* (2002) 17:398–410. doi: 10.1080/15402002.2017.1376206

45. Khawaja I, Woodfield L, Collins P, Benkwitz A, Nevill A. Tracking children's physical activity patterns across the school year: a mixed-methods longitudinal case study. *Children-Basel.* (2020) 7:178. doi: 10.3390/children7100178

46. Goodman A, Paskins J, Mackett R. Day length and weather effects on children's physical activity and participation in play, sports, and active travel. *J Phys Activity Health.* (2012) 9:1105–16. doi: 10.1123/jpah.9.8.1105

47. Carver A, Timperio AF, Crawford DA. Neighborhood road environments and physical activity among youth: the CLAN study. *J Urban Health.* (2008) 85:532–44. doi: 10.1007/s11524-008-9284-9

48. Ferrão MM, Gama A, Marques VR, Mendes LL, Mourão I, Nogueira H, et al. Association between parental perceptions of residential neighbourhood environments and childhood obesity in Porto, Portugal. *Eur J Public Health.* (2013) 23:1027–31. doi: 10.1093/eurpub/cks187

49. Bhosale J, Duncan S, Schofield G. Intergenerational change in children's independent mobility and active transport in New Zealand children and parents. *J Transport Health.* (2017) 7:247–55. doi: 10.1016/j.jth.2017.09.004

50. Forsberg H, Rutberg S, Mikaelsson K, Lindqvist AK. It's about being the good parent: exploring attitudes and beliefs towards active school transportation. *Int J Circumpolar Health.* (2020) 79:113. doi: 10.1080/22423982.2020.1798113

51. James K, Embrey L. "Anyone could be lurking around!": constraints on adolescent girls' recreational activities after dark. *World Leisure J.* (2001) 43:44–52. doi: 10.1080/04419057.2001.9674248

52. Carver A, Timperio A, Hesketh K, Crawford D. Are safety-related features of the road environment associated with smaller declines in physical activity among youth? *J Urban Health.* (2009) 87:29–43. doi: 10.1007/s11524-009-9402-3

53. Jago R, Baranowski T, Zakeri I, Harris M. Observed environmental features and the physical activity of adolescent males. *Am J Prevent Med.* (2005) 29:98–104. doi: 10.1016/j.amepre.2005.04.002

54. Sallis JF, Cain KL, Conway TL, Gavand KA, Millstein RA, Geremia CM, et al. Is your neighborhood designed to support physical activity? A brief streetscape audit tool. *Prevent Chro Dis.* (2015) 12:98. doi: 10.5888/pcd12.150098

55. Da Silva IC, Hino AA, Lopes A, Ekelund U, Brage S, Gonçalves H, et al. Built environment and physical activity: domain-and activity-specific associations among

Brazilian adolescents. *BMC Public Health*. (2017) 17:7. doi: 10.1186/s12889-017-4538-7

56. Wilson DK, Lawman HG, Segal M, Chappell S. Neighborhood and parental supports for physical activity in minority adolescents. *Am J Prevent Med.* (2011) 41:399–406. doi: 10.1016/j.amepre.2011.06.037

57. Evenson KR, Birnbaum AS, Bedimo-Rung AL, Sallis JF, Voorhees CC, Ring K, et al. Girls' perception of physical environmental factors and transportation: reliability and association with physical activity and active transport to school. *Int J Behav Nutr Phys Act.* (2006) 3:28. doi: 10.1186/1479-5868-3-28

58. Goon S, Kontulainen S, Muhajarine N. Neighborhood built environment measures and association with physical activity and sedentary time in 9-14-year-old children in Saskatoon, Canada. *Int J Environ Res Public Health.* (2020) 17:3873. doi: 10.3390/ijerph17113837

59. Timperio A, Giles-Corti B, Crawford D, Andrianopoulos N, Ball K, Salmon J, et al. Features of public open spaces and physical activity among children: Findings from the CLAN study. *Prevent Med.* (2008) 47:514–8. doi: 10.1016/j.ypmed.2008.07.015

60. Evenson KR, Scott MM, Cohen DA, Voorhees CC. Girls' perception of neighborhood factors on physical activity, sedentary behavior, and BMI. *Obesity.* (2007) 15:430–45. doi: 10.1038/oby.2007.502

61. Reis RS, Hino AAF, Florindo AA, Añez CRR, Domingues MR. Association between physical activity in parks and perceived environment: a study with adolescents. *J Phys Activity Health.* (2009) 6:503–9. doi: 10.1123/jpah.6.4.503

62. Evenson KR, Murray DM, Birnbaum AS, Cohen DA. Examination of perceived neighborhood characteristics and transportation on changes in physical activity and sedentary behavior: the trial of activity in adolescent girls. *Health Place.* (2010) 16:977–85. doi: 10.1016/j.healthplace.2010.06.002

63. Nelson NM, Woods CB. Neighborhood perceptions and active commuting to school among adolescent boys and girls. *J Phys Activity Health.* (2010) 7:257–66. doi: 10.1123/jpah.7.2.257

64. Pizarro AN, Santos MP, Ribeiro JC, Mota J. Physical activity and active transport are predicted by adolescents' different built environment perceptions. *J Public Health.* (2012) 20:5–10. doi: 10.1007/s10389-011-0432-4

65. Mier N, Lee C, Smith ML, Wang X, Irizarry D, Avila-Rodriguez EH, et al. Mexican-American children's perspectives: Neighborhood characteristics and physical activity in Texas-Mexico border colonias. *J Environ Health.* (2013) 76:8–17.

66. He G, Cerin E, Huang WY, Wong SH. Understanding neighborhood environment related to Hong Kong children's physical activity: a qualitative study using nominal group technique. *PLoS ONE.* (2014) 9:6578. doi: 10.1371/journal.pone.0106578

67. Kamargianni M, Polydoropoulou A. Generation Y's travel behavior and perceptions of walkability constraints. *Transp Res Rec.* (2014) 2430:59–71. doi: 10.3141/2430-07

68. Onywera VO, Larouche R, Oyeyemi AL, Prista A, Akinroye KK, Heyker S, et al. Development and convergent validity of new self-administered questionnaires of active transportation in three African countries: Kenya, Mozambique and Nigeria. *BMC Public Health.* (2018) 18:5954. doi: 10.1186/s12889-018-5954-z

69. Hermosillo-Gallardo ME, Sebire SJ, Jago R. Perception of safety and its association with physical activity in adolescents in Mexico. *Am J Prevent Med.* (2019) 58:748–55. doi: 10.1016/j.amepre.2019.12.007

70. Pooley C, Whyatt D, Walker M, Davies G, Coulton P, Bamford W, et al. Understanding the school journey: integrating data on travel and environment. *Environ Plann a-Econ Space.* (2010) 42:948–65. doi: 10.1068/a41405

71. Ergler CR, Kearns RA, Witten K. (2013). Seasonal and locational variations in children's play: implications for wellbeing. *Soc Sci Med.* (2012) 91:178–85. doi: 10.1016/j.socscimed.2012.11.034

72. Ergler CR, Kearns R, Witten K. Exploring children's seasonal play to promote active lifestyles in Auckland, New Zealand. *Health Place.* (2016) 41:67–77. doi: 10.1016/j.healthplace.2016.07.001

73. Nguyen HT, Le HT, Connelly LB. Weather and children's time allocation. *Health Econ.* (2021) 5:16. doi: 10.1002/hec.4264

74. Mecca M. The role of village and local festivals in adolescents' discovery of nightlife. *World Leis J.* (2019) 61:260–75. doi: 10.1080/16078055.2019.1661103

75. Mecca M. Adolescents' daily places to discover nightlife in Barcelona, Spain. *Childrens Geographies.* (2020) 3:7951. doi: 10.1080/14733285.2020.1787951

76. Edwards N, Hooper P, Knuiman M, Foster S, Giles-Corti B. Associations between park features and adolescent park use for physical activity. *Int J Behav Nutri Phys Act.* (2015) 12:178. doi: 10.1186/s12966-015-0178-4

77. Flowers EP, Timperio A, Hesketh KD, Veitch J. Examining the features of parks that children visit during three stages of childhood. *Int J Environ Res Public Health.* (2019) 16:1658. doi: 10.3390/ijerph16091658

78. Hidding LM, Chinapaw MJM, Altenburg TM. An activity-friendly environment from the adolescent perspective: a concept mapping study 17 psychology and cognitive sciences 1701 psychology. *Int J Environ Res Public Health.* (2018) 15:733. doi: 10.1186/s12966-018-0733-x

79. Verhoeven H, Van Hecke L, Van Dyck D, Baert T, Van de Weghe N, Clarys P, et al. Differences in physical environmental characteristics between adolescents' actual and shortest cycling routes: a study using a Google Street View-based audit. *Int J Health Geogr.* (2018) 17:136. doi: 10.1186/s12942-018-0136-x

80. Dessing D, de Vries SI, Hegeman G, Verhagen E, Van Mechelen W, Pierik FH. Children's route choice during active transportation to school: difference between shortest and actual route. *Int J Behav Nutri Physical Activity.* (2016) 13:373. doi: 10.1186/s12966-016-0373-y

81. Thomas GM, Elliott E, Exley E, Ivinson G, Renold E. Light, connectivity and place: young people living in a post-industrial town. *Cult Geograph.* (2018) 25:537–51. doi: 10.1177/1474474018762811

82. Robinson C. 'Nightscapes and leisure spaces': an ethnographic study of young people's use of free space. *J Youth Stud.* (2009) 12:501–14. doi: 10.1080/13676260903081657

83. Crawford D, Timperio A, Giles-Corti B, Ball K, Hume C, Roberts R, et al. Do features of public open spaces vary according to neighbourhood socio-economic status? *Health Place.* (2008) 14:889–93. doi: 10.1016/j.healthplace.2007.11.002

84. Lopes F, Cordovil R, Neto C. Children's independent mobility in Portugal: effects of urbanization degree and motorized modes of travel. *J Trans Geography.* (2014) 41:210–9. doi: 10.1016/j.jtrangeo.2014.10.002

85. Mullan E. Do you think that your local area is a good place for young people to grow up? The effects of traffic and car parking on young people's views. *Health and Place.* (2003) 9:351–60. doi: 10.1016/S1353-8292(02)00069-2

86. Johansson K, Hasselberg M, Laflamme L. Exploring the neighborhood: A web-based survey on prevalence and determinants of fear among young adolescent girls and boys. *Int J Adolesc Med Health.* (2009) 21:347–59. doi: 10.1515/IJAMH.2009.21.3.347

87. Rišová K, Madajová MS. Gender differences in a walking environment safety perception: a case study in a small town of Banska Bystrica (Slovakia). *J Transport Geography.* (2020) 85:2723. doi: 10.1016/j.jtrangeo.2020.102723

88. Johansson K, Hasselberg M, Laflamme L. Young adolescents' independent mobility, related factors and association with transport to school. A cross-sectional study. *BMC Public Health.* (2010) 10:635. doi: 10.1186/1471-2458-10-635

89. Wiebe DJ, Richmond TS, Poster J, Guo W, Allison PD, Branas CC, et al. Adolescents' fears of violence in transit environments during daily activities. *Security J.* (2014) 27:226–41. doi: 10.1057/sj.2014.8

90. McCray TM, Mora S. Analyzing the activity spaces of low-income teenagers: how do they perceive the spaces where activities are carried out? *J Urban Aff.* (2011) 33:511–28. doi: 10.1111/j.1467-9906.2011.00563.x

91. Rišová K. Questioning gender stereotypes: a case study of adolescents walking activity space in a small Central European city. *J Transport Geography.* (2021) 91:2970. doi: 10.1016/j.jtrangeo.2021.102970

92. Johansson K, Laflamme L, Eliasson M. Adolescents' perceived safety and security in public space—A Swedish focus group study with a gender perspective. *Young.* (2012) 20:69–88. doi: 10.1177/110330881102000104

93. Carver A, Timperio A, Crawford D. Perceptions of neighborhood safety and physical activity among youth: the CLAN study. *J Phys Activity Health.* (2008) 5:430–44. doi: 10.1123/jpah.5.3.430

94. Jones L, Davis A, Eyers T. Young people, transport and risk: comparing access and independent mobility in urban, suburban and rural environments. *Health Edu J.* (2000) 59:315–28. doi: 10.1177/001789690005900405

95. Cote-Lussier C, Jackson J, Kestens Y, Henderson M, Barnett TA. A child's view: social and physical environmental features differentially predict parent and child perceived neighborhood safety. *J Urban Health-Bullet New York Acad Med.* (2015) 92:10–23. doi: 10.1007/s11524-014-9917-0

96. Côté-Lussier C, Knudby A, Barnett TA. A novel low-cost method for assessing intra-urban variation in night time light and applications to public health. *Soc Sci Med.* (2020) 248:2820. doi: 10.1016/j.socscimed.2020.112820

97. Durkin MS, Laraque D, Lubman I, Barlow B. Epidemiology and prevention of traffic injuries to urban children and adolescents. *Pediatrics.* (1999) 103:6. doi: 10.1542/peds.103.6.e74

98. DiMaggio C, Durkin M. Child pedestrian injury in an urban setting descriptive epidemiology. *Acad Emerg Med.* (2002) 9:54–62. doi: 10.1197/aemj.9.1.54

99. Nance ML, Hawkins LA, Branas CC, Vivarelli-O'Neill C, Winston FK. Optimal driving conditions are the most common injury conditions for child pedestrians. *Ped Emerg Care.* (2004) 20:569–73. doi: 10.1097/01.pec.0000139736.00850.da

100. Clifton KJ, Burnier CV, Akar G. Severity of injury resulting from pedestrian-vehicle crashes: what can we learn from examining the built environment? *Transport Res Part D-Transport Environ.* (2009) 14:425–36. doi: 10.1016/j.trd.2009.01.001

101. Culyba AJ, Jacoby SF, Richmond TS, Fein JA, Hohl BC, Branas CC, et al. Modifiable neighborhood features associated with adolescent homicide. *JAMA Pediatr.* (2016) 170:473–80. doi: 10.1001/jamapediatrics.2015.4697

102. Nakanishi H, Black J. Residential relocation, school relocation and children's transport: the effect of the Great East Japan Earthquake and Tsunami 2011. *Int J Dis Risk Red.* (2016) 18:232–243. doi: 10.1016/j.ijdrr.2016.07.006

103. Lopes F, Cordovil R, Neto C. independent mobility and social affordances of places for urban neighborhoods: a youth-friendly perspective. *Front Psychol.* (2018) 9:2198. doi: 10.3389/fpsyg.2018.02198

104. Wells NM, Jimenez FE, Mårtensson F. "Children and nature," in *Oxford Textbook of Nature and Public Health: The Role of Nature in Improving the Health of a Population*, eds. M van den Bosch, W Bird, M van den Bosch and W Bird *Oxford University Press.* (2018) 4. doi: 10.1093/med/9780198725916.003.0004

105. Clark H, Coll-Seck AM, Banerjee A, Peterson S, Dalglish SL, Ameratunga S, et al. A future for the world's children? A WHO–UNICEF–lancet commission. *The Lancet.* (2020) 395:605–58. doi: 10.1016/S0140-6736(19)32540-1

106. Badland HM, Oliver M. Child independent mobility: making the case, and understanding how the physical and social environments impact on the behaviour. in *Urbanization and the Global Environment*. NOVA Science Publishers. (2012) 51–79.

107. Carroll P, Witten K, Kearns R, Donovan P. Kids in the City: children's use and experiences of urban neighbourhoods in Auckland, New Zealand. *J Urban Design.* (2015) 20:417–36. doi: 10.1080/13574809.2015.1044504

108. Matthews H, Taylor M, Sherwood K, Tucker F, Limb M. Growing-up in the countryside: children and the rural idyll. *J Rural Stud.* (2000) 16:141–53. doi: 10.1016/S0743-0167(99)00059-5

109. Shucksmith M. Re-imagining the rural: from rural idyll to good countryside. *J Rural Stud.* (2018) 59:163–72. doi: 10.1016/j.jrurstud.2016.07.019

110. Gullone E. The development of normal fear: a century of research. *Clin Psychol Rev.* (2000) 20:429–51. doi: 10.1016/S0272-7358(99)00034-3

111. O'brien M, Jones D, Sloan D, Rustin M. Children's independent spatial mobility in the urban public realm. *Childhood.* (2000) 7:257–77. doi: 10.1177/0907568200007003002

112. Loukaitou-Sideris A. Is it safe to walk here? *Res Women's Issues Transport.* (2005) 3:102. Available online at: https://onlinepubs.trb.org/onlinepubs/conf/CP35v2.pdf

113. Koskela H. 'Bold walk and breakings': women's spatial confidence vs. fear of violence. Gender, place and culture. *J Fem Geography.* (1997) 4:301–20. doi: 10.1080/09663699725369

114. Van der Burgt D. *"Där man bor tycker man det är bra": Barns geografier i en segregerad stadsmiljö*. Uppsala: Kulturgeografiska institutionen. (2006).

115. Ferreira IA, Johansson M, Sternudd C, Fornara F. Transport walking in urban neighbourhoods—Impact of perceived neighbourhood qualities and emotional relationship. *Landscape Urban Plann.* (2016) 150:60–9. doi: 10.1016/j.landurbplan.2016.02.009

116. Liempt IV, Van Aalst I, Schwanen T. *"Introduction: Geographies of the Urban Night"*. London, England: Sage Publications Sage UK (2015).

117. Wales M, Mårtensson F, Hoff E, Jansson M. Elevating the role of the outdoor environment for adolescent wellbeing in everyday life. *Front Psychol.* (2022) 13:4592. doi: 10.3389/fpsyg.2022.774592

118. Transportanalys. *Perspektiv på resor och möjligheter att resa*. Report 2018: 17. Stockholm: Tranportanalys. Available online: https://www.trafa.se/globalassets/rapporter/2018/rapport-2018_17-perspektiv-pa-resor-och-mojligheter-att-resa.pdf

119. Joelsson T, Fridén Syrjäpalo L, Henriksson M, Balkmar D. *Vardagen i rörelse: en forsknings-och kunskapsöversikt om familjers vardagsmobilitet, social hållbarhet och mobilitetsrättvisa*. Linköping: Statens väg-och transportforskningsinstitut (2021).

120. Sloane M, Slater D, Entwistle J. *Tackling Social Inequalities in Public Lighting*. London: The London School of Economics and Political Science (2016). Available online at: https://core.ac.uk/download/pdf/42486432.pdf

121. Rahm J, Johansson M. *Walking After Dark–A Systematic Literature Review of Pedestrians' Response to Outdoor Lighting*. Lund: Dept. of Architecture and Built Environment (2016).

122. Collins DC, Kearns RA. The safe journeys of an enterprising school: negotiating landscapes of opportunity and risk. *Health Place.* (2001) 7:293–306. doi: 10.1016/S1353-8292(01)00021-1

123. Chalfin A, Hansen B, Lerner J, Parker L. Reducing crime through environmental design: Evidence from a randomized experiment of street lighting in New York City. *J Quant Criminol.* (2022) 38:127–57. doi: 10.1007/s10940-020-09490-6

124. Pain R, MacFarlane R, Turner K, Gill S. 'When, where, if, and but': qualifying GIS and the effect of streetlighting on crime and fear. *Environ Plann A.* (2006) 38:2055–74. doi: 10.1068/a38391

125. Gilling D, Barton A. Crime prevention and community safety: a new home for social policy? *Crit Soc Policy.* (1997) 17:63–83. doi: 10.1177/026101839701705204

126. Koskela H, Pain R. Revisiting fear and place: women's fear of attack and the built environment. *Geoforum.* (2000) 31:269–80. doi: 10.1016/S0016-7185(99)00033-0

127. Walklate S. *Victimology (Routledge Revivals): The Victim and the Criminal Justice Process*. Abingdon, UK: Routledge (2013). doi: 10.4324/9780203564363

128. Pease K. A review of street lighting evaluations: crime reduction effects. *Crime Prevent Stud.* (1999) 10:47–76.

129. Farrington DP, Welsh BC. Improved street lighting and crime prevention. *Justice Quart.* (2002) 19:313–42. doi: 10.1080/07418820200095261

130. Mattsson P, Johansson M, Almén M, Laike T, Marcheschi E, Ståhl A, et al. Improved usability of pedestrian environments after dark for people with vision impairment: an intervention study. *Sustainability.* (2020) 12:96. doi: 10.3390/su12031096

131. Rahm J, Sternudd C, Johansson M. "In the evening, I don't walk in the park": the interplay between street lighting and greenery in perceived safety. *URBAN Design Int.* (2020) 26:42–52. doi: 10.1057/s41289-020-00134-6

132. Badland H, Kearns R, Carroll P, Oliver M, Mavoa S, Donovan P, et al. Development of a systems model to visualise the complexity of children's independent mobility. *Children's Geographies.* (2016) 14:91–100. doi: 10.1080/14733285.2015.1021240

133. Derr V, Chawla L, Mintzer M. *Placemaking with Children and Youth: Participatory Practices for Planning Sustainable Communities*. New York, NY: Village Press (2018).

134. Qiu L, Zhu X. Impacts of housing and community environments on children's independent mobility: a systematic literature review. *New ARCH.* (2017) 18:43.

135. Sharmin S, Kamruzzaman M. Association between the built environment and children's independent mobility: a meta-analytic review. *J Transport Geography.* (2017) 61:104–17. doi: 10.1016/j.jtrangeo.2017.04.004

136. Marzi I, Demetriou Y, Reimers AK. Social and physical environmental correlates of independent mobility in children: a systematic review taking sex/gender differences into account. *Int J Health Geogr.* (2018) 17:1–17. doi: 10.1186/s12942-018-0145-9

137. Harcourt D, Einarsdottir J. Introducing children's perspectives and participation in research. European early childhood education. *Res J.* (2011) 19:301–7. doi: 10.1080/1350293X.2011.597962

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Living by the sea: place attachment, coastal risk perception, and eco-anxiety when coping with climate change

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Climate change poses major threats to coastal regions. In Portugal, the Aveiro district is one of the most vulnerable areas due to urbanized areas' exposure to the dangers of rising water. The prospect of flood threats can trigger a range of cognitions and emotions that affect adaptation and mitigation measures' success. This study sought to examine whether active and traditional place attachment is associated with residents' active and passive coping strategies to deal with the risk of rising water levels. An additional aim was to clarify whether these relationships are mediated by risk perception and eco-anxiety. The links between individuals' level of trust in authorities and coping mechanisms were also examined. An online questionnaire was completed by 197 Aveiro residents. The data show that active place attachment is connected to greater risk perception, eco-anxiety, and adoption of active coping strategies (e.g., problem solving). Low eco-anxiety was also found to have a positive effect on active coping strategies. Lower trust in the responsible authorities was additionally associated with active coping mechanisms. Overall, the results support the sequential mediation model for active coping but not for passive coping. The findings reinforce the need to consider cognitive factors (e.g., risk perception) and emotional factors (e.g., place attachment and practical eco-anxiety) to understand more fully how coastal residents deal with flood threats. Practical implications for policymakers are discussed.

KEYWORDS

place attachment, risk perception, eco-anxiety, coping strategies, trust in authorities, coastal areas, Aveiro

1. Introduction

In 2018, the United Nations published the Intergovernmental Report on Climate Change based on research into the impact of a 1.5° centigrade rise in the planet's temperature, warning of the urgent need to reduce carbon dioxide (CO_2) emissions. Climbing temperatures are driven by CO^2 levels in the atmosphere, and thawing glaciers contribute to rising water levels, which pose major threats to coastal regions and communities. Despite these risks, people feel attracted to coastal areas, so these zones are characterized by high productivity and population growth (Lloret et al., 2008). By 2030, 50% of the population is expected to reside within 100 kilometers (km) of the coast (Small and Nicholls, 2003), thereby increasing these regions' socioeconomic vulnerability. Aveiro has been flagged as one of the most at-risk coastal areas in Portugal (Kulp and Strauss, 2019). Rising water levels in this low-altitude region in northern Portugal could

have a severe impact on existing habitats and local communities' livelihoods (Luís et al., 2016).

Despite growing concerns worldwide about mounting exposure to environmental threats, the "slow scale" (Sullivan and Young, 2020) of disasters' occurrence helps explain the marked variability of how people perceive and deal with this problem. On the one hand, debates, protests, and mentions in the news have increased, suggesting individuals' greater involvement in and increased stress and anxiety about the issue. On the other hand, people living near the coast are aware of climate change's effect, yet they still appear to minimize their region's risk and to be less concerned and prepared (Costas et al., 2015; Domingues et al., 2021). Coastal residents thus often resist the responsible authorities' policies and mitigation plans (Goeldner-Gianella, 2007; Goeldner-Gianella et al., 2015).

To deal with future threats, individuals use various coping strategies (Folkman and Lazarus, 1991), namely, psychological adaptative mechanisms focused on reducing external or internal conflicts. These responses are the outcome of each person's assessment of their relationship with the environment, and the mechanisms can be both behavioral and cognitive (Lazarus and Folkman, 1991). People's coping strategies can be more active or passive and inhibit or encourage behavioral change (Folkman and Lazarus, 1988; Lazarus and Folkman, 1991; Homburg et al., 2007; Lemée et al., 2019). Individuals' diverse responses can play a decisive role in their communities' adaptation to climate change. If residents feel informed and empowered to help control threats, they can work with the relevant agencies. If locals feel unable to deal with the problem, they may, for example, respond with denial (i.e., treating the issue as a distant problem), avoid negative emotions, or stay away from the topic (Ojala and Bengtsson, 2019; Sullivan and Young, 2020).

It is thus crucial to better understand the psychological mechanisms underlying residents' choice and implementation of coping strategies. Threat assessments are influenced by cognitive responses, such as risk perception (Stancu et al., 2020) and trust in authorities (Siegrist et al., 2005), and affective reactions, such as fear, anxiety (Siegrist et al., 2005; Homburg et al., 2007; Terpstra, 2011), and place attachment (de Dominicis et al., 2015; Sullivan and Young, 2020).

Place attachment reflects the intensity and psychological nature of individuals' relationship with their place of residence, manifested as affective, cognitive, and behavioral processes (Devine-Wright, 2011; Sullivan and Young, 2020). Place attachment has traditionally been studied as a factor that influences how people perceive risks and which coping strategies they adopt (de Dominicis et al., 2015; Stancu et al., 2020; Casakin et al., 2021; Domingues et al., 2021). Researchers have detected both positive and negative impacts of place attachment (de Dominicis et al., 2015; Bonaiuto et al., 2016; Casakin et al., 2021), which underlines the need to understand more deeply these effects' role in efforts to manage climate change threats.

In addition, many scholars have conducted a one-dimensional analysis of place attachment, that is, comparing stronger and weaker attachment (Hidalgo and Hernández, 2001; Casakin et al., 2021), often not considering that people can establish strong attachment to places across distinct dimensions (Lewicka, 2011; Devine-Wright and Quinn, 2021). The inconsistent findings on this variable's role may, therefore, be due in part to a lack of acknowledgement of place attachment's complexity and multidimensionality (Lewicka, 2011; Sullivan and Young, 2020; Casakin et al., 2021; Devine-Wright and Quinn, 2021). The present study sought to fill this gap by investigating how two types of place attachment—active and traditional—are related to coastal residents' varied coping strategies.

This research looks at risk perception as a mediator that links place attachment and adaptive coping mechanisms. People with strong place attachment seem to perceive more risk (Bernardo, 2013), but studies in coastal areas have shown that individuals with stronger traditional place attachment show no desire to participate in risk reduction measures, a response associated with their distrust of the authorities and relativization of risks (Martins et al., 2009; Domingues et al., 2021).

Persistent concerns about future threats and uncertainties associated with climate change can also generate distress about future uncertainties, which has been defined as eco-anxiety (Kurth and Pihkala, 2022) or climate anxiety (Clayton, 2020). This anxiety is associated with the anguish caused by on-going concerns about climate threats and impending risks (Pihkala, 2020). Recent research has, however, highlighted that eco-anxiety leads to practical solutions that build more sustainable, resilient lifestyles (Grose, 2020; Pihkala, 2020; Kurth and Pihkala, 2022).

The present study focused on the sequential relationships between active and traditional place attachment, risk perception, eco-anxiety, and coping strategies. More specifically, this research sought to contribute to the existing literature by addressing the following questions:

- What roles do different types of place attachment play in the adoption of active and passive coping strategies?
- How are these connections affected by perceived risk and eco-anxiety?

This investigation further examined trust in authorities' effect on individuals' adoption of coping strategies.

2. Theoretical framework and hypothesis development

2.1. Aveiro and rising water levels

In Portugal, the Aveiro district is one of the main areas that could be affected by rising water levels (Kulp and Strauss, 2019). Between 1976 and 2003, the average sea level rose by 1.15 ± 0.68 millimeters per year, which strongly affected coastal erosion (Lopes et al., 2013). Aveiro is characterized by high population density in quite low coastal areas and intensely urbanized areas with agricultural fields near lagoon zones, such as the Aveiro estuary and the Vouga River. These patterns make this region and its population extremely vulnerable to climate change's effects.

The district's most prominent characteristic is the Vouga River's convergence with the Ria de Aveiro in the Baixo Vouga Lagunar area, with shallow saltwater zones influenced by both tides and fresh water (ADAPT-MED, 2015). The Ria de Aveiro is approximately 45 km long and 10 km wide, and it crosses the Aveiro city center and connects the Baixo Vouga Lagunar area with the Atlantic Ocean (Luís et al., 2016). This region is quite prone to river floods due to heavy rains, among other factors (Lopes et al., 2013). Higher water levels can also be caused by extreme maritime events (e.g., live tides and storm surges) combined with intensive rainfall, which can have

varied impacts such as floods, coastal erosion, contaminated drinking water, agricultural land salinization, and loss of habitats (Luís et al., 2016).

Varied initiatives have been created to minimize these events' impact, notably the north jetty's extension on Barra beach in Ílhavo and an Action Plan for Adaptation to Climate Change in 2021. The Aveiro Municipality has made the latter plan available to the public as it brings together varied adaptation measures that address climate change. These efforts include increasing residents' awareness of and knowledge about their exposure to extreme weather events and these incidents' effect on goods and people's safety. Measures will also be taken to adapt infrastructure to cope with events such as floods, including the restoration of streams, recovery of water retention structures, improvement of streamflow conditions, and promotion of water reuse systems. These and other adaptation and mitigation procedures' success is largely dependent on communities' support and adherence, which means the authorities need to better understand how individuals cope with potential local danger.

2.2. Coping strategies

People develop coping strategies to deal with threatening events that can include cognitive, emotional, and behavioral processes, such as psychological adaptative mechanisms that control, tolerate, or reduce conflicts between external and internal demands (Folkman and Lazarus, 1991). Individuals thus adopt the strategies they have available or consider the most appropriate ones. Coping mechanisms are selected based on assessments of threats' probability and their potential harm to valued property or people. If threats are perceived as real, individuals then evaluate their ability to cope with—or avoid being harmed by—these stressful situations (Lazarus and Folkman, 1991; Lemée et al., 2019; Ojala and Bengtsson, 2019) by using both constructive and defensive strategies (Sullivan and Young, 2020).

The same climate change threat can be perceived by one person as an obstacle and by another as a challenge to overcome (Mah et al., 2020), so a distinction must be made between the kinds of strategies adopted. The extant literature contains classifications of different types of coping mechanisms that distinguish between strategies focused on solving the problem or minimizing the resulting emotions (Lazarus and Folkman, 1991). A consensus has been reached on defining two major types of mechanisms: active coping and passive coping strategies (Nielsen and Knardahl, 2014; Lemée et al., 2019).

Active coping refers to ways to maintain surveillance of the situation by defining problems and actions to minimize or solve those issues (Lemée et al., 2019; Navarro et al., 2021). These mechanisms can include problem-focused and emotion-focused strategies, such as self-protection and problem solving that comprises seeking information about and planning or directing participation in climate-change adaptation measures (Homburg et al., 2007; Stancu et al., 2020).

Passive coping, in contrast, is characterized by strategies focused on non-involvement usually through passive or minimally adaptive responses (Nielsen and Knardahl, 2014) and on the reduction of negative feelings and emotions (Lemée et al., 2019) through changes in perceptions of threats. Some mechanisms are relativization (e.g., treating the risk as a future problem), denial of guilt (e.g., considering the problem as separate from personal actions), and positive thinking (e.g., trusting that someone else will solve the problem, trying to stay calm, and maintaining normal routines) (Homburg et al., 2007; Nielsen and Knardahl, 2014; Sullivan and Young, 2020).

People's affective relationship with their place of residence (i.e., place attachment) can affect how individuals and communities choose between different coping strategies. This effect is discussed in greater detail in the next subsection.

2.3. Place attachment and coping strategies

Place attachment can be defined as people's affective link to a specific place, neighborhood, community, or city, including a desire to remain close to that area because it conveys security and trust (Hidalgo and Hernández, 2001). Personal experiences and symbolic, emotional, and social connections cause individuals to acquire a sense of belonging and purpose associated with a place, linking it with their personal identity and well-being (Lemée et al., 2019; Sullivan and Young, 2020). Stronger place attachment has been associated with greater civic activity, mediated by local, social, and cultural factors (Lewicka, 2011).

Prior studies have highlighted the importance of place attachment to the way people deal with climate change's impacts, namely, coping with weather-related disasters (Ruiz and Hernández, 2014), adopting preventive behaviors (de Dominicis et al., 2015), or accepting adaptation projects (Devine-Wright, 2011). Sullivan and Young (2020) argues that "if people are more emotionally connected to their environment, they should be more informed and vigilant about potential threats" (p. 6) and thus seek to deal more actively and adaptively with climate change. Other scholars found that when people deal with climate change, a strong place attachment seems to be positively correlated with more optimistic outlooks of the future, even for those experiencing solastalgia (Phillips and Murphy, 2021). This in turn leads to higher acceptance of adaptation measures and resilience.

However, other researchers have reported evidence suggesting that stronger place attachment can also negatively influence intentions to deal directly with climate change threats. Research on floods in Faro and Aveiro revealed that residents with higher levels of "traditional" place attachment were willing to make preparations to face potential disasters but refused to relocate to safer places despite the imminent threat (Martins et al., 2009; Domingues et al., 2021).

Individuals create relationships with and symbolism of the place where they live, which can increase their resistance to accepting environmental management measures (Devine-Wright, 2011). Various authors have proposed a typology of the affective relationships that people establish with their place of residence, which in turn are associated with distinct reactions to threats (Sullivan and Young, 2020) and the coping strategies adopted. Previous studies have confirmed that long-term residents' place attachment is inherited through an intergenerational transmission of memories and that this kind of connection is paired with resistance to accepting disaster prevention measures (Domingues et al., 2021). Other research has revealed place attachment can arise from an active sense of community that leads to involvement in local measures focused on climate changes' consequences (Paton et al., 2001). However, the exact nature of this relationship is unclear possibly because of place attachment's complexity (Sullivan and Young, 2020).

Thus, a better understanding is needed of this attachment's different dimensions and its relationship with the perceptions and emotions that contribute to individuals' adoption of diverse coping strategies. Based on Hummon (1991) and Lewicka (2011), two place attachment dimensions were identified. The first is traditional attachment, defined as an inherited sense of place (Lewicka, 2011, 2013) associated with long-term residence in a family home. This type of bond is also linked with more religious and conservative values, a strong connection to the surrounding neighborhood, identification with the place through family tradition, and a greatest resistance to leaving that location (Lewicka, 2011).

The second dimension is place discovered attachment, connected with a long period of residence in a chosen place and with higher social and cultural capital and more active involvement with the community and institutions through civic participation or social capital contributions (Lewicka, 2011, 2013; Sullivan and Young, 2020). Given the latter dimension's characteristics, the present study designated this type of link as active attachment.

Lewicka (2011) further identified a third dimension related to a highly mobile lifestyle and weak affective relationship with the place of residence. The latter was not included in the current research because this dimension is associated with quite low involvement with the place and in the surrounding community (Lewicka, 2011; Sullivan and Young, 2020).

Various studies reported in the environmental literature have concentrated on place attachment and coping strategies' relationship, but few scholars have examined the association between different types of place attachment and diverse coping strategies. One exception is an investigation conducted in Italy and Romania that found evidence of a connection between diverse place attachment dimensions and coping strategy styles (Stancu et al., 2020). The attachment dimensions studied were based on the literature on interpersonal attachment (i.e., safe, anxious, and avoidant attachment). Stancu et al.'s (2020) results show that residents with a more active attachment style are more likely to use active coping mechanisms, and residents with avoidant attachment tend to have fewer social ties in the community and to adopt more passive coping strategies.

Based on the above findings, the present research included the following hypothesis:

> *H1*: Different types of place attachment (i.e., active vs. traditional) are associated with different types of coping strategies.
>
> *H1a*: Active place attachment is associated with more active coping strategies.
>
> *H1b*: Traditional place attachment is associated with more passive coping strategies.

2.4. Place attachment, risk perception, and coping strategies

Risk perception is defined as an intuitive, situational assessment of risks made by individuals faced with uncertainties and limited information when interpreting specific threats (Slovic, 1987). Perceived risk is not constant over time as it reflects the relationships between threat awareness, concern, and preparedness. When one of these components increases, the perceived risk grows, but resilience increases as a result (Raaijmakers et al., 2008).

The literature on risk perception in coastal communities exposed to flood risks provides evidence that factors such as risk exposure frequency, past experiences, and place attachment affect risk perceptions (Slovic, 1987; Lemée et al., 2019). For instance, locals may ignore events that are less likely to occur even if their impact could be catastrophic (de Dominicis et al., 2015). Residents of places that have never had natural disasters are more likely to report a lower chance of these events occurring in their area (Domingues et al., 2021). People also appear to minimize flood risks shortly after an inundation has occurred, so these individuals are often resistant to adopting preventive behaviors to deal with future floods (de Dominicis et al., 2015).

Place attachment can function as a driver of or barrier to various cognitive, emotional, and behavioral processes related to the specific locality (Knez, 2005; de Dominicis et al., 2015). Individuals with strong place attachment tend to be more aware of environmental risks that threaten their zone (Bonaiuto et al., 2016), but other authors have reported that a strong attachment may actually reduce awareness of existing problems or dangers (Domingues et al., 2021). For example, individuals with a strong bond can avoid risk assessment to avoid the distress of dealing with threats, which contributes to denial and reduced risk perception (de Dominicis et al., 2015). Another potential explanation for this pattern may be that people establish different place attachment styles (i.e., active and passive) that can trigger different levels of risk perception. The latter reason is in line with Lazarus and Folkman's (1991) transactional model of stress and coping, which states that, in stressful situations linked to perceived risks due to a known threat, individuals opt for specific coping strategies.

Risk perception has further been studied as a predictor of coping strategies. An investigation in China (Xu et al., 2018) found that people with higher risk perception report adopting more disaster reduction measures. This behavior has a direct effect on these threats' consequences (Xu et al., 2018). Risk perception can thus influence residents' willingness to participate in risk reduction strategies and improve their preparedness for potential disasters. Various scholars, however, have called for more multifaceted studies to explain the relationship between perceived risks of coastal flooding and locals' willingness to deal with these threats (Lemée et al., 2019).

Risk perception is defined by both individual and situational characteristics and is associated with person-place variables, so the present research explored risk perception's mediation of the relationship between place attachment and coping strategies. Higher levels of risk perception can have a positive effect on individuals' intention to deal more actively with threats, but this impact is weaker in the presence of a strong traditional place attachment (de Dominicis et al., 2015). Given these findings, the current research defined the following hypothesis:

> *H2*: Risk perception mediates the relationship between place attachment and coping strategies' adoption.

H2a: Stronger active place attachment is associated with higher risk perception, which in turn is associated with more active coping strategies.

H2b: Stronger traditional place attachment is associated with lower risk perception so that, the lower the perceived risk, the more often passive coping strategies are adopted.

2.5. Place attachment, eco-anxiety, and coping strategies

The environmental literature shows that the role of emotions associated with climate change is increasingly being investigated because of not only these feelings' relationship with well-being but also their effect on pro-environmental attitudes (Kurth and Pihkala, 2022). Individuals faced with prospective threats report emotions such as anxiety or anguish that affect the relationship between place attachment and intentions to deal with threats (Lemée et al., 2019). Potential dangers near people's residences combined with their perceived inability to reduce threats effectively can trigger anxiety due to the anticipated negative events. These worries about climate change are defined in the extant literature as eco-anxiety arising from persistent concerns about climate change and related future uncertainties (Kurth and Pihkala, 2022).

Greater anxiety about climate change is, however, not necessarily related to the adoption of more sustainable lifestyles (Lemée et al., 2019). Several recent studies of climate change's impact on mental health have suggested that eco-anxiety levels are progressively increasing (Hayes et al., 2018). High eco-anxiety is associated with reduced overall well-being (Ojala and Bengtsson, 2019), general suffering, fear, worry, guilt, hopelessness, and existential questions about future mortality rates due to climate change (Hickman, 2020; Panu, 2020; Pihkala, 2020). Emotions of grief and solastalgia may also be experienced when changes in the landscape occur due to climate change events (Moser, 2013; Phillips and Murphy, 2021). Scholars suggests that emotions can be influenced by past experiences, exposure to media or social norms, since individuals tend to engage with social referents and can also feel social pressure to act toward climate change (van der Linden, 2014; Ogunbode et al., 2022).

Not all negative emotions related to climate change have the same effects, and the literature on eco-anxiety is still unclear on how these feelings are connected to actions focused on reducing climate change. Negative emotions can trigger different responses fostering either disengagement from a perceived threat or active behaviors that lessen the threat (Stanley et al., 2021). On the one hand, higher eco-anxiety is associated with existential fears, feelings of insecurity, and defensive behaviors such as denial, which are often associated with depression. Kapeller and Jäger (2020) assert that, when exposed to quite dense information on climate change's effects, people experience more anxiety, but, when associated with greater skepticism and a weaker environmental identity, they engage in denial behaviors.

On the other hand, eco-anxiety can manifest itself in "practical anxiety." Individuals can be uncertain about how to respond to ecological threats and challenges and can ponder questions such as whether they should have more children due to future risks from climate change (Kurth and Pihkala, 2022). Practical eco-anxiety has been associated with a stronger motivation to engage in risk assessment and minimization (Kurth and Pihkala, 2022). Specific negative emotions linked to risk perception can foster attitudes that promote problem solving through active involvement with dangers. For example, people can seek more information about related subjects to understand and assess threats, which is connected with active coping strategies (Kurth and Pihkala, 2022). Various studies have shown that, if people discuss issues that they feel challenge their views and values (i.e., topics such as politics or civil society), those individuals who experience more anxiety become more involved and willing to learn about those controversial subjects (Valentino et al., 2008; MacKuen et al., 2010).

Still other research has underlined the importance of understanding eco-anxiety's significant contribution to explaining social behaviors that reveal a desire to deal with climate change. That is, people who care about ecology and have low levels of anxiety get more involved in green policies and report being motivated to act in accordance with their beliefs (Verplanken and Roy, 2013). Moreover, people expressing deep distress tend to criticize the lack of good responses to climate change at all governance levels, but only the more informed and politically engaged contribute with concrete adaptative suggestions (Moser, 2013).

Varied social and cultural factors can strengthen or reduce the feelings triggered by negative stimuli. For instance, children are particularly vulnerable to adults and peers' influence on their perceptions of and attitudes toward climate change (Ojala and Bengtsson, 2019). In coastal communities, place attachment also plays an important role in regulating person-environment relationships. Individuals actively engage in surveillance when faced with potential dangers to the place to which they are attached, becoming more aware of risks and exhibiting higher anxiety (Lemée et al., 2019; Clayton, 2020; Sullivan and Young, 2020). Climate change's effects have been felt at a "slow" pace in the Aveiro region as they are not always easily observable, so the present study focused on eco-anxiety's practical effect as a motivator or inhibitor of residents' adoption of coping strategies rather than its impact on their mental health.

This research thus included the following hypothesis:

H3: Place attachment is associated with increased eco-anxiety, which in turn is linked with the adoption of coping strategies, so eco-anxiety has a mediator effect on place attachment and coping strategies' relationship.

H3a: Stronger active place attachment is associated with greater eco-anxiety, which in turn is connected with more active coping strategies.

H3b: Stronger traditional place attachment is associated with lower eco-anxiety, which in turn is related to more passive coping strategies.

2.6. Place attachment, risk perception, eco-anxiety, and coping strategies

This investigation sought to understand how active and traditional place attachment is connected to active and passive coping strategies—through a sequential mediation by perceived risk and eco-anxiety. Previous research has looked at the link between place attachment, risk perception, and different types of coping strategies (Devine-Wright, 2011; Ruiz and Hernández, 2014; de Dominicis et al., 2015; Stancu et al., 2020; Sullivan and Young, 2020; Domingues et al., 2021), but few studies have examined the relationship between varied place attachment dimensions and coping strategy styles. Other investigations have also focused on the relationship between types of attachment and ways individuals cope with anxiety levels (Ruiz and Hernández, 2014; Stanley et al., 2021). However, to our best knowledge, only one research has explored the connection between people-place bonds, states of anxiety, risk perception, and coping strategies (Lemée et al., 2019). The cited study did not concentrate specifically on eco-anxiety, so a gap exists in the empirical research on how eco-anxiety helps or constrains the ways people deal with climate change risks (Kurth and Pihkala, 2022).

The extant literature reports that people with active place attachment are more involved with community initiatives and that these residents seek to be more informed and vigilant, which means they have a more realistic perception of their area's imminent dangers. This risk perception can thus trigger negative emotions such as persistent concerns about environmental issues and future uncertainties (i.e., eco-anxiety), thereby contributing to attitudes that encourage solving problems (Kurth and Pihkala, 2022). People with traditional place attachment tend to resist and complain more about measures that imply changes, preferring to outsource responsibility and relegate threats to more distant times and places. By perceiving less risk, these individuals also enjoy lower eco-anxiety, which is associated with inhibition of action, and they are more likely to adopt more passive coping strategies in order to diminish the negative emotions triggered by, for instance, problem relativization.

Based on the theoretical findings discussed, the present study's fifth hypothesis were formulated as follows:

> *H4*: The relationship between place attachment and coping strategies occurs through a sequential mediation by risk perception and eco-anxiety.
>
> *H4a*: Residents with stronger active place attachment report higher risk perception and eco-anxiety, and this relates to their use of active coping strategies.
>
> *H4b*: Residents with stronger traditional place attachment report lower risk perception and eco-anxiety and this relates to their adoption of passive coping strategies.

2.7. Trust in responsible authorities

Most residents do not have specialized knowledge about climate threats' uncertainties. The extant literature argues that, given any knowledge gaps regarding threats, individuals' risk perception is based on how much they trust the organizations responsible for risk management (Terpstra, 2011). In addition, people tend to form their opinions based on the information given by trusted authorities (Cologna and Siegrist, 2020). Trust in authorities is the level of confidence inspired by administration agencies responsible for managing climate change risks (Siegrist et al., 2005).

Individuals who have greater trust in the responsible authorities feel less at risk than people who are less trusting (Cologna and Siegrist, 2020). Relying on the authorities is a way to cope with the cognitive complexity of threat assessment and decision making about mitigation or adaptation behaviors (Cologna and Siegrist, 2020). These authorities play an important role in large-scale risk management by introducing risk reduction and community adaptation policies and providing useful information and financial resources for protection measures' implementation. Administration officials can thus potentially influence different behaviors' adoption when people seek to deal with risk (Cologna and Siegrist, 2020).

The current research controlled for the effect of trust in authorities on coping strategies' adoption. The final hypothesis was defined as follows:

> *H5*: Trust in authorities is correlated with coping strategies.
>
> *H5a*: Greater trust in authorities is linked with more passive coping strategies.
>
> *H5b*: Less trust in authorities is associated with more active coping strategies.

Figures 1, 2 present the two theoretical models proposed.

3. Materials and methods

3.1. Participants and procedures

The sample of this study consists of 197 participants recruited through informal processes (i.e., non-probabilistic convenience sampling). The inclusion criteria were that the respondents had to be at least 18 years old and live in the Aveiro district. Most participants were female (58%) with a higher education degree (71%). The mean (M) age was 39.35 years (SD = 9.96; min = 23; max = 68), and the average time residing in the Aveiro area was 32.11 years (SD = 14.03; min = 2; max = 66).

In addition, most respondents reported living close to one of the three areas that may be affected by rising water levels:

- Seacoast: 19% resided up to 5 km from the coast, 40% up to 10 km and 32.5% between 11 km and 20 km from the coast ($M = 11.32$; SD = 8.14; min = 0; max = 51).
- Ria de Aveiro: 49% resided up to 2 km from the Ria de Aveiro and 19% between 2 and 5 km away ($M = 5.62$; SD = 8.46; min = 0; max = 60).
- Vouga River/other: 21% lived less than 5 km from the Vouga River, and 50% indicated they resided between 5 and 10 km from the river ($M = 16.71$; SD = 16.17; min = 0; max = 80).

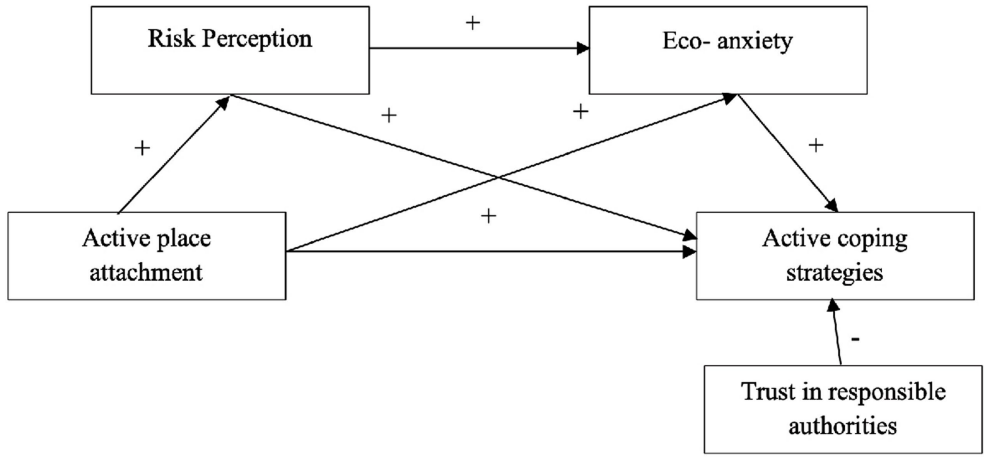

FIGURE 1
Sequential mediation model of active coping strategies.

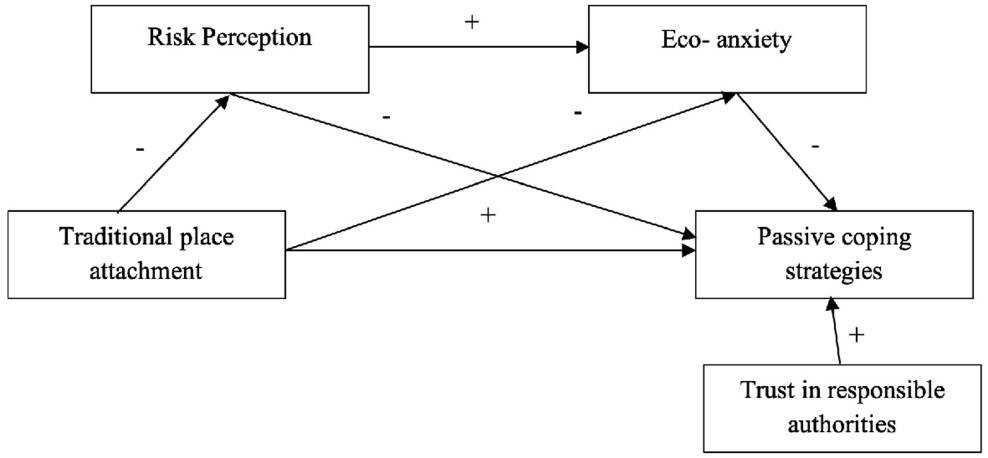

FIGURE 2
Sequential mediation model of passive coping strategies.

The data were collected with an online questionnaire created on the Qualtrics platform and distributed to Aveiro district residents via direct contact, email, or social media such as Facebook and Instagram. The participants were informed of the study's objective and assured that their data would remain anonymous and confidential. After giving their informed consent, the respondents completed the questionnaire. At the end, these individuals were given more information about the research project and a link to the Aveiro municipal's Plan for Adaptation to Climate Change. The study's procedures were approved by the university's Ethics Committee (Ref. 25/2022). Further details about the study's procedures can be consulted at Parreira (2022).

3.2. Instruments

All measurement instruments were selected from the relevant literature, translated into Portuguese, and adapted to reflect the Aveiro region's rising water levels. The scales' items were randomly presented to the respondents to diminish any effects that order or tiredness might have.

3.2.1. Types of place attachment (predictor)

Different types of place of residence attachment were assessed (i.e., the active and traditional dimensions) with a 16-item scale adapted from the City/Town/Village Attachment Scale (Lewicka, 2011). The responses were given on a Likert scale (1 = "Totally disagree"; 5 = "Totally agree"). Active place attachment was measured with six items (e.g., "I like to get involved in local affairs" or "I like to follow the changes that occur in my locality") This dimension's composite index has moderate reliability (Cronbach's alpha [α] = 0.69). Traditional place attachment was evaluated with five items (e.g., "I cannot imagine leaving this locality forever" and "I have strong family connections to this locality"). Only four items were included in this dimension's composite index, which has moderate reliability ($\alpha = 0.68$).

3.2.2. Risk perception (mediator)

The perceived risk of rising water levels in the surrounding area was assessed using the five-item risk perception scale developed by de Dominicis et al. (2015) and adapted for the present research to the context of rising water levels in Aveiro. The responses were given on a Likert scale (1 = "Not likely"; 5 = "Extremely likely"). The participants were asked to indicate their opinion about the probability of certain events occurring (e.g., "being affected by the rise in water levels" or "being harmed more easily than other people in the district"). The scale aimed to assess participants' risk perception by evaluating their judgment about the likelihood of flood occurrence and consequences for the self and the place/others. This scale has high reliability ($\alpha = 0.86$).

3.2.3. Eco-anxiety (mediator)

Respondents were given 12 items of the Hogg Eco-Anxiety Scale – HEAS-13 (Hogg et al., 2021). These individuals indicated how often during the last 2 weeks they had felt bothered by the listed problems while thinking about climate change (e.g., global warming, rising sea levels, species extinction, or ocean pollution). Their answers were given on a Likert scale (1 = "Not at all"; 4 = "Almost every day") with reference to the listed statements (e.g., "feeling anxious about your personal responsibility to help solve environmental problems" or "unable to stop thinking about future climate change and other environmental problems"). The scale's reliability is high ($\alpha = 0.86$).

3.2.4. Coping strategies (criterion)

The participants responded to 17 items adapted for the present study from Homburg et al.'s (2007) Coping Measurement Models for Eight Coping Scales. The answers were recorded on a Likert scale (1 = "Not true"; 4 = "Totally true"). The original study validated a two-dimensional metastructure of active (i.e., focused on problem solving) versus passive strategies (i.e., focused on "deproblematization"). As recommended by Homburg et al. (2007), the subdimensions of resignation, positive thinking, and guilt denial were left out of the current research.

For active coping, the respondents evaluated two strategies. These were problem solving (e.g., "I try to obtain precise information about the rising water levels in my region") and expression of emotions (e.g., "I feel angry when I see what is happening here due to the rise in water levels"). A composite index was created, which presents quite good internal consistency ($\alpha = 0.81$).

For passive coping, the items referred to three strategies. These were relativization (e.g., "I think that in the near future there will be a solution to this problem"), self-protection ("When there is the possibility of rising waters, I reduce my activities outside the home"), and well-being (e.g., "When problems occur with rising water levels, I stay calm and stick to my normal routine"). An acceptable reliability score was obtained when only relativization and well-being were considered ($\alpha = 0.59$).

3.2.5. Trust in authorities (predictor)

The residents' trust in the authorities responsible for managing environmental risks was assessed with six items based on Vaske et al.'s (2007) and Carlton and Jacobson's (2013) research. The responses were given on a Likert scale (1 = "I do not trust them"; 5 = "I fully trust them"). The participants indicated their trust in local authorities regarding various actions (e.g., "effectively managing risks connected with rising water levels" and "preventing future situations"). This scale's reliability is high ($\alpha = 0.96$).

4. Results

The statistical data analysis was conducted using IBM's SPSS Statistics 27 software. The first step was to generate descriptive statistics and correlations. The second was to test the sequential mediation models using PROCESS macro version 3.5 (Hayes et al., 2018).

4.1. Descriptive analysis and correlations between variables

Table 1 lists the means, standard deviations, and Spearman's correlation coefficients for the selected variables. On average, the respondents reported low levels of both coping mechanisms, with more frequent higher implementations of passive strategies ($M = 2.35$; SD = 0.58) than of active strategies ($M = 1.88$; SD = 0.56). The participants also reported strong active place attachment ($M = 4.05$; SD = 0.45) and moderate traditional attachment ($M = 3.44$; SD = 0.79). The perceived risk of increased water levels was rated as moderate ($M = 3.05$; SD = 0.79), and there was a low report of eco-anxiety ($M = 1.49$; SD = 0.46). The respondents also expressed an overall low level of trust in the authorities responsible for dealing with rising water levels' effects in the Aveiro district ($M = 2.58$; SD = 0.79).

The correlations between the models' variables reveal a non-significant relationship between active and passive coping. Active coping has a significant positive relationship with active place attachment (rho = 0.20; $p < 0.01$), risk perception (rho = 0.38; $p < 0.01$), and eco-anxiety (rho = 0.54; $p < 0.01$). Active place attachment is, in turn, positively associated with risk perception (rho = 0.19; $p < 0.01$), and risk perception is positively connected to eco-anxiety (rho = 0.33; $p < 0.01$).

No significant correlation was found between traditional place attachment and passive coping. Passive coping is negatively linked with risk perception (rho = −0.18; $p < 0.05$) and eco-anxiety (rho = −0.36; $p < 0.01$). The variables of gender (rho = −0.14; $p < 0.05$) and distance to Aveiro's estuary (i.e., the Ria) (rho = −0.25; $p < 0.01$) were controlled for because they are significantly associated with passive coping mechanisms.

In addition, trust in authorities has a negative correlation with active coping (rho = −0.19; $p < 0.01$), risk perception (rho = −0.20; $p < 0.01$), and eco-anxiety (rho = −0.15; $p < 0.05$). The results also show that people who adopt more passive coping strategies also report higher levels of confidence in authorities (rho = 0.17; $p < 0.05$).

4.2. Sequential mediation analysis for active coping

The sequential mediation predicted by the theoretical models (see Figures 1, 2 above) was tested using Model 6 of PROCESS version 3.5 (Hayes et al., 2018). H1a proposes that active place attachment is associated with more active coping strategies, but, as Table 2 shows, this attachment dimension's total effect is not statistically significant

TABLE 1 Correlation coefficients.

Variables	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Active coping	1.88	0.56	–												
2. Passive coping	2.35	0.58	−0.11	–											
3. Active place attachment	4.05	0.45	0.20**	0.02	–										
4. Traditional place attachment	3.44	0.79	−0.02	0.06	0.28**	–									
5. Risk perception	3.05	0.85	0.38**	−0.18*	0.19**	0.03	–								
6. Eco-anxiety	1.49	0.46	0.54**	−0.39**	0.09	0.01	0.33**	–							
7. Trust in authorities	2.58	0.97	−0.19**	0.17*	0.02	0.08	−0.20**	−0.15*	–						
8. Age	39.35	9.96	0.08	0.09	0.09	0.00	−0.11	−0.02	−0.02	–					
9. Residence tenure	32.11	14.02	0.10	0.05	0.08	0.29**	−0.07	0.03	−0.04	0.65**	–				
10. Gender	1.58	0.50	0.10	−0.14*	−0.02	0.02	0.20**	0.12	−0.02	−0.09	−0.07	–			
11. Education	3.68	0.53	0.05	0.00	0.09	−0.04	0.15*	−0.07	−0.17*	−0.18**	−0.26**	0.19**	–		
12. Distance to seacoast	11.32	8.14	0.00	−0.06	−0.07	−0.03	−0.29**	0.18*	−0.09	0.04	0.06	0.09	−0.04	–	
13. Distance to Ria de Aveiro	5.62	8.46	0.01	−0.25**	−0.09	−0.01	−0.20**	0.16*	−0.06	−0.14	−0.05	0.10	−0.16*	0.55**	–
14. Distance to Vouga River/other	16.71	16.17	0.02	−0.03	0.01	−0.03	0.15*	0.13	−0.14	−0.13	−0.09	0.18**	0.08	0.02	0.12

M, mean; SD, standard deviation; **Correlation significant at the 0.01 level (two-tailed); *Correlation significant at the 0.05 level (two-tailed); gender: 1 = male, 2 = female.

(beta coefficient [B] = 0.10; not statistically significant [n.s.]). Therefore, H1a was not supported.

H2a stated that risk perception mediates the relationship between active place attachment and active coping mechanisms. The results confirm that active attachment significantly predicts risk perception ($B = 0.18$; $p < 0.05$), which in turn is significantly connected with active coping ($B = 0.25$; $p < 0.001$). The indirect effect is also statistically significant, which is further evidence of a mediation effect ($B = 0.06$; lower limit confidence interval [LLCI] = 0.01; upper limit confidence interval [ULCI] = 0.11) and which thus confirms H2a.

H3a posited that eco-anxiety mediates the relationship between active place attachment and active coping strategies. Eco-anxiety has a significant association with active coping strategies ($B = 0.44$; $p < 0.001$), but active place attachment has no significant impact on eco-anxiety ($B = 0.01$; n.s.). The indirect effect is, therefore, statistically non-significant ($B = 0.00$; LLCI = −0.07; ULCI = 0.09), and H3a was unsupported by the data.

H4a proposed that a sequential mediation exists between active place attachment, risk perception, eco-anxiety, and active coping strategies. The results indicate a statistically significant indirect effect is present ($B = 0.03$; LLCI = 0.00; ULCI = 0.06). This finding means that active place attachment is associated with more risk perception ($B = 0.18$; $p < 0.05$), which in turn increases eco-anxiety ($B = 0.26$; $p < 0.001$) and then strengthens the use of active coping strategies ($B = 0.44$; $p < 0.001$). These results provide empirical support for H4a (see Table 3).

Finally, H5b stated that less trust in authorities is associated with more active coping strategies. The data analysis confirmed a direct connection exists between these variables ($B = -0.18$; $p < 0.05$), thereby confirming H5b. However, the link becomes non-significant when all the mediation model's variables are considered ($B = 0.05$; n.s.). The model explains 33% of the variance in active coping mechanisms (coefficient of determination [R^2] = 0.33; F[2.192] = 24.09; $p < 0.000$).

4.3. Sequential mediation analysis for passive coping

H1b posited that traditional place attachment is associated with more passive coping strategies. As Table 4 shows, the total effect is non-significant ($B = 0.06$, n.s.), thus H1b was not supported. In addition, H2b stated that risk perception mediates the relationship between traditional place attachment and passive coping strategies. The results indicate that no significant link exists between traditional attachment and risk perception ($B = 0.00$; n.s.), which in turn fails to predict more adoption of passive coping strategies ($B = -0.08$; n.s.). The indirect effect is also not statistically significant ($B = 0.00$; LLCI = −0.01; ULCI = 0.01), so H2b was not validated.

H3b suggested that eco-anxiety mediates the relationship between traditional attachment and passive coping strategies. The findings include that traditional attachment has no significant impact on eco-anxiety ($B = 0.04$; n.s.), but higher eco-anxiety is associated with a fewer passive coping strategies ($B = -0.28$; $p < 0.001$). This indirect effect is, however, statistically non-significant ($B = -0.01$; LLCI = −0.05; ULCI = 0.02), so the mediation effect and thus H3b were not supported by the data.

TABLE 2 Testing of sequential mediation model for active coping.

	Risk perception		Eco-anxiety		Active coping	
	B	SE	*B*	SE	*B*	SE
Total effect						
Constant	–	–	–	–	1.64***	0.37
Active place attachment	–	–	–	–	0.10	0.09
Trust in authorities	–	–	–	–	−0.18*	0.41
					$F(2,194) = 4.07$; $p < 0.01$; $R^2 = 0.04$	
Direct effect						
Constant	2.09***	0.55	1.20***	0.30	0.49	0.33
Active place attachment	0.18**	0.13	0.01	0.07	0.03	0.08
Risk perception	–	–	0.26***	0.04	0.25***	0.04
Eco-anxiety	–	–	–	–	0.44***	0.08
Trust in authorities	−0. 18	0.06	−0.13	0.03	−0.05	0.04
	$F(2,194) = 7.18$; $p < 0.001$; $R^2 = 0.07$		$F(3,193) = 6.94$; $p < 0.000$; $R^2 = 0.10$		$F(4,192) = 24.09$; $p < 0.000$; $R^2 = 0.33$	

B, beta coefficient; SE, standard error; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; R^2 = coefficient of determination.

TABLE 3 Indirect effects for sequential mediation model of active coping.

Indirect effect	Effect	BootLLCI	BootULCI
Total	0.09	−0.02	0.20
AA > RP > AC	0.06	0.01	0.11
AA > EA > AC	0.00	−0.07	0.09
AA > RP > EA > AC	0.03	0.00	0.06

BootLLCI, Bootstrap lower limit confidence interval; BootULCI, Bootstrap upper limit confidence interval; AA, active place attachment; RP, risk perception; AC, active coping; EA, eco-anxiety.

H4b proposed a sequential mediation in which traditional attachment is linked to less risk perception, which in turn is correlated with low eco-anxiety and with more passive coping strategies. The results reveal a statistically non-significant indirect effect ($B = 0.00$; LLCI = −0.01; ULCI = 0.01), which means the sequential mediation was not confirmed, and H4b was not corroborated by the results.

The findings nonetheless suggest that a mediation relationship exists between risk perception, eco-anxiety, and passive coping strategies. In this case, risk perception is associated with increased eco-anxiety ($B = 0.27$; $p < 0.001$), which then has a negative impact on residents' adoption of passive coping strategies ($B = -0.28$; $p < 0.001$).

Finally, H5a posited that more trust in authorities is linked with more passive coping strategies. The results show that the effect is statistically non-significant ($B = 0.05$; n.s.), so H5a received insufficient support (see Table 5). The models explain 17% of the variance of passive coping ($F[6,190] = 6.50$; $p < 0.000$; $R^2 = 0.17$). Figures 3, 4 present the models' main findings.

5. Discussion

Coastal areas are subject to the negative impacts of rising water levels that put communities and natural habitats at risk. Despite these threats, and because the dangers of higher sea levels often manifest themselves gradually, more communities are still located along the coast (Lloret et al., 2008). As residents vary in how they deal with and feel about water level threats, there is the need to better understand the cognitive and emotional factors that influence individuals' choice of diverse coping responses.

The present study focused on communities dealing with rising water levels in the Aveiro district. The main goal was to analyze whether different types of place attachment are associated with contrasting coping strategies and whether these relationships are mediated by risk perception and eco-anxiety. The authorities have formulated strategies and plans for adaptation to or mitigation of climate change's impacts on coastal regions, so the research model also considered the connection between residents' trust in authorities and the coping strategies adopted.

The test of the proposed research models reveals that place attachment is not directly associated with either active or passive coping mechanisms. Place attachment's role in residents' choice of coping strategies appears to depend more on whether individuals perceive risk and feel some eco-anxiety, particularly in the case of active attachment. More active coping strategies thus imply that residents are aware of threats and their severity (Lazarus and Folkman, 1991; Navarro et al., 2021), and that they consider climate change to be a pressing issue. Active place attachment is associated with a greater awareness of local environmental threats, but, in the current research context, this recognition of risks may not be enough to motivate locals directly to adopt coping strategies.

Although Aveiro is considered an at-risk region, the current study was conducted outside any period involving imminent dangers or disasters, which may have contributed to weaker links between the model's variables. Regardless, the results confirm that risk perception mediates the relationship between active place attachment and active coping strategies. As expected (Bonaiuto et al., 2016; Xu et al., 2018), active place attachment predicts greater risk perception, which in turn predicts more active coping mechanisms. The conclusion can be drawn that people who are more involved in the area where they live are more attentive to potential dangers and threats, and this awareness then leads to more active coping strategies.

TABLE 4 Testing of sequential mediation model of passive coping.

Total effect	Risk perception		Eco-anxiety		Passive coping	
	B	SE	*B*	SE	*B*	SE
Constant	–	–	–	–	2.32***	0.24
Traditional place attachment	–	–	–	–	0.06	0.05
Trust in authorities	–	–	–	–	0.13	0.04
Gender					−0.13	0.08
Distance to Ria de Aveiro					−0.17*	0.00
					$F(4,192) = 4.00$; $p < 0.01$; $R^2 = 0.08$	
Direct effect						
Constant	3.02***	0.35	1.01***	0.22	3.00***	0.29
Traditional place attachment	0.00	0.07	0.04	0.04	0.07	0.05
Risk perception	–	–	0.27***	0.04	−0.08	0.05
Eco-anxiety	–	–	–	–	−0.28***	0.09
Trust in authorities	−0.20**	0.06	−0.12	0.03	−0.06	0.04
Gender	0.21**	0.12	0.04	0.06	−0.09	0.08
Distance to Ria de Aveiro	−0.16*	0.01	0.12	0.00	−0.16	0.00
	$F(4,192) = 5.32$; $p < 0.000$; $R^2 = 0.10$		$F(5,191) = 5.04$; $p < 0.000$; $R^2 = 0.12$		$F(6,190) = 6.50$; $p < 0.000$; $R^2 = 0.17$	

B, beta coefficient; SE, standard error; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; R^2 = coefficient of determination.

TABLE 5 Indirect effects of sequential mediation model for active coping.

Indirect effect	Effect	BootLLCI	BootULCI
Total	−0.01	−0.05	0.03
TA > RP > PC	0.00	−0.01	0.01
TA > EA > PC	−0.01	−0.05	0.02
TA > RP > EA > PC	0.00	−0.01	0.01

BootLLCI, Bootstrap lower limit confidence interval; BootULCI, Bootstrap upper limit confidence interval; TA, traditional place attachment; RP, risk perception; PC, passive coping; EA, eco-anxiety.

In contrast, no evidence was found of risk perception's mediation of the relationship between traditional attachment and passive coping mechanisms. Traditional place attachment seems not to determine the level of risk that people in Aveiro perceive regarding rising water levels, and the perceived risk is not related to adopting passive coping strategies. These findings differ from those reported by Stancu et al. (2020), yet these authors have focused on avoidant place attachment, which may be a less rooted attachment than the traditional type here examined. One possible explanation for the absence of the proposed relationship is that risk awareness seems to be related to higher involvement in local initiatives (Bonaiuto et al., 2016) and residents with higher traditional place attachment tend to be less socially active (Lewicka, 2013). Moreover, as perceived risk may hinder the type of attachment these residents have with their place (i.e., rootedness, not leaving) it is possible that they are less prone to consider such information as relevant in their daily life and, in turn, it would not trigger a specific coping behavior. Clarifying these results could also relate to how active and traditional attachment are linked. In this research, the two attachments are positively correlated, possibly because both types rate high on localism (Lewicka, 2013). Still, Lewicka (2013) showed that there can be cultural differences in how attachment types score on localism and activity, thus more cross-cultural research is needed on this subject.

The present investigation proposed that eco-anxiety mediates the link between place attachment and more coping strategies, but this empirical research did not validate the related hypotheses. A relationship was detected between eco-anxiety and more active coping strategies. However, place attachment has no direct impact on eco-anxiety for both active and passive coping mechanisms. This finding may indicate that eco-anxiety is triggered by residents' surveillance of dangers to their area, so eco-anxiety is associated with the intensity of locals' concerns (Lemée et al., 2019; Pihkala, 2020; Sullivan and Young, 2020) and this anxiety's effect may be strongly dependent on risk perception.

In addition, the current results confirm a sequential mediation effect. People with stronger active attachment to their place of residence tend to perceive greater risk, which is related to greater eco-anxiety, and locals thus become more motivated to use active coping strategies to deal with perceived threats. Previous studies have similarly highlighted that individuals who actively engage in their neighborhood and community seek to be more informed about relevant risks and feel higher anxiety, which motivates them to adopt more active measures when dealing with these threats (Devine-Wright, 2011; Lemée et al., 2019; Sullivan and Young, 2020).

The present findings also reveal that risk perception can be enough to push people to implement active coping strategies, but eco-anxiety appears to be more closely associated with coping mechanisms than risk perception is. The sample's data showed low eco-anxiety levels, a finding that could indicate that practical eco-anxiety is present (Kurth and Pihkala, 2022). Eco-anxiety may thus play a positive role that so far has been underresearched. Most studies of eco-anxiety have focused on its negative effects on mental health, yet the current results show that low eco-anxiety can motivate residents to use active coping strategies to deal with risks, such as trying to be more informed,

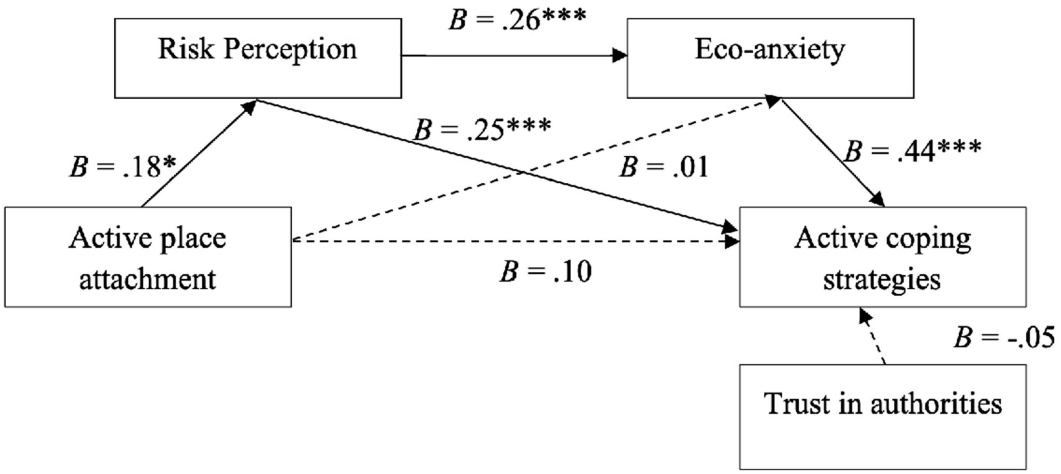

FIGURE 3
Sequential mediation model of active coping strategies through risk perception and eco-anxiety, controlling for trust in authorities (number=197 participants).

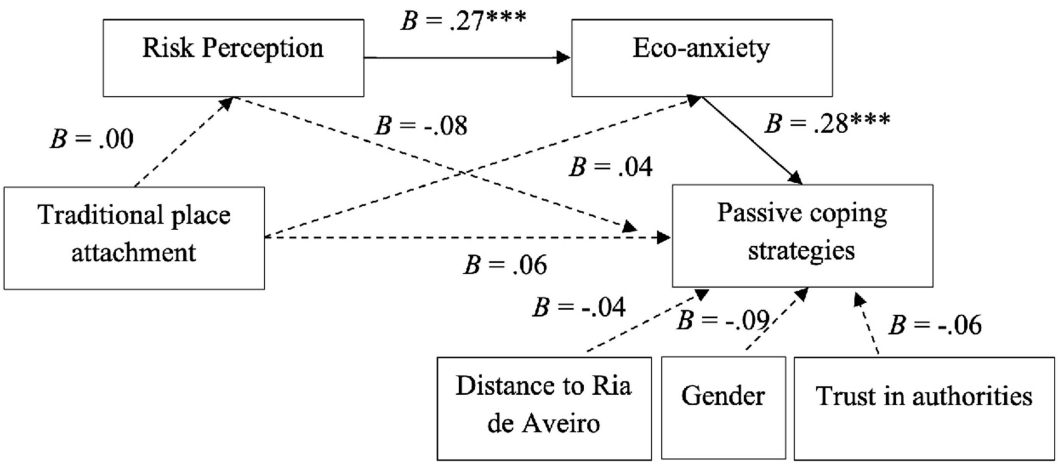

FIGURE 4
Sequential mediation model of active coping strategies through risk perception and eco-anxiety, controlling for trust in authorities, gender, and distance to Ria de Aveiro (number=197 participants).

participating in debates, or accepting and joining risk mitigation initiatives. Eco-anxiety can evidently be a moral emotion that suggests how much individuals care about important problems and uncertainties, which strengthens problem-solving attitudes (Kurth and Pihkala, 2022).

The current research further found that low eco-anxiety is positively related to both more active coping strategies and fewer passive coping mechanisms. These results indicate that eco-anxiety promotes more active ways of dealing with environmental problems and greater cognitive involvement in information collection, reorientation, and deliberation to make informed decisions. Eco-anxiety also increases responsiveness to uncertainties (Kurth and Pihkala, 2022) and prevents ruminating, deresponsibilization, and other passive strategies.

Contrary to expectations, the present study confirmed that the proposed sequential mediation is statistically non-significant for passive coping mechanisms. However, a mediating effect appears to exist for low risk perception, which leads to lower eco-anxiety and thus increases residents' adoption of passive coping strategies. More research is needed to confirm this relationship.

Regarding trust in authorities, the results show that the less confident locals feel about the competence of the authorities responsible for solving problems, the more they tend to implement active coping strategies. This pattern may arise because residents who rely less on the authorities' ability to manage and report the risks can perceive more risks, becoming more vigilant and actively engaging in resolving issues (Devine-Wright, 2011; Devine-Wright and Quinn, 2021). However, in the current final model, trust in authorities has no influence on other variables possibly due to risk perception and/or eco-anxiety's mediation effect—a hypothesis that could be addressed in future studies.

5.1. Theoretical and practical implications

This empirical research sought to contribute to the existing knowledge by analyzing data on two place attachment dimensions' impacts on different coping strategies. Much of the relevant literature focuses on place attachment as a one-dimensional construct, producing divergent results for its role in locals' choice of ways to deal with environmental problems (Martins et al., 2009; Sullivan and Young, 2020; Devine-Wright and Quinn, 2021; Domingues et al., 2021). The present results indicate how residents' different types of place attachment influence the way they cope with and feel about climate change threats, which emphasizes the importance of considering different attachment dimensions separately.

In other words, researchers must take into account that, for example, individuals who have lived in the same locality for a long time establish different types of place attachment. Scholars should also consider that active attachment can improve emotional regulation and trigger cognitive engagement processes that determine more surveillance of risks, which are significant when dealing with "slow-scale" threats such as rising water levels (Navarro et al., 2021). Different attachment dimensions should be considered as these influence how people deal with climate change, as well as having possible implications for cities' future strategies and plans, especially regarding community-wide measures for adapting to climate change. Moser (2013) suggests that adaptation measures must be tailored to the social context and focus on engaging residents in their formulation and implementation. Actively involving people in search for adaptative responses can lead to greater engagement and may increase the resilience of coastal residents to climate change (Moser, 2013).

The current findings also add new knowledge about the driving role that eco-anxiety and low trust in authorities can play in individuals' adoption of active coping mechanisms. The results indicate that the authorities responsible for implementing adaptation plans or communication and information strategies need to acknowledge that residents who demonstrate mistrust and eco-anxiety may more actively search for solutions. These residents are probably seeking to debate—and gain access to more credible information about—their area's dangers and uncertainties (Terpstra, 2011; Kurth and Pihkala, 2022), and their involvement in discussions could result in an improvement and also greater acceptance of government measures.

Understanding the relevance of affective variables to how people deal with climate change can contribute to a fuller understanding of community behavior and to an improved design and implementation of local policies and coastal strategies. The latter may promote a better quality of life, particularly in regions where climate change's impacts are more subtle.

5.2. Limitations and future implications

The present study had some limitations. First, the participants were recruited mostly via community groups' social media networks, which tend to be used by people who actively engage in solving community problems. This sampling technique allowed more people to participate, but it may have produced a non-representative sample. For instance, the results showed that the inquired Aveiro community members have more active versus traditional place attachment. This tendency could be due to the participants' recruitment through social networks, which may have favored people who like to get involved in community initiatives. Older longer-term residents with less education appear to establish a more traditional attachment to their area (*cf.* Lewicka, 2011), and they also tend to be less predisposed to filling out online or digital questionnaires. The data analysis further revealed that locals living closer to the Aveiro estuary and seacoast perceive more dangers that could affect them directly. This finding is not in line with the existing literature, which shows that coastal communities exposed daily to dangers feel less worried about risks in the long run (Martins et al., 2009; Luís et al., 2016; Domingues et al., 2021; Navarro et al., 2021). The present results could be explained by how residents' proximity to the Ria de Aveiro seems to be associated with higher education levels. People with more education may try to be more informed about threats to their area, which contributes to stronger risk perception (Navarro et al., 2021). The sample size could also have been even larger to ensure the data analyses were more reliable and empirically robust.

Second, the place attachment and passive coping scales were found to have low reliability, so future research may want to use other more robust measures of these variables. The literature on eco-anxiety is quite recent and strongly focused on negative effects, which means that additional studies are needed to develop eco-anxiety scales that assess eco-anxiety's less negative effects (Kurth and Pihkala, 2022). Further investigations could also examine eco-anxiety's positive role in risk preparedness or climate change awareness campaigns to understand better how communication can trigger practical eco-anxiety in particular.

Notably, the measures applied were all self-reported, thereby restricting the data to how people perceive the ways they deal with threats and rather than their concrete actions. Given the specificities of coastal communities, the current results should be carefully analyzed before being generalized to other regions.

Future research may also need to examine the relationship of the proposed model's variables specifically with passive coping mechanisms since no statistically significant results were obtained. The role of trust in authorities as a predictor or moderator variable can also be explored with regard to specific relationships. Studies of communication through digital channels can additionally analyze the effect that trust in the responsible authorities can have on individuals' emotions or received information about climate change.

The models' explained variance was low, so more research should be done to investigate other variables that may affect the relationships between place attachment styles and types of coping strategies, for example, place identity or coping mechanisms' perceived efficacy (Lemée et al., 2019). Further research in the Aveiro district may also examine the relationship between place attachment and solastalgia (Phillips and Murphy, 2021), exploring its role in the acceptance of coastal adaptation policies. Longitudinal studies may also clarify changes in place attachment style (i.e., from active to traditional and vice versa), as well as how these shifts affect the coping strategies used by inhabitants of regions recovering from climate-related disasters.

6. Conclusion

Rapid behavioral change is urgently needed as the planet's future and the human species' destiny will be determined by people's ability

to adapt to climate change. Policymakers thus need to focus on understanding the factors and motivations that influence how individuals understand related threats and deal with risks, as communities' cooperation is vital to formulating effective responses. This research highlighted the importance of analyzing multidimensional cognitive and emotional variables that can be associated with more active ways of dealing with climate change's dangers. The results suggest that place attachment and eco-anxiety should be taken into account when developing communication strategies and change management plans seeking to ensure local communities' active participation in finding solutions for adaptation to and mitigation of climate change's effects.

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 Iscte Instituto Universitário de Lisboa Ethics Committee. The patients/participants provided their written informed consent to participate in this study.

Author contributions

NP and CM formulated the study's plan and designed the data collection process. NP conducted the analyses and wrote the first version of the article. CM supervised the study's development and revised the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

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References

ADAPT-MED (2015). Baixo Vouga Lagunar knowledge database. 92p., ADAPT-MED Report D2.1b. Available at: http://media.wix.com/ugd/18e7df_57e5bed821bb4e5990d28251b683dda8.pdf

Bernardo, F. (2013). Impact of place attachment on risk perception: exploring the multidimensionality of risk and its magnitude. *Estud. Psicol.* 34, 323–329. doi: 10.1174/021093913808349253

Bonaiuto, M., Alves, S., de Dominicis, S., and Petruccelli, I. (2016). Place attachment and natural hazard risk: research review and agenda. *J. Environ. Psychol.* 48, 33–53. doi: 10.1016/j.jenvp.2016.07.007

Carlton, S. J., and Jacobson, S. K. (2013). Climate change and coastal environmental risk perceptions in Florida. *J. Environ. Manag.* 130, 32–39. doi: 10.1016/j.jenvman.2013.08.038

Casakin, H., Ruiz, C., and Hernández, B. (2021). Place attachment and the neighborhood: a case study of Israel. *Soc. Indic. Res.* 155, 315–333. doi: 10.1007/s11205-020-02603-5

Clayton, S. (2020). Climate anxiety: psychological responses to climate change. *J. Anxiety Disord.* 74:102263. doi: 10.1016/j.janxdis.2020.102263

Cologna, V., and Siegrist, M. (2020). The role of trust for climate change mitigation and adaptation behaviour: a meta-analysis. *J. Environ. Psychol.* 69:101428. doi: 10.1016/j.jenvp.2020.101428

Costas, S., Ferreira, O., and Martinez, G. (2015). Why do we decide to live with risk at the coast? *Ocean Coastal Manag.* 118, 1–11. doi: 10.1016/j.ocecoaman.2015.05.015

de Dominicis, S., Fornara, F., Ganucci Cancellieri, U., Twigger-Ross, C., and Bonaiuto, M. (2015). We are at risk, and so what? Place attachment, environmental risk perceptions and preventive coping behaviours. *J. Environ. Psychol.* 43, 66–78. doi: 10.1016/j.jenvp.2015.05.010

Devine-Wright, P. (2011). Place attachment and public acceptance of renewable energy: a tidal energy case study. *J. Environ. Psychol.* 31, 336–343. doi: 10.1016/j.jenvp.2011.07.001

Devine-Wright, P., and Quinn, T. (2021). "Dynamics of place attachment in a climate changed world" in *Place attachment: advances in theory, methods and applications*. eds. L. C. Manzo and P. Devine-Wright (Abingdon: Routledge), 226–242.

Domingues, R. B., Jesus, S. N., and Ferreira, Ó. (2021). Place attachment, risk perception, and preparedness in a population exposed to coastal hazards: a case study in Faro Beach, southern Portugal. *Int. J. Disaster Risk Reduct.* 60:102288. doi: 10.1016/j.ijdrr.2021.102288

Folkman, S., and Lazarus, R. S. (1988). Coping as a mediator of emotion. *J. Pers. Soc. Psychol.* 54, 466–475. doi: 10.1037/0022-3514.54.3.466

Folkman, S., and Lazarus, R. S. (1991). "10. Coping and emotion" in *Stress and coping: An anthology* (New York: Columbia University Press), 207–227.

Goeldner-Gianella, L. (2007). Perceptions and attitudes toward De-polderisation in Europe: a comparison of five opinion surveys in France and the UK. *J. Coast. Res.* 23, 1218–1230. doi: 10.2112/04-0416R.1

Goeldner-Gianella, L., Bertrand, F., Oiry, A., and Grancher, D. (2015). Depolderisation policy against coastal flooding and social acceptability on the French Atlantic coast: the case of the Arcachon Bay. *Ocean Coastal Manag.* 116, 98–107. doi: 10.1016/j.ocecoaman.2015.07.001

Grose, A. (2020). *A guide to eco-anxiety: how to protect the planet and your mental health. 2020th Edn*. London: Watkins media limited.

Hayes, K., Blashki, G., Wiseman, J., Burke, S., and Reifels, L. (2018). Climate change and mental health: risks, impacts and priority actions. *Int. J. Ment. Heal. Syst.* 12:28. doi: 10.1186/s13033-018-0210-6

Hickman, C. (2020). We need to (find a way to) talk about … eco-anxiety. *J. Soc. Work. Pract.* 34, 411–424. doi: 10.1080/02650533.2020.1844166

Hidalgo, M. C., and Hernández, B. (2001). Place attachment: conceptual and empirical questions. *J. Environ. Psychol.* 21, 273–281. doi: 10.1006/jevp.2001.0221

Hogg, T. L., Stanley, S. K., O'Brien, L. V., Wilson, M. S., and Watsford, C. R. (2021). The Hogg eco-anxiety scale: development and validation of a multidimensional scale. *Glob. Environ. Chang.* 71:102391. doi: 10.1016/j.gloenvcha.2021.102391

Homburg, A., Stolberg, A., and Wagner, U. (2007). Coping with global environmental problems. *Environ. Behav.* 39, 754–778. doi: 10.1177/0013916506297215

Kapeller, M. L., and Jäger, G. (2020). Threat and anxiety in the climate debate—an agent-based model to investigate climate Scepticism and pro-environmental behaviour. *Sustainability* 12:1823. doi: 10.3390/su12051823

Knez, I. (2005). Attachment and identity as related to a place and its perceived climate. *J. Environ. Psychol.* 25, 207–218. doi: 10.1016/j.jenvp.2005.03.003

Kulp, S. A., and Strauss, B. H. (2019). New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding. *Nat. Commun.* 10:4844. doi: 10.1038/s41467-019-12808-z

Kurth, C., and Pihkala, P. (2022). Eco-anxiety: what it is and why it matters. *Front. Psychol.* 13:1814. doi: 10.3389/fpsyg.2022.981814

Lazarus, R. S., and Folkman, S. (1991). "9. The concept of coping" in *Stress and coping: An anthology* (New York: Columbia University Press), 189–206.

Lemée, C., Fleury-Bahi, G., and Navarro, O. (2019). Impact of place identity, self-efficacy and anxiety state on the relationship between coastal flooding risk perception and the willingness to cope. *Front. Psychol.* 10:499. doi: 10.3389/fpsyg.2019.00499

Lewicka, M. (2011). On the varieties of People's relationships with places. *Environ. Behav.* 43, 676–709. doi: 10.1177/0013916510364917

Lewicka, M. (2013). Localism and activity as two dimensions of people–place bonding: the role of cultural capital. *J. Environ. Psychol.* 36, 43–53. doi: 10.1016/j.jenvp.2013.07.002

Lloret, J., Marín, A., and Marín-Guirao, L. (2008). Is coastal lagoon eutrophication likely to be aggravated by global climate change? *Estuar. Coast. Shelf Sci.* 78, 403–412. doi: 10.1016/j.ecss.2008.01.003

Lopes, C. L., Azevedo, A., and Dias, J. M. (2013). Flooding assessment under sea level rise scenarios: Ria de Aveiro case study. *J. Coast. Res.* 65, 766–771. doi: 10.2112/SI65-130.1

Luís, S., Pinho, L., Lima, M. L., Roseta-Palma, C., Martins, F. C., and Almeida, A. (2016). Is it all about awareness? The normalization of coastal risk. *J. Risk Res.* 19, 810–826. doi: 10.1080/13669877.2015.1042507

MacKuen, M., Wolak, J., Keele, L., and Marcus, G. E. (2010). Civic engagements: resolute partisanship or reflective deliberation. *Am. J. Polit. Sci.* 54, 440–458. doi: 10.1111/j.1540-5907.2010.00440.x

Mah, A. Y. J., Chapman, D. A., Markowitz, E. M., and Lickel, B. (2020). Coping with climate change: three insights for research, intervention, and communication to promote adaptive coping to climate change. *J. Anxiety Disord.* 75:102282. doi: 10.1016/j.janxdis.2020.102282

Martins, F., Almeida, A. B., and Pinho, L. (2009). Have you ever listened coastal inhabitants? Know what they think. *J. Coast. Res.* 56, 1242–1246.

Moser, S. C. (2013). "Navigating the political and emotional terrain of adaptation: communication challenges when climate change comes home" in *Successful adaptation to climate change: Linking science and practice in a rapidly changing world*. eds. S. C. Moser and M. T. Boykoff (Abingdon: Routledge), 289–305.

Navarro, O., Krien, N., Rommel, D., Deledalle, A., Lemée, C., Coquet, M., et al. (2021). Coping strategies regarding coastal flooding risk in a context of climate change in a French Caribbean Island. *Environ. Behav.* 53, 636–660. doi: 10.1177/0013916520916253

Nielsen, M. B., and Knardahl, S. (2014). Coping strategies: a prospective study of patterns, stability, and relationships with psychological distress. *Scand. J. Psychol.* 55, 142–150. doi: 10.1111/sjop.12103

Ogunbode, C. A., Doran, R., Hanss, D., Ojala, M., Salmela-Aro, K., van den Broek, K. L., et al. (2022). Climate anxiety, wellbeing and pro-environmental action: correlates of negative emotional responses to climate change in 32 countries. *J. Environ. Psychol.* 84:101887. doi: 10.1016/j.jenvp.2022.101887

Ojala, M., and Bengtsson, H. (2019). Young People's coping strategies concerning climate change: relations to perceived communication with parents and friends and Proenvironmental behavior. *Environ. Behav.* 51, 907–935. doi: 10.1177/0013916518763894

Panu, P. (2020). Anxiety and the ecological crisis: an analysis of eco-anxiety and climate anxiety. *Sustainability* 12:7836. doi: 10.3390/su12197836

Parreira, N. (2022). Apego ao lugar, risco, emoções e estratégias de coping no contexto das alterações climáticas. [Master's dissertation, Iscte-Instituto Universitário de Lisboa]. Repositorio do Iscte-IUL. Available at: https://repositorio.iscte-iul.pt/handle/10071/26818

Paton, D., Millar, M., and Johnston, D. (2001). Community resilience to volcanic Hazard consequences. *Nat. Hazards* 24, 157–169. doi: 10.1023/A:1011882106373

Phillips, C., and Murphy, C. (2021). Solastalgia, place attachment and disruption: insights from a coastal community on the front line. *Reg. Environ. Chang.* 21:1778. doi: 10.1007/s10113-021-01778-y

Pihkala, P. (2020). Eco-anxiety and environmental education. *Sustainability* 12:10149. doi: 10.3390/su122310149

Raaijmakers, R., Krywkow, J., and van der Veen, A. (2008). Flood risk perceptions and spatial multi-criteria analysis: an exploratory research for hazard mitigation. *Nat. Hazards* 46, 307–322. doi: 10.1007/s11069-007-9189-z

Ruiz, C., and Hernández, B. (2014). Emotions and coping strategies during an episode of volcanic activity and their relations to place attachment. *J. Environ. Psychol.* 38, 279–287. doi: 10.1016/j.jenvp.2014.03.008

Siegrist, M., Gutscher, H., and Earle, T. C. (2005). Perception of risk: the influence of general trust, and general confidence. *J. Risk Res.* 8, 145–156. doi: 10.1080/1366987032000105315

Slovic, P. (1987). Perception of risk. *Science* 236, 280–285. doi: 10.1126/science.3563507

Small, C., and Nicholls, R. J. (2003). A global analysis of human settlement in coastal zones. *J. Coast. Res.* 19, 584–599.

Stancu, A., Ariccio, S., de Dominicis, S., Cancellieri, U. G., Petruccelli, I., Ilin, C., et al. (2020). The better the bond, the better we cope. The effects of place attachment intensity and place attachment styles on the link between perception of risk and emotional and behavioral coping. *Int. J. Disaster Risk Reduct.* 51:101771. doi: 10.1016/j.ijdrr.2020.101771

Stanley, S. K., Hogg, T. L., Leviston, Z., and Walker, I. (2021). From anger to action: differential impacts of eco-anxiety, eco-depression, and eco-anger on climate action and wellbeing. *J. Climate Change Health* 1:100003. doi: 10.1016/j.joclim.2021.100003

Sullivan, D., and Young, I. F. (2020). Place attachment style as a predictor of responses to the environmental threat of water contamination. *Environ. Behav.* 52, 3–32. doi: 10.1177/0013916518786766

Terpstra, T. (2011). Emotions, trust, and perceived risk: affective and cognitive routes to flood preparedness behavior. *Risk Anal.* 31, 1658–1675. doi: 10.1111/j.1539-6924.2011.01616.x

Valentino, N. A., Hutchings, V. L., Banks, A. J., and Davis, A. K. (2008). Is a worried citizen a good citizen? Emotions, political information seeking, and learning via the internet. *Polit. Psychol.* 29, 247–273. doi: 10.1111/j.1467-9221.2008.00625.x

Vaske, J. J., Absher, J. D., and Bright, A. D. (2007). Salient value similarity, social trust and attitudes toward wildland fire management strategies. *Hum. Ecol. Rev.* 14, 223–232.

Verplanken, B., and Roy, D. (2013). "My worries are rational, climate change is not": habitual ecological worrying is an adaptive response. *PLoS One* 8:e74708. doi: 10.1371/journal.pone.0074708

Xu, D., Peng, L., Liu, S., and Wang, X. (2018). Influences of risk perception and sense of place on landslide disaster preparedness in southwestern China. *Int. J. Disaster Risk Sci.* 9, 167–180. doi: 10.1007/s13753-018-0170-0

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Free word association analysis of German laypeople's perception of biodiversity and its loss

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Due to the dramatic biodiversity crisis, it is crucial to understand how people perceive biodiversity. Knowledge of how thoughts are organized around this concept can identify which ideas are best to focus on biodiversity conservation information campaigns. The primary aim of the present study was to identify social representations of the German public regarding the concept of biodiversity and its loss using a free word association test. Furthermore, unique association networks were analyzed. For this purpose, data collection was performed in September 2021 in Germany using an online questionnaire to assess participants' associations with the prompt "biodiversity" (n = 131) and "biodiversity loss" (n = 130). Additionally, we used the social network software Gephi to create biodiversity (loss) association networks. The five most commonly mentioned associations for biodiversity were "animal," "plant," "nature," "human," and "flower." For biodiversity loss, the five most commonly mentioned associations were "species extinction," "climate change," "plant," "insect," and "bee." Neither "land use change" nor "invasive species," as key drivers of biodiversity loss, were present in social representations of the German public. A difference was observed in the total number of mentioned associations between biodiversity and biodiversity loss. For both, the associations "plant" and "animal" were related. However, participants associated specific taxa only with animals, such as "insects" and "birds." For plants, no specific taxa were named. Based on the network analysis, the most commonly mentioned word pairs for biodiversity and biodiversity loss were "plant – animal" and "species loss – climate change," respectively. Based on our statistical network analysis, these associations were identified as the most central associations with the greatest influence in the network. Thus, they had the most connections and the function of predicting the flow in the network. In sum, the public's multifaceted views on biodiversity and its loss, as well as the aforementioned central associations, hold great potential to be utilized more for the communication and education of biodiversity conservation. In addition, our findings contribute to the scientific community's understanding of social representations and perceptions of biodiversity and its loss.

KEYWORDS

social representation theory, biodiversity crisis, free word association test, network analysis, climate change, species loss, IUCN red list of threatened species

1. Introduction

Biological diversity, which is synonymous with "biodiversity" (Menzel and Bögeholz, 2009), is the scientific term used for the variety of life on Earth (Chivian and Bernstein, 2010). Biodiversity is regarded as a multidimensional, abstract, and complex concept (van Weelie and Wals, 2002; Zemits, 2006; Dikmenli, 2010). Precisely because biodiversity is such an abstract concept and can be interpreted in various ways, it is difficult to communicate biodiversity issues to the public (van Weelie and Wals, 2002). For example, according to the Convention on Biological Diversity (CBD), biodiversity can be defined as "*the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and their ecological complexes, encompassing diversity within species, between species and within ecosystems*" (United Nations Conference on Environment and Development (UN), 1992, Article 2).

The concept of biodiversity has many shapes and forms. Apart from the ecological dimension, biodiversity encompasses social, ethical, and economic dimensions (Gayford, 2000). For instance, in sustainability policy, biodiversity is considered a natural resource; however, in evolutionary theory, it is considered a product of evolution (van Weelie and Wals, 2002). In the present study, the working definition of "biodiversity" is based on three levels: (1) genetic diversity, which depends on heritable variation within and between populations of organisms; (2) species diversity, which describes the number of species in each area; (3) ecosystem diversity, which can be inferred with the help of species diversity, since it increases with increasing ecosystem diversity (Swingland, 2001).

Biodiversity is the primary indicator of ecosystem health. Notably, humans cannot live without the ecosystem services that biodiversity offers (Chivian and Bernstein, 2010). This reliance implies that healthy ecosystems clean our water, purify our air, maintain our soil, regulate the climate, recycle nutrients, and provide us with food. Moreover, healthy ecosystems provide raw materials and resources for medicines and serve additional purposes, such as—being the foundation of all civilization and sustaining global economies (Chivian and Bernstein, 2010; IPBES, 2019). However, biodiversity is declining at an unprecedented rate in human history, which will have severe impacts on people and the environment (IPBES, 2019).

This problem is less known and covered in the media than issues related to climate change (Legagneux et al., 2018). Moreover, there is increasing concern about the consequences of biodiversity loss on ecosystem functioning and the resulting provision of ecosystem services (Balvanera et al., 2006). The main driver of biodiversity loss is human behavior (Saunders et al., 2006). There are three key drivers of biodiversity loss caused by human behavior: (1) climate change; (2) land use change (including sealing of land, fragmentation of landscapes, and alteration of natural water body structures); (3) exposure to nutrients and pollutants (Mohaupt-Jahr and Küchler-Krischun, 2008; IPBES, 2019). The consequences of this environmental degradation affect both our quality of life and economic prosperity (Ehrlich and Ehrlich, 2013; Dirzo et al., 2014; Sockhill et al., 2022) while also leading to irreversible biodiversity loss.

National Biodiversity Strategies and Action Plans (NBSAPs) are instruments used to incorporate biodiversity protection plans and measures in CBD parties [United Nations Conference on Environment and Development (UN), 1992]. Germany implemented a 'National Strategy on Biological Diversity' (NBS) in 2007, as well as the 'Nature Conservation Action Programme 2020' [Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUB), 2007, 2015]. The strategy describes fields of action in which the protection of biodiversity has a high priority (e.g., promoting public relations work for more wilderness or exemplary nature conservation in German public forests). Strategies promote biodiversity conservation through appropriate measures, which are made available to key decision-makers and policymakers [Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUB), 2015]. Additionally, strategies such as Article 13 of the CBD aim to promote and support understanding of the importance of biodiversity conservation and the measures required to achieve it, as well as disseminating these measures through the media and including them in educational programs [United Nations Conference on Environment and Development (UN), 1992].

In a recent European survey, respondents reported that EU initiatives should focus on restoring biodiversity and the natural environment to compensate for damages to date and better inform citizens about the importance of biodiversity (European Commission, 2019a,b). Educating people about biodiversity and the implications of biodiversity loss requires an understanding of how individuals perceive biodiversity and its associations, as well as identifying misconceptions and barriers to effective behaviors in biodiversity conservation (Bele and Chakradeo, 2021; Bernardo et al., 2021). Such an initiative would add to the existing body of knowledge in the scientific community and address various social groups' representations, perceptions, and understandings of biodiversity and its loss. Only in the last decade has research focused on people's perceptions of biodiversity, and their understanding of this complex concept (Bele and Chakradeo, 2021).

1.1. Laypeople's representations and perceptions of biodiversity and its loss: current state of research

In the present study, the theory of social representation was applied as a theoretical framework, which was first proposed by Moscovici (1961) within social psychology (Wagner, 2020). In this theory, social representations are defined as the shared beliefs, values, attitudes, and practices of a particular social group or society (Moscovici, 2000). Shared representations help individuals understand and interpret their environment and improve communication within their social groups. Investigating social representations increases our understanding of socially relevant or problematic issues (Marková, 2008), including biodiversity and its loss, as explored in the present paper. Social representations "familiarize the unfamiliar" (Moscovici, 2000, p. 37), thereby enabling the public to make sense of scientific terms such as "biodiversity" and to align such terms with their own conceptual experience and knowledge. In a cognitive anchoring process, new information is assigned to an existing knowledge system. Over time, new ideas, experiences, and social influences can challenge and reshape existing social representations, such that social representations cannot be perceived as static or fixed (Moscovici, 2000).

The theory of social representation provides a useful framework for understanding how individuals and groups make sense of biodiversity and biodiversity loss. Several studies have investigated

social representations of the concept of biodiversity with focus group discussions, open questions, photographs, or association tests, among others (e.g., Buijs et al., 2008; Levé et al., 2019; Bernardo et al., 2021; Bosone and Bertoldo, 2022). Bernardo et al. (2021) used two different methods (open questions and photographs) to investigate social representations of biodiversity in respondents from Lisbon, Portugal. The study found that a considerable number of participants were unfamiliar with the concept of biodiversity, with approximately 20% understanding biodiversity as "the diversity of animals and/or plants." Other definitions included "related to the environment" and "nature." Similar results were found in a study by Buijs et al. (2008), in which participants from the Netherlands, Scotland, and Germany offered rich and complex social representations in focus groups but understood biodiversity primarily in terms of species diversity and sometimes habitat diversity. Genetic diversity was rarely mentioned in participants' shared representations. According to the study's authors, the concepts and definitions of biodiversity among laypeople differed from those of the scientific community. Among laypeople, an understanding of biodiversity can be shaped by daily experiences, feelings, and knowledge about their environment, which together form their perceptions of biodiversity. Bosone and Bertoldo (2022) used a free-association task with French citizens to identify their common associations with biodiversity. Participants were asked to name the first three words that came to mind when hearing the term "biodiversity." The most common responses were "nature," "fauna," and "flora." Other common associations included scientific terms, science, risk, and preservation. Levé et al. (2019) explored the social representations of 1,260 French citizens by posing an open-ended question on how biodiversity should be defined. Overall, 1,065 different words were obtained. Associations named by more than 100 people mainly echoed institutional or scientific definitions such as "species," "diversity," and "ecosystem."

Other studies have explored issues related to social representations, such as conceptual structures and frameworks, as well as the mental constructs of biodiversity (Turner-Erfort, 1997; Fischer and Young, 2007; Kostova and Radoynovska, 2008; Lindemann-Matthies and Bose, 2008; Dikmenli, 2010; Kilinc et al., 2013; Bakhtiari et al., 2014; Kaltenborn et al., 2016). As early as 1997, when the concept of biodiversity was still new, the study of Turner-Erfort (1997) identified a wide range of definitions for biodiversity by surveying participants in Chicago. However, only a few included elements of definitions that are currently endorsed by the scientific community. Dikmenli (2010) collected ideas about the term "biodiversity" from a group of student teachers in Turkey by using a word association test to explore their conceptual framework. The study's results showed that the student teachers named more associations pertaining to ecosystem and species diversity and fewer associations pertaining to genetic diversity. Another study on Turkish students' conceptions of biodiversity found that the students preferred the definition "biodiversity is the diversity of living organisms" (Kilinc et al., 2013). Among members of the Swiss public, an understanding of biodiversity as species diversity most often referred to animals and plants (Lindemann-Matthies and Bose, 2008). Kostova and Radoynovska (2008) used word associations with the prompt "biodiversity" to build conceptual structures and found various representations of biodiversity for different groups in schools, even though biology teachers taught all previously defined levels and aspects of biodiversity. Representations from the younger students focused on the emotional aspects of biodiversity (e.g., happiness, feelings, or peace of mind). Among older students, the ecological and genetic aspects of biodiversity were more widely acknowledged, while supervisors tended to name the social aspects of biodiversity such as humans, life, and social diversity (Kostova and Radoynovska, 2008). Research on perceptions of the ecological concept of forests as part of biodiversity found that individuals understood the value and role of regulation (Bakhtiari et al., 2014). The analysis of a series of group discussions with members of the public in Scotland showed that mental constructs of the concept of biodiversity increasingly included terms such as "balance," "food chains," and "dominance." Additionally, the participants were aware of the irreversible loss of biodiversity (Fischer and Young, 2007). In Norway, half of the surveyed public perceived that biodiversity loss is both real and a major environmental problem (Kaltenborn et al., 2016).

In Germany, some studies have investigated social representations of biodiversity or related issues by surveying the German public. The *Nature Awareness Study 2019* found that 45% of Germans were familiar with the term "biodiversity," had an understanding of its substantive meaning, and can named at least one of its three subcomponents [i.e., genes, diversity of species, and ecosystems; Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMU) and Federal Agency for Nature Conservation (BfN), 2019]. The results for adolescents were similar to those in the aforementioned studies, with species diversity being the most present factor. However, in general, biodiversity was increasingly perceived as a one-dimensional concept (Schneiderhan-Opel and Bogner, 2019). Fiebelkorn and Menzel (2013) found that the prospective biology teachers in their study lacked an understanding of genetic diversity and did not view this concept as an integral component of biodiversity, and biodiversity was typically equated with species diversity. In the recent *Weleda Nature Study 2021* on biodiversity, results for Germany showed that the term "biodiversity" has a concrete meaning for many and the majority view biodiversity as worth protecting. Overall, 73% of Germans answered "yes" to the question of whether the conservation of biodiversity is important to them (Weleda, 2021). Moreover, in a survey conducted by the European Commission, German citizens indicated that pollution, man-made disasters, and climate change are the primary threats to biodiversity (European Commission, 2019a). Most respondents perceived human intervention (e.g., the destruction of forests and unlimited consumption) as a threat to biodiversity (Weleda, 2021). However, in a study of German students, the loss of biodiversity at the local level was not represented (Menzel and Bögeholz, 2009).

1.2. Study aim

The present study aimed to identify a socially constructed understanding of the German public regarding the concepts of biodiversity and its loss by using free word association tests and further analyzing association networks. Included in this aim is an expansion of the general knowledge of "biodiversity" by using—for the first time—the negative stimulus "biodiversity loss" with these methods. In addition to contributing to the scientific community's understanding of the social representations and perceptions of these concepts, the results from this study may help improve campaigns for the conservation of biodiversity and enhance interdisciplinary collaboration.

Results from the aforementioned studies suggest that more associations are named when assigned to the dimensions of species and ecosystem diversity, with fewer associations for genetic diversity. Rather than create an assignment for already existing dimensions of biodiversity, the present study aimed to collect naïve associations of biodiversity and its loss. Thus, lay or nonscientific associations were not evaluated as incorrect, but as valid representations in their own right (Moloney et al., 2014), since an investigation of social representations should be focused on the way concepts such as biodiversity and its loss are understood in the public domain (Bauer and Gaskell, 2008). Existing studies nevertheless provide a good basis for interpreting and classifying our results in the context of social representations or issues related to biodiversity and its loss for the German public.

The present study used the following methodology: (1) self-reported knowledge was surveyed to gain insights into the German public's awareness of the concept of biodiversity and its meaning; (2) free word association tests were implemented as an assessment tool since they provide a method for capturing associations by surveying social representations with a greater range of freedom than closed questionnaires. Additionally, we investigated whether there was a difference between the total number of named associations and the stimulus words "biodiversity" and "biodiversity loss" since the frequency of difference could be considered a quantitative and collective criterion in social representation theory (Lo Monaco et al., 2017). Furthermore, the categories were inductively derived from the free word associations to represent the perceptions of the German public and then generalized from the associations; (3) a novel approach in the form of an association network and its analysis (a method adapted from social network analysis) was used to visualize both the overall and the connected social representations of biodiversity and its loss, as perceived by members of the German public. Association networks can demonstrate how participants' representations are cognitively organized and how central representations can be derived from them (Danowski, 1993). Moreover, association networks indicate which associations are frequently named together, while central representations of the networks can be identified using statistical network analysis. To the best of our knowledge, no other study to date has generated an association network that illustrates associations with biodiversity or biodiversity loss among members of the German public.

2. Materials and methods

2.1. Sample

Data collection for this study occurred in September 2021 and was conducted via an online questionnaire and the access panel of Consumerfieldwork GmbH. The panel book listed 39,306 available participants (Consumerfieldwork GmbH, 2020). Two questionnaires were available on the following topics: (1) the perception of *biodiversity*; (2) the perception of *biodiversity loss*. Quotas for age, gender, and federal state were applied to ensure a sample approaching the representativeness of the German population. The minimum age for participation was 18 years.

The surveys initially resulted in sample sizes of $N = 177$ (*biodiversity*) and $N = 171$ (*biodiversity loss*), which were subsequently processed to ensure the quality of the data. First, participants who did not correctly answer the following attention check were excluded: "*Please click 'Strongly disagree' on the far left to demonstrate that you are paying attention to our study.*" Additionally, the review included checking for "completeness" (Schendera, 2007) and removing data from participants who did not complete the questionnaire. Participants' questionnaires were also checked for the "plausibility of the answer pattern." When recurring patterns were detected in the Likert scales of the questionnaires, they were excluded from the dataset. Participants who were thought not to be serious about completing the questionnaires were removed from the sample. For this purpose, half of the median total processing time of all participants was calculated. Participants whose processing time was less than the calculated value were sorted out (Hartmann and Siegrist, 2020). Finally, participants were removed from the sample due to missing associations. Associations such as "*do not know*" were also removed from the dataset. If this filtering resulted in participants being left with no associations, they were also excluded. The total sample sizes for the final analysis were thus $n = 131$ (*biodiversity*) and $n = 130$ (*biodiversity loss*). The descriptive data of the sample are presented in Table 1.

The sample of *biodiversity* was composed of 58 men (44.3%) and 73 women (55.7%). The sample of *biodiversity loss* was composed of 56 men (43.1%) and 74 women (56.9%). Compared to the gender distribution in Germany [49.3% men and 50.6% women; Destatis (Federal Statistical Office), 2021], it is noticeable that the proportions of males in the samples were slightly smaller than those of females. The average ages of the participants were 49.2 years ($SD = 16.8$; *biodiversity*) and 47.8 years ($SD = 17.0$; *biodiversity loss*). Compared to the German population [44.7 years, Destatis (Federal Statistical

TABLE 1 Detailed overview of the samples for the *biodiversity* ($n = 131$) and *biodiversity loss* ($n = 130$) questionnaires.

Variable	Response format	Biodiversity [%]	Biodiversity loss [%]
Gender	"Men"	44.3	43.1
	"Women"	55.7	56.9
Age	"Open question" 18–20 years	0.8	1.5
	21–24 years	5.4	5.4
	25–39 years	26.1	29.3
	40–59 years	37.4	35.2
	60–64 years	8.3	5.5
	> 65 years	22.4	23.0
Education level	"Secondary education"	26.7	20.7
	"Intermediate school certificate"	31.3	29.8
	"Advanced technical college entrance qualification"	6.9	11.5
	"General qualification for university entrance"	28.2	37.7
	"Another school degree"	3.8	0.8

Sociodemographic data were collected according to the specifications of the Federal Statistical Office [Destatis (Federal Statistical Office), 2021].

Office), 2022] the average ages of the samples were significantly higher. This discrepancy could be explained by setting the minimum age of the participants at 18 years. When considering the level of education, measured by the highest school-leaving qualification ('General qualification for university entrance'), the level of education in the samples was lower (*biodiversity:* 28.2%) or higher (*biodiversity loss:* 37.7%) than the average highest level of education of the German population [33.5%; Destatis (Federal Statistical Office), 2020].

2.2. Questionnaire

The questionnaires were created using the SoSci Survey (v. 3.2.30) online platform (Leiner, 2019) and included the following sections:

(1) *Self-reported knowledge*: Following the *Nature Awareness Study 2019* published by the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMU) and Federal Agency for Nature Conservation (BfN), 2019, participants were asked whether the term "biodiversity" was previously known ("*Were you familiar with the term 'biodiversity' before the association test?*").

(2) *Free word association test*: Within the *biodiversity* questionnaire, participants were asked for free word associations for the stimulus word "biodiversity." Within the *biodiversity loss* questionnaire, participants were asked for the stimulus word "biodiversity loss." Notably, the term "biological diversity" was always used instead of biodiversity [in German: *Biologische Vielfalt* instead of *Biodiversität*] in this study. By changing the original Latin and educational language term, we expected it to be easier for participants to name associations. Finally, participants were given one working definition of biodiversity and its loss to allow for equal prerequisites of the participants for the processing of further questions.

(3) At the end of the questionnaire, *sociodemographic data* were collected from the participants. These data included the gender, age, postal code of the current place of residence, information on school-leaving qualifications, monthly net income, political party one would currently vote for, place of origin, and current place of residence. The questionnaire contained additional scales that are irrelevant to the presentation of the data in this publication.

2.2.1. Free word association test

Free word association tests are a viable method for determining participants' attitudes and perceptions about an object (Szalay and Deese, 1978). Lo Monaco et al. (2017) described word association tasks as one of the main methods for collecting the content of social representations (Lo Monaco et al., 2017, p. 309). Wagner et al. (1996, p. 334) further described the technique as having unrestricted access to mental representations. Moreover, word association tests reveal scientific conceptual structures that depend on scientific education on the one hand and social environment on the other (Kostova and Radoynovska, 2008). In general, an association could be concrete or abstract, and it could be expressed in many ways (e.g., by a verb, a noun, or an adjective; Kahnemann, 2012).

In the present study, we investigated possible distinctions between the associations of the two association tests for the stimulus words *biodiversity* and *biodiversity loss*. The association tests of both questionnaires started with an introductory text informing the participants about the anonymity of the test. Participants were then asked to express their associations freely and spontaneously. Additionally, the associations were to be written down in the order in which they came to the participants' minds. Participants were told to avoid chain responses, loose phrases, and complete sentences. Next, the following prompt was shown: "*When you are ready for the association test, click 'Next.' The test will then begin immediately.*" Once participants clicked "Next," the processing time of 1 minute began, and 10 response boxes appeared. As soon as the participants submitted an answer, another answer field was added. Thus, there were always 10 answer fields available. The following text was also displayed above the answer fields: "*What associations come to mind when you hear the term 'biodiversity'/'biodiversity loss'?*" "*Please write down here any terms that come to mind. Please write only one word per line.*"

The remaining time was displayed with the help of a countdown timer above the question sheet page. According to Szalay and Deese (1978), it is useful for an association test to introduce a time limit for the submission of the associations. The associations given are influenced if participants are not under any time pressure (Siipola et al., 1955). Therefore, it is recommended that participants should be given 1 minute to state associations (Szalay and Deese, 1978).

Notably, the association tests for both questionnaires were placed at the very beginning to avoid possible influences from other questions. All associations were translated from German into English by employing the DeepL Pro translation service and several biological dictionaries, (e.g., a dictionary for animal names; Cole, 2008, 2015a,b).

2.3. Data analysis

2.3.1. Coding

First, the associations were checked for spelling and grammatical errors. The terms were converted to the singular for standardization. Except for a few associations, such as those that describe a variety by their form in the plural, remained in the plural (e.g., "species," "races"). In this manner, it was possible to combine terms that were singular as well as plural into one code. All rules that were applied to edit the associations can be requested from the first author. The adjustments were made in Microsoft Excel. Responses from participants that contained two associations were included as two single-word associations. Subsequently, the Excel files were imported into MAXQDA (v. 20.4.0) (VERBI Software, 2021). Here, identical associations were combined into one code. In this manner, it was possible to locate the frequency of individual associations. This was followed by inductive category formation. Deriving categories inductively involves starting with raw data and then systematically organizing it into meaningful categories, often through a process of coding or categorization. This may involve identifying common themes or patterns across different responses and looking for recurring words or phrases (Rädiker and Kuckartz, 2019). Based on the available associations of both questionnaires, 26 categories could be assigned to them. For example, the associations "animal," "insect," and "dog" were coded into the category "animals." For the category "plants," associations such as "plant," "flower," and "tree" were coded.

Furthermore, the associations "bee extinction," "insect extinction," or "forest decline" were coded into the category "animal and plant extinction." Associations, that could not be clearly interpreted were sorted into the category "other" (e.g., "freedom," or "time"). The complete codebook is available in the Supplementary material.

Subsequently, the intercoder-reliability was checked in MAXQDA (v. 20.4.0). For this purpose, an independent person recoded the associations into the existing categories based on the associated definitions. The two independently coded document groups were merged in MAXQDA and then compared using the intercoder match function. The goal was to achieve a match of at least 80%. Additionally, *kappa* according to Brennan and Prediger (1981) was calculated in MAXQDA. This characteristic value considers the likelihood of agreement among the coders (Rädiker and Kuckartz, 2019). The Brennan and Prediger (1981) *kappa* value can range from −1 to 1, with 0% agreement among coders having a value of −1. When *kappa* takes the value of 1, the agreement among coders is 100%. A value of 0 represents chance (Brennan and Prediger, 1981). A *kappa* value from 0.61 to 0.80 is considered "substantial," or good. When *kappa* has a value from 0.81 to 1, it is considered "almost perfect" (Landis and Koch, 1977). To improve the agreement, non-matches were discussed again, with coders agreeing on a category. Only associations that were mentioned at least three times were considered. Conducted intercoder–reliability testing in MAXQDA revealed the following: The resulting *kappa* value for *biodiversity* was "almost perfect" ($\kappa = 0.82$). The resulting *kappa* value for *biodiversity loss* was "substantial" ($\kappa = 0.72$). After discussion of doubtful cases between the coders and subsequent adjustment, the intercoder–reliability revealed higher kappa values ($\kappa = 0.87$; almost perfect; *biodiversity* / $\kappa = 0.79$; substantial; *biodiversity loss*). The protocol for discussing the nonconformity of associations can be requested from the first author.

2.3.2. Association network

Following the social network analysis, in this study, networks were used to visually replicate the associations of participants and reveal representations for the stimulus words *biodiversity* and its *loss*. In addition, networks demonstrate how participants' ideas are cognitively organized, and central concepts could be identified (Danowski, 1993). For psychologists, ideas are nodes in a vast network called associative memory, in which each idea is connected to many other ideas (Kahnemann, 2012). To investigate which associations frequently occur together in the mental concepts of participants, association networks were created in Gephi (v. 0.9.7; Bastian et al., 2009), following the procedure used by Vlasák-Drücker et al. (2022). From the free word association tests, the code–relations–browser was first generated in MAXQDA for each, whereby only those associations that were mentioned at least five times were considered. The threshold value was selected to ensure improved network clarity. The code–relations–browser matrices were then imported into Gephi (v. 0.9.7). To create the network, several layouts were available that determined the order of the associations. Here, the "Fruchterman Reingold" option was used. For the sake of clarity, the edges (i.e., connections between the associations) were filtered according to weight. Thus, associations that were named with each other three times (*biodiversity*) or two times (*biodiversity loss*) do not share visible connecting lines in the graphic. This reduced number of edges resulted in better visualization of the network. Furthermore, the networks were edited in Inkscape v. 1.2.1 (2022). Nodes and edges were colored, and the words corresponding to the four largest categories and further categories ("other") were colored in the networks.

2.3.3. Statistical tests

Statistical data analysis was conducted using SPSS® software (IBM® v. 27). To investigate whether there is a significant difference between the total number of mentions in the two questionnaires, their normal distribution was first calculated. After it was determined that the data were not normally distributed, the Mann–Whitney U-test was performed.

In addition, analysis was conducted for statistical network measures using Gephi (v. 0.9.7). The assessment was based on key approaches, that helped understand how a network is structured: *graph density*; *degree centrality*; *betweenness centrality*. First, *graph density* measured the level of connected edges (in our case, the connection lines between associations) within a network relative to a total possible value. Graphs with values near 1 are considered dense, while graphs with values near 0 tended to be sparse graphs (Cherven, 2015; Borgatti et al., 2022). Moreover, centrality statistics were investigated. They provided the framework to compare the roles played by various nodes (in our case, associations) within a single network. *Degree centrality* was investigated for undirected graphs, which provided importance for the number of direct connections (degrees) one node had to other nodes' influence within the network. It was useful to identify strongly connected associations (Cherven, 2015; Borgatti et al., 2022). *Betweenness centrality* showed which nodes functioned as a "bridge" between the nodes of a network. All of the shortest paths were identified and summarized based on how often a node passed the shortest path. The identification of *betweenness centrality* was useful to predict the flow of the network based on associations (Cherven, 2015; Borgatti et al., 2022). All centrality measures were normalized to simplify the comparison.

3. Results

3.1. Self-reported knowledge of biodiversity

For surveying self-reported knowledge, participants were asked whether they were familiar with the term "biodiversity" and knew what it meant (Figure 1). The results showed, that in total, 47.3% (*biodiversity*, $n = 62$) and 53.8% (*biodiversity loss*, $n = 70$) of the participants indicated that they had already heard of biodiversity and knew what it meant. Moreover, 32.8% (*biodiversity*, $n = 43$) and 26.2% (*biodiversity loss*, $n = 34$) of participants indicated that they had already heard of the term "biodiversity" but had no prior knowledge of it. The remaining 19.8% (*biodiversity loss*, $n = 26$) and 20.0% (*biodiversity loss*, $n = 26$) of participants were completely unfamiliar with the term "biodiversity."

In addition, a Mann–Whitney U-Test was performed to determine whether a statistical difference was observed between the two surveyed groups in terms of self-reported knowledge. No statistically significant difference was observed in the self-reported knowledge of *biodiversity* and *biodiversity loss* ($U = 8098.0$, $Z = -0.64$, $p = 0.53$) between the two surveyed groups. Thus, the self-reported knowledge baseline for the following analysis was the same for both groups.

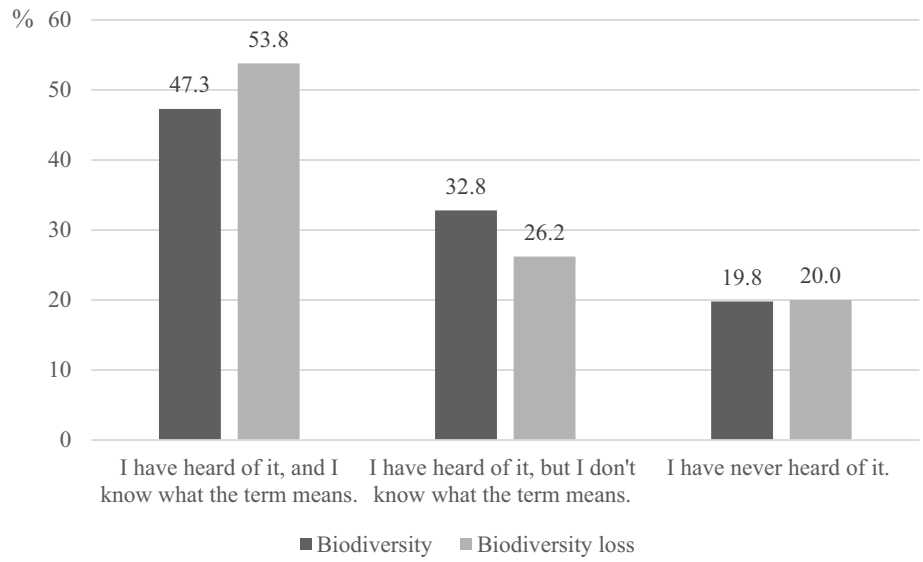

FIGURE 1
Self-reported knowledge of participants from questionnaires on *biodiversity* (n = 131) and *biodiversity loss* (n = 130) for the term "biodiversity." Question asked following the *Nature Awareness Study 2019* published by the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMU) and Federal Agency for Nature Conservation (BfN) (2019). Frequencies are presented as percentages.

3.2. Social representations of Germans regarding biodiversity and its loss

The free word association test was used to survey social representations. The total number of associations named by participants was 1,222. Of these, 652 distinct associations with *biodiversity* and 570 distinct associations with *biodiversity loss* remained. A list of all associations is available in the Supplementary material. On average, 5.02 (SD = 2.55) associations were named per participant for *biodiversity*, while 4.3 (SD = 2.31) associations were named for *biodiversity loss*. A maximum of 12 named associations (*biodiversity*) or 11 named associations (*biodiversity loss*) was achieved in the given time of 1 minute by a small number of participants.

The 10 most frequently mentioned associations of the two questionnaires as well as their relative frequencies are presented in Table 2. For *biodiversity* these account for 32.7% of the total associations (n = 213). For *biodiversity loss*, these account for 24.7% (n = 141). The three most frequently mentioned associations for biodiversity were "animal" (n = 50), "plant" (n = 39), and "nature" (n = 26). For *biodiversity loss*, the associations were "species extinction" (n = 38), "climate change" (n = 16), and "plant" (n = 15). A Mann–Whitney U-Test was calculated to determine whether there were differences in the total number of mentioned associations between participants in the two questionnaires for *biodiversity* (M_{Rank} = 140.94) and *biodiversity loss* (M_{Rank} = 120.98). There was a statistically significant difference in the total number of mentioned associations between *biodiversity* and *biodiversity loss* (U = 7213.0, Z = −2.16, p = 0.03), with a small effect (r = 0.13; Cohen, 1988).

3.3. Categorized social representations of biodiversity and its loss

To answer, which categories can be derived from the overall named associations to the prompts *biodiversity* and *biodiversity loss*, the 10 categories to which the most associations were assigned are shown for both questionnaires (Table 3), including the absolute and relative frequencies. The three categories with the most commonly named associations for *biodiversity* were "animals" (n = 108), "plants" (n = 79), and "diversity" (n = 75). For *biodiversity loss*, these categories were "other" (n = 82), "anthropogenic causes" (n = 69), and "animals" (n = 65).

3.4. Association networks

The results of association networks visualized the overall and connected social representations of *biodiversity* and *biodiversity loss* in the German public. Associations that were frequently named together in the questionnaires are shown in Table 4. The associations "plant" and "animal" were most frequently mentioned together for *biodiversity* (n = 25). For *biodiversity loss*, the associations "species extinction" and "climate change" occurred most frequently together (n = 11; Figures 2, 3). Additionally, the associations were colored based on their membership in the previously created categories. Only the four largest categories were considered, plus "other" categories. In the association network for *biodiversity*, it is noticeable that associations from the categories "animals" and "plants" frequently occurred together. Associations from the category "food" were also frequently mentioned together. For *biodiversity loss*, associations from the categories "anthropogenic causes" and "species extinction" frequently occurred together. Also, associations from the category "animals" were often named together.

Results for the statistical network analysis of the association networks are provided in Table 5. The *graph density* of the two association networks shows that 28.8% (*biodiversity*) and 29.4% (*biodiversity loss*) of the nodes are connected. It can be assumed that this network is rather sparse since the value for *graph density* tended toward 0 (both approximately 0.30) instead of 1. For *degree centrality*, there is a strong differentiation between the nodes for both *biodiversity* and *biodiversity loss*, as seen from the variance of the degree values (*biodiversity*: 0.08 to 0.92; *biodiversity loss*: 0.03 to 0.62). Additionally,

TABLE 2 Top 10 associations of *biodiversity* (n = 652) and *biodiversity loss* (n = 570) with absolute and relative frequency.

Biodiversity			Biodiversity loss		
Association	Absolute frequency	Relative frequency	Association	Absolute frequency	Relative frequency
Animal	50	7.7	Species loss	38	6.7
Plant	39	6.0	Climate change	16	2.8
Nature	26	4.0	Plant	15	2.6
Human	18	2.8	Insect	13	2.3
Flower	16	2.5	Bee	12	2.1
Species diversity	15	2.3	Animal	11	1.9
Environment	14	2.1	Extinct	10	1.8
Insect	13	2.0	Nature	9	1.6
Species	12	1.8	Monoculture	9	1.6
Bird	10	1.5	Human	8	1.4

Relative frequency is presented as a percentage.

TABLE 3 Top 10 categories of *biodiversity* and *biodiversity loss* with absolute and relative frequency.

Biodiversity			Biodiversity loss		
Category	Absolute frequency	Relative frequency	Category	Absolute frequency	Relative frequency
Animal	108	16.6	Other	82	14.4
Plants	79	12.1	Anthropogenic causes	69	12.1
Diversity	75	11.5	Animal	65	11.4
Habitat	54	8.3	Species loss	62	10.9
Other	51	7.8	Animal and plant extinction	58	10.1
Food	42	6.4	States	27	4.7
Conservation	37	5.7	Plants	21	3.7
Nature	34	5.2	Environment	18	3.2
Human	28	4.3	Habitat	17	3.0
States	24	3.7	Diversity	17	3.0

The total number of categories is 26. The full list of the created categories with short definitions and complete definitions can be found in the Supplementary material. Relative frequency is presented as a percentage.

for *betweenness centrality*, significant variation was observed in the centrality values. Both networks seem to require "bridge" nodes. For *biodiversity*, the nodes are "animal" and "plant" (*betweenness* = 0.28; 0.16), while for *biodiversity loss*, these are "species loss" and "climate change" (*betweenness* = 0.17; 0.12). These associations are also centrally located in the networks. Associations such as "animal welfare" (*biodiversity*) and "forest decline" (*biodiversity loss*) have a low *degree* and *betweenness centrality*. These associations are in the periphery of the network (Figures 2, 3).

4. Discussion

Our study's objective was to determine how the German public perceives biodiversity and its loss. We accomplished this by conducting free word association tests and analyzing association networks. By using "biodiversity" and—for the first time—the negative stimulus "biodiversity loss" our results should contribute to the scientific community's understanding of the social representations and perceptions of these concepts. The findings of this study could be used to enhance biodiversity conservation campaigns and promote collaboration across different fields of study.

4.1. Self-reported knowledge of biodiversity

The results of participants' self-reported knowledge showed similar findings as the 2019 German *Nature Awareness Study* [Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMU) and Federal Agency for Nature Conservation (BfN), 2019] and the 2019 Eurobarometer (European Commission, 2019a). In our study, approximately half of the participants believed they knew the term and understood its content. This result differs from slightly fewer participants in Germany (45%) and Europe (41%) who reported knowing and understanding the term. While these two studies reported an increase in awareness of the term, they also noted that

TABLE 4 Top 10 most frequently named association word pairs for *biodiversity* and *biodiversity loss*.

Biodiversity		Biodiversity loss	
Word pair	Frequency	Word pair	Frequency
Plant – Animal	25	Species loss – Climate change	11
Human – Animal	13	Plant – Animal	7
Nature – Animal	11	Extinct – Species loss	5
Nature – Plant	9	Plant – Bee	5
Flower – Animal	8	Plant – Insect	4
Bird – Animal	7	Plant – Bird	4
Human – Plant	7	Nature – Animal	4
Bird – Plant	6	Human – Animal	3
Environment – Plant	6	Monoculture – Species loss	3
Environment – Animal	6	Insect – Species loss	3

more than half of the respondents did not yet know or had never heard of the term's meaning. Nevertheless, the participants in our study who did not know the term and its meaning were able to name associations with biodiversity and its loss.

4.2. Social representations and networks

Social representations were surveyed using free word associations. The resulting presentations in association networks revealed the German public's broad understanding of biodiversity and its loss. Our analysis suggests that individuals possessed certain notions about biodiversity and its loss, which could be assessed as either positive, negative, social, everyday life, or scientific and technical. Naïve associations suggested that biodiversity appears as a comprehensive and multidimensional phenomenon that could evoke varied responses in different people depending on where they come from and the ecosystems with which they are closely associated (Zemits, 2006).

However, a detailed look at our results revealed various conceptualizations that may depend on individual and cultural backgrounds and the shared knowledge of a group (Fiebelkorn and Menzel, 2013). Further investigations could differentiate shared social representations within our surveyed group of German publics according to age, education level, or political preference. Notably, social representations are regarded as static to a limited extent and the results of the present study may only apply in the short term (Moscovici, 2000). The associations of biodiversity and its loss were aggregated and represented across the entire sample from the German public in the association networks. We assumed that many of the associations and their connections could be elements of social representations of biodiversity and its loss among the German public, in this or a similar way. Furthermore, the association networks are not simply a common representation of "word clouds." In the present study, they showed the connections of all associations in a network and, more importantly, how closely they are linked to each other.

4.2.1. Animals and plants: social representations of *biodiversity*

The word stimulus exercise on *biodiversity* showed that animals and plants were the most frequently mentioned associations in the social representations of the participants. Also, network statistics indicated that these two associations ("animal" and "plant") had the most connections to other associations and were identified as bridges from which further associations emanated, thereby predicting the flow in the network. In line with our results, Lindemann-Matthies and Bose (2008) reported that biodiversity was most frequently defined with the terms "animal" and "plant." In our study, participants additionally reported many specific taxa, such as birds and insects, and somewhat fewer mammals. In contrast, plant taxa such as mosses, ferns, or flowering plants were less commonly provided and were thus not visible in the network or among the top 10 associations. In the association network, only one association from "plant" to "flower" was found. Interestingly, plants were at the center of the association network, alongside animals, even though many people tend to overlook the importance of plants in the biosphere—a phenomenon known as "plant blindness" (Jose et al., 2019).

Although certain mammals, including so-called "charismatic megafauna," are often used as flagship species for biodiversity protection (Albert et al., 2018; McGowan et al., 2020), insects and birds were more frequently associated with biodiversity than mammals in the present study. This could be due to the attention currently paid to these groups of organisms by the promotional campaigns of the largest German NGO, the Nature and Biodiversity Conservation Union [Nature and Biodiversity Conservation Union (NABU), 2023]. For example, the NGO's logo depicts a stork, with groups of birds and insects being displayed in their ongoing campaigns (e.g., the election of the bird/insect of the year). Moreover, the most popular flagship species, such as tigers, lions, and elephants (Albert et al., 2018), are not native to Germany, and thus possibly had little presence among the laypeople surveyed. Leandro and Jay-Robert (2019) focused on insects as featured animals of diversity and found that mammals were more entrenched in young adults' concepts of biodiversity. However, this was not demonstrated by the results of the current study.

The decline in bird and insect species in Germany is concerning [International Union for Conservation of Nature (IUCN), 2022]. However, recent research suggests that the German population's attitude and willingness to protect these species is increasingly positive (Dörge et al., 2022; Eylering et al., 2022). Featuring birds and insects in educational campaigns on biodiversity conservation and strengthening links to the concept of biodiversity could thus be beneficial. A public campaign highlighting birds and insects could strengthen other related associations suggested by the network. After starting with birds and insects, efforts could be geared toward "plants" such as helping to reduce the aforementioned plant blindness or focusing on insect "species diversity" to increase the visibility of this particularly species-rich but often endangered group.

Notably, participants seemed to perceive only macroscopically visible organisms as part of biodiversity. Microorganisms such as fungi and protists were not at all integrated with people's associations despite making up an important component of biodiversity, with losses of these organisms having been recorded [International Union for Conservation of Nature (IUCN), 2022].

Overall, diversity terms such as "species diversity," "variety," or "species richness" were socially associated with biodiversity, similar to

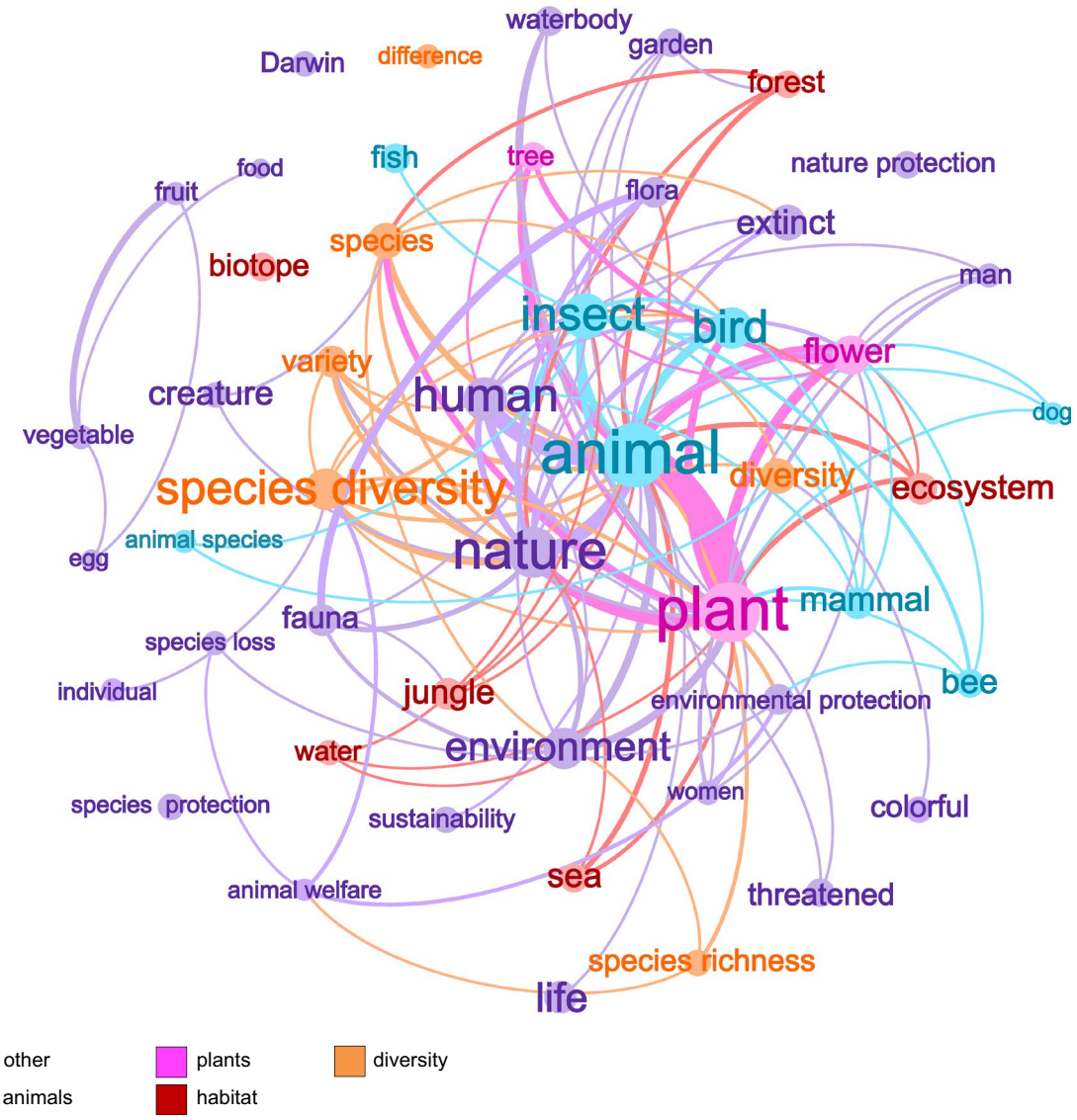

FIGURE 2
Association network for *biodiversity*. Only associations named five or more times were included in the network. The more frequently an association was named, the larger it appears in the network. The more often an association is named with another, the thicker the edge between them. For the sake of clarity, the edges (i.e., connections between associations) were filtered according to weight. Thus, associations that were named with each other fewer than two times do not share visible connection lines in this graphic. Furthermore, the four categories that comprise the most associations have been colored, along with the coloring of all other categories (i.e., "other"). Associations such as "Darwin," "difference," "biotope," "species conservation," and "nature conservation" were mentioned five times, but less than two times with another association. Accordingly, they stand alone in the network.

several other studies (Buijs et al., 2008; Dikmenli, 2010; Kilinc et al., 2013; Schneiderhan-Opel and Bogner, 2019). Furthermore, 93% of German participants in the *Nature Awareness Study* thought they knew the meaning of biodiversity and associated biodiversity with animal and species diversity [Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMU) and Federal Agency for Nature Conservation (BfN), 2019]. It appears that these participants replaced the term "biodiversity" with a closely related word or synonym. The data suggested that the term "biodiversity" was most often interpreted as a synonym for "species diversity," as described by Menzel and Bögeholz (2009).

Social representations related to the genetic dimension were limited in number. In the top 10 associations and *biodiversity* networks, no associations could be directly attributed to the scientifically defined genetic dimension. In the *biodiversity loss* network, only "gene manipulation" was apparent. Other studies have shown that the concept of genetic diversity was less pronounced (Buijs et al., 2008; Dikmenli, 2010; Fiebelkorn and Menzel, 2013). In contrast, a study by Kostova and Radoynovska (2008) found that teachers, and especially older tenth-grade students, named associations for genetics—a finding that is likely due to the school curricula, which could include genetic diversity as a sub-dimension of biodiversity. The interviewed group can also be assigned to the social context of the school. Our sample did not directly interview students; thus, their social representations from the genetic field may be underrepresented.

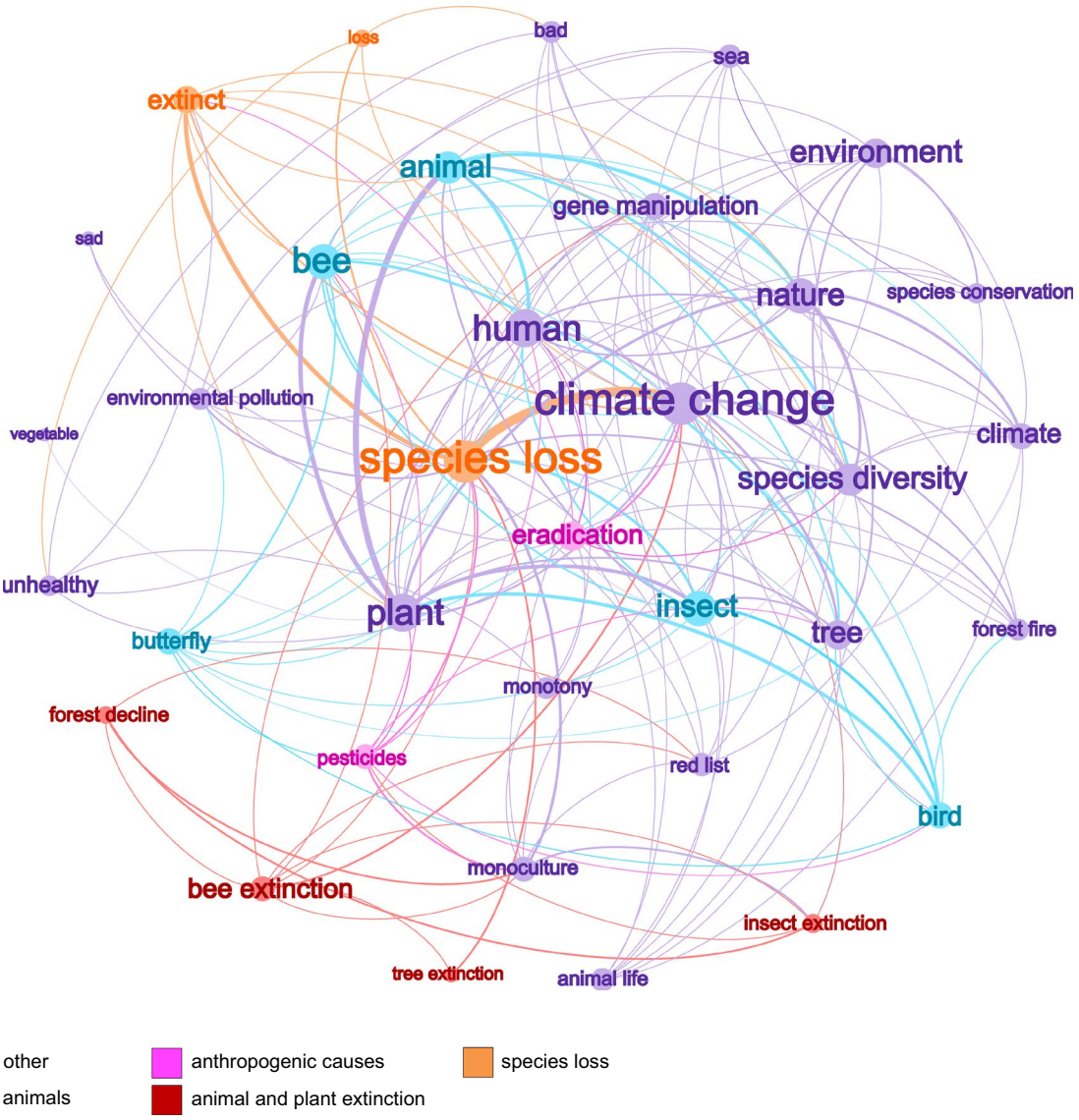

FIGURE 3
Association network for *biodiversity loss*. Only associations named five or more times were included in the network. The more frequently an association was named, the larger it appears in the network. The more often an association is named with another, the thicker the edge between them. For the sake of clarity, the edges (i.e., connections between associations) were filtered according to weight. Thus, associations that were named with each other fewer than three times do not share visible connection lines in this graphic. Furthermore, the four categories that comprise the most associations have been colored, along with the further coloring of all other categories (i.e., "other").

Interestingly, the results of the association network for *biodiversity* showed that associations for the category "food" were often named together, particularly since the participants built their networks without any connection to the main network. Presumably, these food associations were named chain responses in which the participants did not return to the initial term in the free word association test.

Overall, social representations of biodiversity in the German public appear to be multidimensional and multifaceted, even if they do not cover all the facets included in the scientific definitions. Most associations were not related to the loss or threat of biodiversity, which underlines the importance of a second stimulus that focuses more directly on loss. In summary, social researchers and policy makers can be confident that the general public has a broad understanding of biodiversity (Levé et al., 2019), which is a good starting point for individuals to recognize the consequences of biodiversity decline and could increase their willingness to support biodiversity conservation efforts and adopt sustainable practices.

4.2.2. Species loss and climate change: social representations of *biodiversity loss*

The word stimulus exercise on *biodiversity loss* showed that "species loss" and "climate change" were the most frequently mentioned associations in the social representations of the participants. Additionally, network statistics indicated that these two associations ("species loss" and "climate change") had the most connections to other associations and were identified as bridges from which further associations emanated, thereby predicting the flow of the network. This observation suggests that—climate change—one of

TABLE 5 Statistical network analysis for association networks of *biodiversity* (nodes = 51, edges = 367) and *biodiversity loss* (nodes = 35, edges = 175).

Biodiversity			Biodiversity loss		
Graph density	0.288		Graph density	0.294	
	Degree	Betweenness		Degree	Betweenness
Animal	0.92	0.28	Species loss	0.62	0.17
Plant	0.84	0.16	Climate change	0.62	0.12
Nature	0.66	0.05	Plant	0.53	0.08
Insect	0.56	0.04	Human	0.53	0.06
Human	0.52	0.02	Insect	0.47	0.04
Species diversity	0.48	0.02	Bee	0.47	0.03
[…]			[…]		
Individual	0.14	0.0003	Insect extinction	0.15	0.0077
Animal species	0.14	0.0009	Loss	0.15	0.0053
Animal welfare	0.12	0.0001	Forest decline	0.12	0.0009
Dog	0.12	0.0002	Sad	0.06	0.0006
Egg	0.10	0.0018	Tree extinction	0.06	0
Food	0.08	0.0004	Vegetable	0.03	0

All centrality measures were normalized. For better comparability, the presets of edge weight for the calculation of the statistics have been omitted. The presets are only used for the clarity of presenting the networks in Figures 2, 3. Original Gephi networks without any preset edge weight and the total results for statistical network analysis are provided in the Supplementary material.

the key drivers of biodiversity loss caused by human behavior—was present in the participants' thought processes and social representations of biodiversity loss (Mohaupt-Jahr and Küchler-Krischun, 2008; European Commission, 2019a). Hence, a competing environmental problem was at the center of the network and was likely used as a substitute association in this case. Although climate change and biodiversity loss are two related but different issues (Bosone and Bertoldo, 2022), the concept of climate change could be far more present in the public's perception than biodiversity loss, with the latter potentially being perceived as a lesser global environmental problem than climate change. These related issues may be difficult to separate because biodiversity loss could be perceived as just one aspect of other environmental problems (Kaltenborn et al., 2016; Legagneux et al., 2018). The participants in the study may have had difficulties in distinguishing between the related environmental issues of biodiversity and climate change. The perception of a close relationship between these two environmental issues was also shown in the recent *Weleda Nature-Study 2021* (Weleda, 2021), in which 53% of participants believed that intact biodiversity plays an important role in slowing down climate change. Conversely, even more participants (82%) were convinced that the loss of biodiversity accelerates climate change.

Therefore, as suggested by some researchers, it seems logical to embed the communication of biodiversity loss within the framework of the climate crisis (Veríssimo et al., 2014). However, due to the many other causes of biodiversity loss, we believe it is more appropriate to give the biodiversity crisis the same emphasis as that of climate change in politics, public discourse, and the media. Legagneux et al. (2018) noted that the inherent bias in communications about climate change and biodiversity is largely due to the Intergovernmental Panel on Climate Change (IPCC) being introduced twenty years before the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). The amount of news and information about climate change in the media has increased over time. This trend suggests that coverage and attention toward issues of biodiversity may also increase (Legagneux et al., 2018). To raise awareness and drive action on biodiversity loss, communication strategies that have been successful in addressing climate change could be employed. For example, these may include connecting people's values, using compelling narratives or stories, and disseminating effective imagery about threatened species to communicate action on biodiversity as a form of social belonging (Sippel et al., 2022).

Interestingly, with regard to *biodiversity loss*, the network showed that the terms "species loss – climate change – human" were very central to the network. A possible explanation for this observation is that the study participants considered climate change to be human-caused and that a perception of species loss was consequently formed. A report by the International Union for Conservation of Nature (IUCN) describes how species are already being affected by anthropogenic climate change, the rapid onset of which is limiting the ability of many species to adapt to their environments [International Union for Conservation of Nature (IUCN), 2019]. Climate change currently affects at least 10,967 species on the IUCN Red List of Threatened Species, thus increasing the likelihood of their extinction [International Union for Conservation of Nature (IUCN), 2019]. For biodiversity conservationists, the findings that humans may also perceive themselves as "polluters" in the concept of biodiversity could be an important factor to consider in communications about biodiversity. However, it must simultaneously be assumed that even if people do not believe that climate change is human-caused, species extinction is also associated with climate change.

Although changes in land use are one of the paramount causes of biodiversity loss (Sala et al., 2000; IPBES, 2019), social representations of *biodiversity loss* showed little association with this factor. This finding contradicts the assumption that, over the past few centuries, changes in land use have had a far greater

impact on ecological variables than climate change. Although land use seems not to be directly related to climate change, the effects of climate change have forced inhabitants in some regions to alter land use practices that ultimately affect ecosystems (Dale, 1997). Similarly, invasive alien species severely impact biodiversity (IPBES, 2019). Neither land-use changes nor invasive alien species were present in the social representations of the participants, even though these factors are assumed to directly result in biodiversity loss. Lipták et al. (2023) showed that the majority of the Czech and Slovak populations recognize that such invasions are a threat to native biodiversity. The authors suggested that access to self-education, particularly regarding invasive and protection measures, should be facilitated. Smartphone applications that provide comprehensive information on biological invasions and species identification guidance could be beneficial for users (Verbrugge et al., 2021). Moreover, the perception of the threat to biodiversity posed by invasive species may occur at the regional level (Lipták et al., 2023). In this case, further study of social representations of people in different regions would be required.

The fact that insects and bees appeared in the perceptions of participants for the term *biodiversity loss* is striking. This perception may be due to the sharp decline in insect populations in recent decades (Hallmann et al., 2017; Seibold et al., 2019). A study that used the stimulus word "insects" in a free word association test, suggested that the public seemed to be aware of the benefits of insects (Vlasák-Drücker et al., 2022). Moreover, respondents mainly associated "bees" with insects. Another study found highly positive attitudes toward the conservation of bees, and the authors recommended using bees as a flagship species to promote the local conservation of pollinating insects and to conserve biodiversity (Schlegel et al., 2015; Schönfelder and Bogner, 2017). These results suggest a need to highlight participants' representations of insects—particularly bees—for conservation communications that focus on the prevention of biodiversity loss. However, since participants' understanding of biodiversity loss may be constantly changing, it is also important to investigate social representations of the context of biodiversity and its loss on an ongoing basis.

4.2.3. Comparison of social representations of *biodiversity* and *biodiversity loss*

Commonalities can be found in both prompts in the top 10 associations, in the top 10 categories formed, and in the word pairs. This suggests overlaps that may be helpful in biodiversity conservation campaigns by indicating what is already most associated with biodiversity and its loss.

But results for the stimulus terms *biodiversity* and *biodiversity loss* revealed also many differences. First, a difference was observed in the associations between *biodiversity* and *biodiversity loss*. Significantly fewer associations were named for *biodiversity loss*. A possible reason for this finding is that the term "biodiversity" may cause difficulties for respondents; thus, naming associations for its loss would be difficult. Nevertheless, it should be emphasized that an association test on *biodiversity loss* was a unique feature of this study, and many associations were made.

Second, general differences in associations between *biodiversity* and *biodiversity loss* can be found in the connotations of the two terms' associations. Compared to the term *biodiversity*, negative associations such as "species loss" and "climate change" were mostly found with the term *biodiversity loss*. The biggest categories for *biodiversity loss* also contained associations describing human causes for the loss of biodiversity, along with associations addressing the extinction of species. More positive associations were mentioned for *biodiversity*, including "species protection," "species richness," and "sustainability." In general, fundamental differences appeared to exist in the perception and understanding of biodiversity and its loss. The associations had a range close to the dimensions of working definitions such as "species diversity" to different habitats such as "jungle," or "sea" to social representations such as "skin aging," "love," and "food."

Third, association networks clearly differed in terms of visualization. The *biodiversity* association network seemed much more densely populated, although its density differed only slightly from the values in *biodiversity loss* association network. However, more associations in the *biodiversity* network—and thus more connections—had stronger connections between individual associations. For example, "plant" and "nature" had high degrees of centrality in that these associations were frequently mentioned together. For *biodiversity loss*, which also contained "plant," and "nature," the associations were much weaker. The *biodiversity loss* network also showed many—though weaker—connections between individual associations. In both networks, terms with high betweenness centrality (as described above) were found in the center, just as lower betweenness centrality was found in the periphery, which is a common phenomenon (Cherven, 2015).

A particularly common feature of both networks was the association "human," which was anchored in the center of both networks and displayed a high degree and betweenness centrality. Presumably, humans are viewed as a factor in biodiversity and are understood to be an integral feature of the biodiversity concept, whether positive or negative. However, the respondents possibly perceived humans as the primary cause of biodiversity loss. When interpreting the present results, additional research on social representations may be required to investigate the role of humans in relation to their contact with nature. According to Bosone and Bertoldo (2022), individuals who frequently engage with nature had a greater awareness of the threat to biodiversity posed by human activities. Furthermore, such individuals tend to perceive this threat as being more imminent when compared to those who have limited exposure to nature. Also, people's own experiences of nature, and the feelings and impacts associated with it, could broaden their understanding of biodiversity and its loss (Levé et al., 2019).

Fourth, in the survey of associations on biodiversity loss, not only the stimulus word had a negative connotation, but the title of the questionnaire also framed the loss of biodiversity. A recent study, in the environmental field showed that negative framing can attract the attention of individuals in the general population; for example, through the image-framing of human-caused impacts on the environment (Salazar et al., 2022). For communicating results on biodiversity and its loss via framed messages, Kusmanoff et al. (2020) suggested that messages must include an emphasis on things that matter to the audience (e.g., by using "bridge" associations from the participants), reduce the psychological distance (e.g., providing temporal or spatial examples where biodiversity loss is obvious), exploit useful biases (e.g., between associations of technical or social dimensions), and, where possible, test different messages that communicate biodiversity and its loss. Nevertheless, it was noticeable

that aspects of protection were more often mentioned for *biodiversity*, (e.g., "species protection," "nature protection," and "animal welfare"). However, this does not mean that naming a corresponding association alone influences environmentally protective behavior.

4.3. Study limitations

The sample size of the study was relatively small for depicting an overall social representation of the German public. To offset this limitation, we controlled the samples as much as possible in terms of quotas. Moreover, expanded answer fields were deliberately provided to facilitate the collection of as many free word associations as possible.

Although participants were instructed to refrain from giving chain responses, we suspect that some participants did not always mentally return to the original stimulus.

Uncertainties were revealed at specific points of the inductive coding process. For example, many associations could have been coded into two or more categories. For the sake of clarity, double or more coding was performed within our study and on the networks. Associations such as "climate change" mainly triggered discussions between the two coders and were revisited even after assessing the terms for inter–coder–reliability. Since we wanted to maintain neutrality and coded associations with as little interpretation as possible, "climate change," for example, could be classified as either "anthropogenic causes" or "change." Thus, "climate change" was subordinated to the category "change" due to semantics. However, it should be noted that meaningful categorization requires knowledge of the association between a stimulus and its corresponding meaning (Lo Monaco et al., 2017). This requirement typically creates a challenge in interpreting the associations and is one of the most significant limitations. This task requires careful consideration of the context and meaning of the responses to determine a reliable and accurate social representation. In this type of analysis, associations are extracted from a broad context. Thus, the absence of contextualization hinders our comprehension of the intended meaning behind associations held by individuals. A potential solution was offered by Piermattéo et al. (2014), who recommended asking participants to write a sentence that expresses the meaning of their association in relation to the stimulus word—a technique referred to as "semantic contextualization" (Piermattéo et al., 2014; Lo Monaco et al., 2017).

Another difficulty was the creation of association networks. The clarity of the association network was highest for *biodiversity* when only the edges between associations occurring together at least three times were displayed; however, this filter setting was unsuitable for *biodiversity loss*. At the expense of uniformity, the edges between associations mentioned together twice were also visualized. In addition, we decided not to show all of the categories in color. Thus, in the present study, only the largest four categories are shown in color, plus an additional color for all other categories. We believed that this provided the network with a much clearer overview.

Association networks facilitate an overview of social representations but do not represent an individual network of a single participant. Moreover, due to time constraints, it was not possible to capture all associations for each individual. However, this limitation ensured that the associations were named as spontaneously as possible. Notably, in the brief time available, participants may not have been able to enter all of their associations in the fields provided.

Finally, the frequencies of word associations do not justify a direct inference of social representations (Wagner et al., 1996). However, the present study may provide a current indication of how the forms of understanding biodiversity and its loss are socially representative in Germany.

The Supplementary material contains the code book, original associations, and translations to make the process as transparent as possible and allow others to reconstruct our methodology for their own purposes. Despite these limitations, free word association tests remain a valuable tool for exploring social representations, provided the results are interpreted with these limitations in mind.

5. Conclusion

In the present study, social representations of the public regarding biodiversity and its loss were examined with the elicitation of free word associations and visualization via association networks. A process called "associative activation" underlies the events triggered when a participant views stimulus words. The elicited associations trigger many other associations in a spreading cascade of activity in the participant's thought process. Each element is connected to other elements and supports and reinforces the others. A word might evoke memories, which may subsequently evoke emotions or other representations (Kahnemann, 2012).

Our results indicate that participants were able to express a complex understanding of biodiversity and its loss, encompassing various dimensions. The social representations surveyed reflected positive and negative dimensions, social dimensions, aspects of scientific work definition, and the role of climate change as a key driver of biodiversity loss. The concept of biodiversity and its loss appears to be anchored in people's everyday practices and experiences. Thus, their social representations are presumably based on the shared knowledge, attitudes, and feelings that exist in German society. Previous studies measuring public understanding of biodiversity and its loss have focused on scientific terminology, revealing a lack of knowledge (Fischer and Young, 2007). These studies used a positivist approach that judged understanding as either "wrong" or "right." However, the present study took a social representation theory perspective and revealed that the German public has diverse meanings for the stimulus words "biodiversity" and "biodiversity loss." Understanding these representations is crucial for inferring the causal factors behind human thought processes and actions.

Furthermore, a novel approach to association networks that utilize the software for social network analysis was employed in the present study. Our association networks visualized the social representations described above and provided deeper insights into participants' perceptions and understanding of biodiversity and its loss. By employing methods that determine how people organize their thinking about biodiversity and its loss, it may be possible to assess this relationship with social representations. By using association network analysis, we were able to identify which social representations were most central and select those that might hold the greatest potential for biodiversity conservation, outreach, and educational programs. However, creating more associations in the minds of the public should not be the primary focus. Rather, we suggest that communications about biodiversity and biodiversity

loss should draw on existing ideas from the center or periphery of our network and embrace and strengthen the links between the network's existing ideas.

In conclusion, we argue that the general public's wide-ranging understanding of biodiversity and its loss should be recognized and incorporated into conservation management and further research on these concepts. Such initiatives may be needed to improve public support for biodiversity management; for example, to raise awareness of associations with invasive species and land use change, which are major causes of biodiversity loss that were underrepresented in this study. An adaptive understanding of representations of biodiversity and its loss may foster improved communication about biodiversity, conservation, and management measures (Buijs et al., 2008). Studying social representations may lead to improving a common understanding of biodiversity and its loss in the German public.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

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

AE: conceptualization, investigation, writing – original draft, formal analysis, visualization, and software. FK: investigation, methodology, writing – original draft preparation, and software. KN: conceptualization, investigation, methodology, writing – original draft preparation, and software. SH: validation and data curation. FF: conceptualization, investigation, writing – review and editing, resources, supervision, and project administration. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

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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.2023.1112182/full#supplementary-material

References

Albert, C., Luque, G. M., and Courchamp, F. (2018). The twenty most charismatic species. *PLoS One* 13:e0199149. doi: 10.1371/journal.pone.0199149

Bakhtiari, F., Jacobsen, J. B., Strange, N., and Helles, F. (2014). Revealing lay people's perceptions of forest biodiversity value components and their application in valuation method. *Glob. Ecol. Conserv.* 1, 27–42. doi: 10.1016/j.gecco.2014.07.003

Balvanera, P., Pfisterer, A. B., Buchmann, N., He, J. S., Nakashizuka, T., Raffaelli, D., et al. (2006). Quantifying the evidence for biodiversity effects on ecosystem functioning and services. *Ecol. Lett.* 9, 1146–1156. doi: 10.1111/j.1461-0248.2006.00963.x

Bastian, M., Heymann, S., and Jacomy, M. (2009). Gephi: an open source software for exploring and manipulating networks. *Int. AAAI Conf. Weblogs Social Media* 3, 361–362. doi: 10.1609/icwsm.v3i1.13937

Bauer, M. W., and Gaskell, G. (2008). Social representations theory: a progressive research programme for social psychology. *J. Theory Soc. Behav.* 38, 335–353. doi: 10.1111/j.1468-5914.2008.00374.x

Bele, A., and Chakradeo, U. (2021). Public perception of biodiversity: a literature review of its role in urban green spaces. *J. Lands. Ecol.* 14, 1–28. doi: 10.2478/jlecol-2021-0008

Bernardo, F., Loupa-Ramos, I., and Carvalheiro, J. (2021). Are biodiversity perception and attitudes context dependent? A comparative study using a mixed-method approach. *Land Use Policy* 109:105703. doi: 10.1016/j.landusepol.2021.105703

Borgatti, S. P., Geverett, M. G., Johnson, J. C., and Agneessens, F. (2022). *Analyzing social network using R* (*1st Edn*). Thousand Oaks, CA: SAGE Publications Ltd.

Bosone, L., and Bertoldo, R. (2022). The greater the contact, the closer the threat: the influence of contact with nature on the social perception of biodiversity loss and the effectiveness of conservation behaviours. *Sustainability (Switzerland)* 14:6490. doi: 10.3390/su142416490

Brennan, R. L., and Prediger, D. J. (1981). Coefficient kappa: some uses, misuses, and alternatives. *Educ. Psychol. Meas.* 41, 687–699. doi: 10.1177/001316448104100307

Buijs, A. E., Fischer, A., Rink, D., and Young, J. C. (2008). Looking beyond superficial knowledge gaps: understanding public representations of biodiversity. *Int. J. Biodivers. Sci. Manag.* 4, 65–80. doi: 10.3843/Biodiv.4.2:1

Cherven, K. (2015). *Mastering Gephi network visualization* (*1st Edn*). Birmingham: Packt Publishing.

Chivian, E., and Bernstein, A. (2010). "How our health depends on biodiversity" in *Center for Health and the global environment* (Boston, MA: Harvard Medical School)

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (*2nd Edn*). Mahwah, NJ: Lawrence Erlbaum Associates.

Cole, T. C. H. (2008). *Dictionary of biology-German/English*, (*4th Edn*). Berlin: Springer-Verlag.

Cole, T. C. H. (2015a). *Dictionary of animal names-Latin/English/German* (*2nd Edn*). Berlin: Springer-Verlag.

Cole, T. C. H. (2015b). *Dictionary of mammal names-Latin/English/German*. Berlin: Springer-Verlag.

Consumerfieldwork GmbH. (2020). *Panel Book Germany*.

Dale, V. H. (1997). The relationship between land-use change and climate change. *Ecol. Appl.* 7, 753–769. doi: 10.1890/1051-0761(1997)007[0753:TRBLUC]2.0.CO;2

Danowski, J. A. (1993). "Network analysis of message content" in *Progress in communication sciences*. eds. W. D. Richards and G. A. Barnett, vol. *7* (New York: Ablex Publishing Cooperation), 197–221.

Destatis (Federal Statistical Office). (2020). *Bildungsstand der Bevölkerung: Ergebnisse des Mikrozensus 2019*.

Destatis (Federal Statistical Office). (2021). *Bevölkerung und Demografie: Auszug aus dem Datenreport 2021*.

Destatis (Federal Statistical Office). (2022). Pressemitteilung Nr. 251: Bevölkerung Deutschlands im Jahr 2021 leicht gewachsen. Available at: https://www.destatis.de/DE/Presse/Pressemitteilungen/2022/06/PD22_251_12411.html (Accessed May 15, 2023).

Dikmenli, M. (2010). Biology student teachers' conceptual frameworks regarding biodiversity. *Education* 130, 479–489.

Dirzo, R., Young, H. S., Galetti, M., Ceballos, G., Isaac, N. J. B., and Collen, B. (2014). Defaunation in the Anthropocene. *Science* 345, 401–406. doi: 10.1126/science.1251817

Dörge, L., Büscher, M., Drews, J., Eylering, A., and Fiebelkorn, F. (2022). German Laypeople's willingness to donate toward insect conservation: application of an extended protection motivation theory. *Front. Psychol.* 12:3913. doi: 10.3389/fpsyg.2021.773913

Ehrlich, P. R., and Ehrlich, A. H. (2013). Can a collapse of global civilization be avoided? *Proc. R. Soc. B Biol. Sci.* 280:20122845. doi: 10.1098/rspb.2012.2845

European Commission. (2019a). *Special Eurobarometer 481: Attitudes of Europeans towards biodiversity-summary - en*. Kantar Public Brussels.

European Commission. (2019b). *Special Eurobarometer 481: Attitudes of Europeans towards biodiversity-factsheets Germany - en*. Kantar Public Brussels.

Eylering, A., Büscher, M., Funk, M., Boldt, J., and Fiebelkorn, F. (2022). Willingness of the German population to donate toward bird conservation: an application of the protection motivation theory. *Global Ecol. Conserv.* Kantar Public Brussels.38:e02176. doi: 10.1016/j.gecco.2022.e02176

Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMU) and Federal Agency for Nature Conservation (BfN). (2019). *Nature awareness study-public survey of nature and biodiversity*.

Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUB). (2007). *National Strategy on biological diversity*.

Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUB). (2015). *Nature conservation action Progamme 2020*.

Fiebelkorn, F., and Menzel, S. (2013). Student teachers' understanding of the terminology, distribution, and loss of biodiversity: perspectives from a biodiversity hotspot and an industrialized country. *Res. Sci. Educ.* 43, 1593–1615. doi: 10.1007/s11165-012-9323-0

Fischer, A., and Young, J. C. (2007). Understanding mental constructs of biodiversity: implications for biodiversity management and conservation. *Biol. Conserv.* 136, 271–282. doi: 10.1016/j.biocon.2006.11.024

Gayford, C. (2000). Biodiversity education: a teacher's perspective. *Environ. Educ. Res.* 6, 347–361. doi: 10.1080/713664696

Hallmann, C. A., Sorg, M., Jongejans, E., Siepel, H., Hofland, N., Schwan, H., et al. (2017). More than 75 percent decline over 27 years in total flying insect biomass in protected areas. *PLoS One* 12:e0185809. doi: 10.1371/journal.pone.0185809

Hartmann, C., and Siegrist, M. (2020). Our daily meat: justification, moral evaluation and willingness to substitute. *Food Qual. Prefer.* 80:103799. doi: 10.1016/j.foodqual.2019.103799

Inkscape Project, (2022). *Inkscape*. Available at: https://inkscape.org

International Union for Conservation of Nature (IUCN). (2019). Issues brief: Species and climate change. Available at: https://www.iucn.org/resources/issues-brief/species-and-climate-change

International Union for Conservation of Nature (IUCN). (2022). The IUCN red list of threatened species. Version 2022-1. Available at: https://www.iucnredlist.org

IPBES (2019) in *Global assessment report of the intergovernmental science-policy platform on biodiversity and ecosystem services*. Key Messages. B. Direct and indirect drivers of change. eds. E. S. Brondizio, J. Settele, S. Díaz and H. T. Ngo (Bonn: IPBES Secretariat)

Jose, S. B., Wu, C. H., and Kamoun, S. (2019). Overcoming plant blindness in science, education, and society. *Plants People Planet* 1, 169–172. doi: 10.1002/ppp3.51

Kahnemann, D. (2012). *Thinking, fast and slow*. London: Penguin Books Ltd..

Kaltenborn, B. P., Gundersen, V., Stange, E., Hagen, D., and Skogen, K. (2016). Public perceptions of biodiversity in Norway: from recognition to stewardship? *Nor. Geogr. Tidsskr.* 70, 54–61. doi: 10.1080/00291951.2015.1114518

Kilinc, A., Yeşiltaş, N. K., Kartal, T., Demiral, Ü., and Eroğlu, B. (2013). "School students' conceptions about biodiversity loss: definitions, reasons, results and solutions" in *Research in Science Education*, vol. *43* (Amsterdam: Kluwer Academic Publishers), 2277–2307.

Kostova, Z., and Radoynovska, B. (2008). Word association test for studying conceptual structures of teachers and students. *Bulgarian J. Sci. Educ. Policy* 2, 209–231.

Kusmanoff, A. M., Fidler, F., Gordon, A., Garrard, G. E., and Bekessy, S. A. (2020). Five lessons to guide more effective biodiversity conservation message framing. *Conserv. Biol.* 34, 1131–1141. doi: 10.1111/cobi.13482

Landis, J. R., and Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics* 33, 159–174. doi: 10.2307/2529310

Leandro, C., and Jay-Robert, P. (2019). Perceptions and representations of animal diversity: where did the insects go? *Biol. Conserv.* 237, 400–408. doi: 10.1016/j.biocon.2019.07.031

Legagneux, P., Casajus, N., Cazelles, K., Chevallier, C., Chevrinais, M., Guéry, L., et al. (2018). Our house is burning: discrepancy in climate change vs. biodiversity coverage in the media as compared to scientific literature. *Front. Ecol. Evol.* 5:175. doi: 10.3389/fevo.2017.00175

Leiner, D. J. (2019). SoSci survey (Version 3.4.03) [computer software]. Available at: https://www.soscisurvey.de

Levé, M., Colléony, A., Conversy, P., Torres, A. C., Truong, M. X., Vuillot, C., et al. (2019). Convergences and divergences in understanding the word biodiversity among citizens: a French case study. *Biol. Conserv.* 236, 332–339. doi: 10.1016/j.biocon.2019.05.021

Lindemann-Matthies, P., and Bose, E. (2008). How many species are there? Public understanding and awareness of biodiversity in Switzerland. *Hum. Ecol.* 36, 731–742. doi: 10.1007/s10745-008-9194-1

Lipták, B., Kouba, A., Patoka, J., Paunović, M., and Prokop, P. (2023). Biological invasions and invasive species in freshwaters: perception of the general public. *Hum. Dimens. Wildl.* 1–16, 1–16. doi: 10.1080/10871209.2023.2177779

Lo Monaco, G., Piermattéo, A., Rateau, P., and Tavani, J. L. (2017). Methods for studying the structure of social representations: a critical review and agenda for future research. *J. Theory Soc. Behav.* 47, 306–331. doi: 10.1111/jtsb.12124

Marková, I. (2008). The epistemological significance of the theory of social representations. *J. Theory Soc. Behav.* 38, 461–487. doi: 10.1111/j.1468-5914.2008.00382.x

McGowan, J., Beaumont, L. J., Smith, R. J., Chauvenet, A. L. M., Harcourt, R., Atkinson, S. C., et al. (2020). Conservation prioritization can resolve the flagship species conundrum. *Nat. Commun.* 11:14554. doi: 10.1038/s41467-020-14554-z

Menzel, S., and Bögeholz, S. (2009). The loss of biodiversity as a challenge for sustainable development: how do pupils in Chile and Germany perceive resource dilemmas? *Res. Sci. Educ.* 39, 429–447. doi: 10.1007/s11165-008-9087-8

Mohaupt-Jahr, B., and Küchler-Krischun, J. (2008). Die Nationale Strategie zur Biologischen Vielfalt Herausforderung für die Gesamte Gesellschaft. *UWSF-Z Umweltchem Ökotox* 20, 104–111. doi: 10.1065/uwsf2008.03.239

Moloney, G., Leviston, Z., Lynam, T., Price, J., Stone-Jovicich, S., and Blair, D. (2014). Using social representations theory to make sense of climate change: what scientists and nonscientists in Australia think. *Ecol. Soc.* 19:319. doi: 10.5751/ES-06592-190319

Moscovici, S. (1961). La psychanalyse, son image et son public. Paris: Presses Universitaires de France.

Moscovici, S. (2000). *Social representations. Explorations in social psychology*. Cambridge: Polity Press.

Nature and Biodiversity Conservation Union (NABU). (2023). NABU. Available at: https://www.nabu.de

Piermattéo, A., Lo Monaco, G., Moreau, L., Girandola, F., and Tavani, J. L. (2014). Context variations and pluri-methodological issues concerning the expression of a social representation: the example of the gypsy community. *Span. J. Psychol.* 17:E85. doi: 10.1017/sjp.2014.84

Rädiker, S., and Kuckartz, U. (2019). *Analyzing qualitative data with MAXQDA*. New York: Springer VS.

Sala, O. E., Stuart, F., Iii, C., Armesto, J. J., Berlow, E., Bloomfield, J., et al. (2000). Global biodiversity scenarios for the year 2100. *Science* 287, 1770–1774. doi: 10.1126/science.287.5459.1770

Salazar, G., Monroe, M. C., Ennes, M., Jones, J. A., and Veríssimo, D. (2022). Testing the influence of visual framing on engagement and pro-environmental action. *Conserv. Sci. Pract.* 4, 1–12. doi: 10.1111/csp2.12812

Saunders, C. D., Brook, A. T., and Eugene Myers, O. (2006). Using psychology to save biodiversity and human well-being. *Conserv. Biol.* 20, 702–705. doi: 10.1111/j.1523-1739.2006.00435.x

Schendera, C. (2007). *Datenqualität mit SPSS*. Munich: Oldenbourg Wissenschaftsverlag.

Schlegel, J., Breuer, G., and Rupf, R. (2015). Local insects as flagship species to promote nature conservation? A survey among primary school children on their attitudes toward invertebrates. *Anthrozoös* 28, 229–245. doi: 10.1080/08927936.2015.11435399

Schneiderhan-Opel, J., and Bogner, F. X. (2019). Between environmental utilization and protection: adolescent conceptions of biodiversity. *Sustainability* 11:517. doi: 10.3390/su11174517

Schönfelder, M. L., and Bogner, F. X. (2017). Individual perception of bees: between perceived danger and willingness to protect. *PLoS One* 12:e0180168. doi: 10.1371/journal.pone.0180168

Seibold, S., Gossner, M. M., Simons, N. K., Blüthgen, N., Müller, J., Ambarlı, D., et al. (2019). Arthropod decline in grasslands and forests is associated with landscape-level drivers. *Nature* 574, 671–674. doi: 10.1038/s41586-019-1684-3

Siipola, E., Walker, W. N., and Kolb, D. (1955). Task attitudes in word association, projective and nonprojective. *J. Pers.* 23, 441–459. doi: 10.1111/j.1467-6494.1955.tb01168.x

Sippel, M., Shaw, C., and Marshall, G. (2022). Ten key principles: How to communicate climate change for effective public engagement. Climate Outreach Working Paper. Available at: https://ssrn.com/abstract=4151465

Sockhill, N. J., Dean, A. J., Oh, R. R. Y., and Fuller, R. A. (2022). Beyond the ecocentric: diverse values and attitudes influence engagement in pro-environmental behaviours. *People Nature* 4, 1500–1512. doi: 10.1002/pan3.10400

Swingland, I. R. (2001). "Biodiversity, definition of" in *Encyclopedia of biodiversity*. *2nd* ed (Amsterdam: Elsevier Inc.), 377–391.

Szalay, L. B., and Deese, J. (1978). "Subjective meaning and culture: an assessment through word associations" in *American anthropologist* (Mahwah: Lawrence Erlbaum Associate, Inc)

Turner-Erfort, G. (1997). Public awareness and perceptions of biodiversity. *Trans. Ill. State Acad. Sci.* 90, 113–121.

United Nations Conference on Environment and Development (UN). (1992). *Convention on biological diversity*.

van Weelie, D., and Wals, A. E. J. (2002). Making biodiversity meaningful through environmental education. *Int. J. Sci. Educ.* 24, 1143–1156. doi: 10.1080/09500690210134839

VERBI Software. (2021). MAXQDA 2022 [computer software]. Available at: https://www.maxqda.com

Verbrugge, L. N. H., Dawson, M. I., Gettys, L. A., Leuven, R. S. E. W., Marchante, H., Marchante, E., et al. (2021). Novel tools and best practices for education about invasive alien species. *Manag. Biol. Invasions* 12, 8–24. doi: 10.3391/mbi.2021.12.1.02

Veríssimo, D., Macmillan, D. C., Smith, R. J., Crees, J., and Davies, Z. G. (2014). Has climate change taken prominence over biodiversity conservation? *Bioscience* 64, 625–629. doi: 10.1093/biosci/biu079

Vlasák-Drücker, J., Eylering, A., Drews, J., Hillmer, G., Carvalho Hilje, V., and Fiebelkorn, F. (2022). Free word association analysis of Germans' attitudes toward insects. *Conserv. Sci. Prac.* 4:e12766. doi: 10.1111/csp2.12766

Wagner, W. (2020). "Social representation theory: an historical outline" in *Oxford research encyclopedia of psychology* (Oxford: Oxford University Press)

Wagner, W., Valencia, J., and Elejabarrieta, F. (1996). Relevance, discourse and the "hot" stable core of social representations - a structural analysis of word associations. *Br. J. Soc. Psychol.* 35, 331–351. doi: 10.1111/j.2044-8309.1996.tb01101.x

Weleda (2021). Vielfalt?! Unverzichtbar! *Weleda Natur Studie* 2021. Available at: https://www.weleda.de/naturstudie-2021 (Accessed May 15, 2023).

Zemits, B. (2006). Biodiversity: who knows, who cares? *Aust. J. Environ. Educ.* 22, 99–107. doi: 10.1017/S0814062600001415

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Mapping energy citizenship in the south of Europe

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The adoption of new global approaches in the field of energy democratization requires inquiring into how people act to shape the energy system. This is where the concept of energy citizenship (ENCI) appears as a constellation of actors that enable and/or support citizens to became active participants in the debates and energy systems both in private and public sphere, or as a collective citizen that contributes to change (Pel et al., 2021). The aim of this paper is to explore the concept of ENCI in Southern Europe. Using a mixed approach, an extensive mapping of 43 ENCI initiatives in Spain (n = 29) and Portugal (n = 14) was conducted through desktop research, and a stakeholder consultation workshop (n = 7) was carried out through a focus group. Results revealed the major presence of collective ENCI types, with the *citizen-based/hybrid* one standing out (e.g., energy cooperatives). Most of them were motivated by the interest to contribute to energy transition or to produce and/or use renewable energy, and aimed at promoting energy saving, energy justice and reducing the carbon footprint. The general tendency is towards active participation (in Spain) and transformative forms (in Portugal). The possibilities for citizen control in the initiatives analysed is still limited. These results were confirmed by stakeholders who, additionally, pointed out the major political, social, economic, and geographical factors related to ENCI forms. In short, various types of ENCI could be validated in the Spanish and Portuguese context, showing a commitment to sustainability, democracy, and energy justice. Other non-evidenced forms may be raised as a challenge to further in-depth research on latent forms of ENCI in Southern Europe.

KEYWORDS

energy citizenship, social innovation, sustainable transition, energy governance, citizen empowerment, energy democracy

1. Introduction

The complex challenges of climate change, environmental degradation, and biodiversity loss have long signalled the need for fast-paced sustainability transitions. Such transitions imply profound changes in our current systems of production and consumption, including food, mobility, energy, and the built environment (Vita et al., 2020). The last Intergovernmental Panel on Climate Change (IPCC) report signalled that ambitious targets are needed to maintain global temperatures below 1.5 degrees' increase, compared to 1990 levels, and pointed to the need for systemic social and cultural transformations, alongside technological innovation to reach them (Intergovernmental Panel on Climate Change, 2022).

Transforming energy systems and behaviours is an important goal of the European Green Deal, through the Renewables Directive (RED II) and the Internal Electricity Market Directive (IEMD) which introduce both the *prosumer* and a framework to facilitate the development of energy communities. The shift towards renewable energy sources (RES) and the need for deep transformations in energy production and consumption patterns have also led to a reconceptualization of the role of different actors in the energy system, from one that is centralized, dominated by experts and characterized by top-down decision-making, to one that is de-centralized, democratic and horizontal, and in which citizens engage actively and assume a variety of roles and responsibilities.

The concept of energy *citizenship* (hereafter ENCI) has been proposed as a construct that emphasizes more active participation in the shaping of the energy system, towards more sustainable and democratic forms (Devine-Wright, 2007). It has evolved both as a scientific concept and as an imaginary of active and engaged citizens who democratically and collaboratively shape the energy system (Pel et al., 2021). It alludes to the idea of normative commitments and responsibilities in sustainability transformations and responds to a policy desire to build broader acceptability for the fast-paced and often quite radical changes needed stay within planetary boundaries (Rockström et al., 2009). It also points to a certain normative ideal of an enlightened, ecologically-minded citizenship (Pel et al., 2021).

Taking a critical perspective, scholars have argued that traditional forms of energy system organization tend to rely on a social representation of the citizen as passive, and lacking the interest, knowledge, and responsibility to participate in shaping the energy system. An alternative representation emerged that framed energy as a social necessity and the citizen as an active participant in its transformation (Devine-Wright, 2007). Although the neoliberal and more radical forms of ENCI share a core vision of the active citizen, they differ on the prominence they assign to the private versus public spheres of action and to the consideration they give to power relations and the limitations they impose on individual agency (Lennon et al., 2020). While the active-passive distinction refers to behaviour or action, in its ideal version, the concept of ENCI involves particular assumptions regarding individual capacities and profiles. Levels of knowledge, awareness, motivations to act, and skills are assumed. Also, the ideal energy citizen engages in political action in a continuum between the private and the public sphere, and between the system-confirming and system-opposing extremes.

Such a representation entails, in the private sphere, a vision of the energy citizen as someone who expresses herself politically through conscious consumerism. She makes purchase decisions that consider the energy footprint of products, and installs house technologies that contribute to energy efficiency, through monitoring and actions to reduce overall consumption. Within the public sphere, she pays attention to energy debates and expresses positions actively through voting, or the lending of support to various initiatives and movements (e.g., signing petitions, maybe joining a manifestation). Such a perspective has been criticized as reflecting a neoliberal perspective of the citizen as consumer and a constraining public sphere of participation, where questions of exclusion and inequality are avoided (Lennon et al., 2020). A less constraining perspective on citizenship focuses on the active energy citizen as deeply engaged in participation processes to shape the energy transition. A certain type of compliant participation, whereby citizens endorse the basic tenets of the centralised energy system and/or its pathways towards change or transformation (e.g., by focusing the debate on where to install solar panels or windmills) is treated as desirable, with the overall objectives centred on endorsement or acceptability of the top-down policies. In this predominantly top-down approach, participation is equated to active engagement within an agenda set by public officials and endorsed by technical experts.

In contrast, advocates for a bottom-up approach to participation, and an enlarged sphere for citizen engagement with energy system transformation (Lennon et al., 2020) place their empirical and policy focus on the higher-commitment required in starting or joining of energy cooperatives, becoming a prosumer, or joining social movements to change energy systems, lifestyles, or patterns of production and consumption. This type of energy citizen endorses ideals of sustainability, believes in her capacity to act on goals that matter to her (Avelino et al., 2020) and becomes creative in generating the social relations and systems that can support a relocation of citizenship within wider contexts of social engagement in the energy system (Defila et al., 2018; Mullally et al., 2018), as notions such as social innovation have proposed. The active versus passive distinction of ENCI places the emphasis on the acting (knowledgeable and caring) individual, versus the non-acting (ignorant, disinterested) individual. From a business as usual, system-confirming perspective, acting includes classical political behaviour, with its private versus public sphere variants, with empirical manifestations such as conscious consumerism, voting, participating in public consultations and even joining an energy cooperative to have access to RES. From a system transformation or social innovation perspective, acting involves a deeper questioning of existing structures for engagement and participation, and actions or behaviours to enlarge the potential for action, through engagement in collectives and social movements.

This, in turn, has raised the questions of forms of energy citizenship encountered in practice and conditions of, and barriers to, active participation and empowerment of citizens. ENCI has come to include both individual and collective forms of manifestation (Defila et al., 2018; Mullally et al., 2018; Lennon et al., 2020). In the individual sphere, environmentally friendly energy behaviours, decisions to invest in energy efficient and smart technology, to shift to RES, become a prosumer or be an activist for the transformation of the energy systems have been included as manifestations of ENCI. In the collective sphere, manifestations such as energy communities, energy-related social innovation movements, as well as political militancy for the transformation of the energy system, have been considered. Furthermore, the multiplicity of types of engagement with the energy system raises the question of the extent to which they actually have the ambition or manage to contribute to energy system transformation in practice.

Research on social innovations in the energy domain has highlighted their transformative ambitions for empowerment, challenging of power relations and incorporating values of community, solidarity, and authenticity in the organization of the energy system (Wittmayer et al., 2022). Social innovation has been defined as changes in social relations that involves new ways of knowing, doing, organizing, and framing (Pel et al., 2021). Empirical research on social innovations has looked at the impacts they seek, in terms of changes in more or less institutionalized social relations, values, as well as practices and behaviours, which have been highlighted as more important than only focusing on changes in the organization and

institutionalized decision-making structures of the energy system (Avelino et al., 2020). Moreover, environmental awareness, critical insight and the capacity for political mobilization have also been signalled as important outcomes of participatory energy movements and communities (Smith et al., 2016; Pel et al., 2022a).

Citizen participation in the energy system is not an all-or-nothing issue, so it is not possible to refer to what is and is not an energy citizen, nor to a single typology of ENCI (Pel et al., 2021) as it will depend on various factors that define in each context "new roles and responsibilities of citizens in an energy system in a constant transformation" (Van Wees et al., 2022, p. 1). Notable examples of ENCI in the framework of democratising the energy system through social innovations include energy-related grassroots initiatives (Hewitt et al., 2019), which stand out for their potential to promote individual and collective capacity to meeting certain social needs and achieve sustainability goals (Vita et al., 2020; Strasser et al., 2022); for example, by generating and distributing renewable energy whose benefits accrue to citizens themselves; by proposing alternative forms of individual or collective living and housing that are self-sufficient; by generating new forms of participation in the public sphere; and by mobilizing public opinion and voting in favour of energy transition policy measures.

Several authors refer to the concept of ENCI as a useful construct to differentiate the various forms of citizen participation in the energy transition (Campos and Marín-González, 2020) or the adoption of different roles in the energy system (e.g., as consumer, protester, supporter, or prosumer) (Ringholm, 2022; van Wees et al., 2022). ENCI might thus take different forms in practice, and empirical manifestations might differ from the ideal type forms described above (Devine-Wright, 2007).

To make sense of this diversity, and to guide empirical research, a typology of ideal-type forms of ENCI was developed, using two key organizing dimensions: agency whether they take the form of individual commitments, values and behaviours, or to collective forms of participation in the energy system, such as energy cooperatives or communities aiming to promote energy system transformation; and their result-orientation, which can be either reformative or transformative, understood here in terms of the nature of the aims they pursue (Pel et al., 2022a). The typology includes ten ideal-type cases of energy citizenship (Figure 1). Through these ideal types it is possible to describe different forms of energy citizenship, ranging from manifest and visible forms to latent forms, which can only be detected empirically (Debourdeau et al., 2021; Pel et al., 2021, 2022a). All these concepts should be understood within a continuum, and not as opposing poles under which ENCI types are based.

Building on this typology, the present paper zooms in on the empirical manifestations in Southern Europe, in particular in Spain and Portugal. The latest European Parliament Barometer reports (European Commission, 2021) reveal that European citizens consider climate change as one of the most serious problems in the world, followed by poverty, hunger and lack of water. It is ranked as a priority in Northern and Central European countries (e.g., Denmark, Sweden, and the Netherlands), and is also higher than in previous reports in southern European countries such as Spain, Portugal, and Italy. Furthermore, recent data from the Barometer of Attitudes towards the Environment (European Commission, 2020) place Spain and Portugal in the middle of the EU-27 in considering environmental protection as a very important element and show higher concern than in previous years. In Spain, citizens tend to be in favour of the energy transition and the low-carbon economy, although they leave the ultimate responsibility to national governments (67%), companies and industry (60%) or the EU itself (58%), and to a lesser extent, they assume their own responsibility for action (42%), or that of environmental groups (32%). Similarly, in Portugal it is a priority to be addressed mainly by the EU (64%), government (57%) and industry (48%), and to a lesser extent by citizens (43%) and environmental groups (23%).

Despite such apparently promising numbers, some studies have concluded that countries such as Spain or Portugal are lagging behind in terms of energy transition, democratization, and citizen empowerment (Hewitt et al., 2019) as well as in the involvement of civil society in the energy transition, more broadly (Soeiro and Ferreira, 2020).

The present paper aims to identify and analyse the types of energy citizenship that can be encountered in the south of Europe on the basis of different approaches: on the one hand, exploring the characteristics (such as motivations and objectives for their development, agency and outcome orientation) of the ENCI types in the Spanish and Portuguese context; and on the other hand, putting the focus on a particular Spanish region, near to Portugal in order to analyse the social, political, economic and geographical factors that favour or hinder the development of the aforementioned ENCI types.

2. Methodology

We used a mixed methodological design to identify the forms of energy citizenship and their characteristics in Spain and Portugal and to understand the conditions that foster or hinder different forms in this region of Europe.

Previous research has identified different types of energy initiatives present in EU countries. These previous efforts, such as the database created in the H2020 Energise project (Jensen et al., 2017) or cases studied in other EU projects on energy transitions and social innovations were used as a starting point to create a comprehensive catalogue of approximately 600 ENCI initiatives in Europe.

For the selection of the initiatives, unified criteria were established by the consortium: only European initiatives were included, meaning those active either in the European Union, in the EEA or in ascension countries; and that were currently active or had concluded after 2015, when the EU Energy Strategy was published. Five criteria for the selection of cases were used: (a) type of geographical area covered by the initiative (rural, peri-urban and urban); (b) main focus of the initiative, differentiating between those whose direct focus is energy production and consumption, those who address mobility, and those who try to foster sustainable lifestyles from a more holistic perspective, with indirect effects on energy system transformation; (c) type of agency exhibited by the case, either individual or collective and the sphere in which it operates (private, organisational, public, citizenship-based or hybrid, and social movements); (d) outcome orientation, either reformative or transformative, and (e) attention paid to gender and issues of equity, more broadly.

The initiatives selected as meeting the above criteria were mapped through their websites and official documents. The H2020 Energy Prospects consortium designed a survey (Survey Monkey, Vadovics et al., 2022) related to the 5-level approach to identify and classify the different cases and to describe their characteristics. A set of research

OUTCOME-ORIENTATION	AGENCY				
	INDIVIDUAL			COLLECTIVE	
	PRIVATE	ORGANISATIONALLY EMBEDDED (E.G. WORKPLACE)	PUBLIC	CITIZEN-BASED AND HYBRID	SOCIAL MOVEMENTS
	Manifest and latent forms can be differentiated				
REFORMATIVE INCREMENTAL SOCIO-TECHNICAL CHANGE LOW ENERGY DEMOCRACY SHALLOW ENVIRONMENTAL SUSTAINABILITY	1. DO THEIR BIT (in the household) Complying with the green energy transition	3. DO THEIR BIT (within organisations) Energy citizenship within organisations	5. MAKE THEIR VOICE HEARD Participating in societal energy discussions	7. DO THEIR SHARE Joining green energy projects	9. DO THE JOB Facilitating the energy transition through alignment activities
TRANSFORMATIVE RADICAL SOCIO-TECHNICAL CHANGE HIGH ENERGY DEMOCRACY DEEP ENVIRONMENTAL SUSTAINABILITY	2. DO THEIR OWN (in the household) The change-making energy citizen	4. DO IT THEIR WAY (within organisations) The energy-related change maker in organisations	6. MAKE THEIR VOTE COUNT Mobilising votes for energy transition	8. GO AHEAD Building, expanding and linking citizen-based organisational forms	10. MAKE THEIR CLAIMS Protesting against the current energy system

FIGURE 1
Overview of the ten types of ENCI. Extracted from Debourdeau et al. (2021, p. 35).

questions were formulated for each of the cases. These were included in the online survey tool and case researchers were asked to provide an answer based on extended analyses of case documents. The questions included: basic information about the case and the documents used to analyse it; basic characteristics of the case; its objectives and motivations, results, and progress towards objectives; the evolution of the case, including its start, changes over time and reasons for termination, if the case; the actors involved; the governance structure, functioning and funding; and specific questions regarding the theoretical ENCI typology to test (i.e., individual/collective agency, and reformative/transformative outcome orientation).

To both validate and deepen the analysis on the regional characteristics of the different ENCI cases encountered (Pel et al., 2022b) a stakeholder consultation workshop was held energy citizenship experts and stakeholders in Galicia (a Spanish region bordering the Portuguese territory) with which, historically, it has been twinned for reasons of language, proximity, and transnational cooperation.

The purpose of this workshop was to refine the ideal ENCI typologies with key informants, for which seven mainly non-academic ENCI experts and practitioners were selected to discuss key aspects of their experiences with the typology developed in Debourdeau et al. (2021). This workshop was carried out simultaneously by several partners in different regions (Berlin, Germany; Budapest, Hungary; and Galicia, Spain; and Wallonia, Belgium). A common script was used by the different partners; that is: *could you identify two regional examples of ENCI; could you identify one example of ENCI for each type of agency? could you identify two examples of reformative/transformative ENCI? what are the social, political, economic, and geographical factors that favour/hinder the emergence of ENCI types in the region?*

For the selection of informants, a series of steps were carried out: first, an extensive review of different governmental organisations, companies, and various intermediary institutions in Galicia and with a high level of knowledge on the subject (more or less explicitly) was carried out. A database was created with the most relevant information regarding 42 organisations and their representatives (names, contacts, location); secondly, the database was filtered to seek representativeness of the three sectors: Government, intermediaries of the Civil Society and Business; thirdly, contact was established by e-mail with 3–4 agents for each of the three sectors. Finally, seven experts from all over Galicia participated and signed their consent to record the meeting to facilitate its subsequent transcription and authorised the use of the data derived from the event. Each participant had a high-decision making level in his/her organisation, included one of the biggest energy providers, two officials from local and regional public administration and one from a regional delegation of a national centre, one member of a R&D centre, and two representatives of institutions in the construction sector, one of them coming from a non-profit association.

The workshop was held in one morning, from 11 am-14 pm. It was structured in such a way that, at the beginning, members of the research team gave an overview of the project and the ENCI typology (Figure 1) just to structure and focus the workshops. Through the common questions, discussion was opened, and a broader systematic exploration was possible. Conceptual categories were further explored in the context of the social, cultural, economic, and geographical conditions that give rise to ENCI forms. Six people moderated the three-hour workshop in a hybrid format. The role of the moderators was that of modest facilitators, alternating short introductions to the topics with individual and group work and collective discussions afterwards.

3. Results

Results that are presented below give an overview of the representative and visible ENCI types in the Spanish and Portuguese territories. Note that the theoretical model of ideal ENCI types tries to reflect all the possibilities of agency and outcomes, but the aim of

TABLE 1 Potential Spanish and Portuguese ENCI initiatives by geographical location and aim.

		Spain		Portugal		Total	
		n	%	*n*	%	*n*	%
No. ENCI cases		29	67.44	14	32.56	43	100
Geography	Rural	7	77.78	2	22.22	9	20.93
	Peri-urban area	4	100	0	0	4	9.30
	Urban area	4	57.14	3	42.85	7	16.28
	Several/all of above	12	60	8	40	20	46.51
	Non-relevant distinction (virtual case)	2	66.67	1	33.33	3	6.97
Main focus	Direct energy production/consumption	15	71.43	6	28.57	21	2.33
	Mobility	0	0	1	100	1	48.84
	Holistic/focus on broader change	14	66.67	7	33.33	21	48.84

this study is just to verify which of these ideal types fit with the reality studied. So, this mapping was carried out under demanding criteria (see *methodology*) and, as a result, it has revealed initiatives that are manifested in the territory. Latent initiatives may have remained hidden, as well as some others that do not have information available to the public (necessary for the mapping) or that are not known by people involved in the Galician region (stakeholders' workshop).

3.1. Results of energy citizenship mapping

The Spanish and Portuguese mapping included 43 cases distributed throughout the peninsular and insular territory. Table 1 shows a comparison between both countries in terms of potential ENCI initiatives by geographical area covered and aim.

Initiatives covering several geographical areas (rural, peri-urban, and urban) were the most prominent in both Spain ($n = 12$) and Portugal ($n = 8$). As for their aim, initiatives were considered if they fell into one of the following categories: (a) focusing specifically on energy consumption and production, (b) on mobility (car-free living, cycling related cases, travel less, no-flight initiatives), or (c) fostering a holistic perspective to sustainable lifestyle change with implications for energy production and consumption (carbon footprint reduction, communities, sufficiency-oriented cases). Initiatives directly related to production and consumption were the most prominent in Spain ($n = 15$), while holistic cases stood out in Portugal ($n = 7$), as well as one case related to mobility.

In terms of the types of agency characterizing the initiatives, a small percentage of them were individual cases (scientists who become activists, individuals who care about carbon footprint reduction and are an example of this, influencers, people who live self-sufficiently) and the majority were of the collective type (citizens as minority shareholders in a wind or solar farm project; ECs or cooperatives; non-profit organizations promoting debate on and acceptance of transmission power lines and grid development; climate protest movements). However, access to information regarding individual cases was challenging, as many were not sufficiently documented to carry out desk-based mapping. Thus, most of the initiatives identified in the mapping were collective types, with only two cases of individual agency in Spain (6.89%) and none for Portugal.

Table 2 presents the distribution of the potential ENCI according to the type of agency (individual/collective) and the outcome orientation of the initiatives (reformative/transformative), as well as within the former, the sphere in which it operates (private, organisational, public, citizenship-based or hybrid, and social movements). Citizen-based/hybrid ENCI type was the most prominent in both countries. This type of collective agency stood out both for initiatives with reformative and transformative outcomes. Also, some private initiatives (individual and reformative) were found, especially in the case of Spain. At the organisational level, no noteworthy initiatives were found in Portugal, and few were found in Spain. Social movements stood out slightly more in Portugal. There were no initiatives analysed whose main typology was considered public (individual). Only in the Spanish case was there one initiative that was considered, secondarily, as a possible individual - public reformatory type (e.g., Granada in Transition). As for the focus on issues related to disadvantaged groups (e.g., those in fuel poverty, minorities, etc.), five of the 43 initiatives were found to be of this concern, all of them from Spain. Other initiatives may be addressing this issue in a less focused way.

Regarding the empirical manifestations of ENCI in Southern Europe[1], generally the Spanish and Portuguese initiatives that stand out are those initiated by interested citizens (e.g., cooperatives, social protest movements); others are also promoted by public bodies after observing one or more needs in a group of people (e.g., electrification programmes in isolated areas, installation of renewable energy plants in specific locations) or in society (e.g., educational projects, dissemination, and information to citizens). The highest proportion of initiatives have been created in the last 15 years: $n = 18$ (41.9%) between 2011 and 2015 and $n = 7$ (16.3%) between 2016 and 2020 and in equal number between 2006 and 2010. In Spain, the greatest boost to ENCI initiatives occurred in 2011–2015 ($n = 14$, 48.3%) and in Portugal, in equal proportion between 2011–2015 and 2016–2020 ($n = 4$, 28.6%).

Figures 2, 3 graphically represent the main motivations and objectives/ambitions in both contexts (see Supplementary material of information on each initiative).

1 A complete table is presented as supplementary material. It presents a general overview of the mapping carried out in the two contexts studied, incorporating descriptive information on the main characteristics of each initiative.

TABLE 2 Potential Spanish and Portuguese ENCI initiatives according to the type of agency and outcomes orientation.

Outcome orientation		Type of agency												
		Individual							Collective					
		Spain		Portugal		Total			Spain		Portugal		Total	
		n	%	*n*	%	*N*	%		*n*	%	*n*	%	*N*	%
Reformative	Private sphere	7	70	3	30	10	23.8	Citizen-based/ hybrid	5	55.6	4	44.4	9	21.4
	Organizational sphere	3	100			3	7.1	Social movement	2	66.7	1	33.3	3	7.1
Transformative	Private sphere	2	66.7	1	33.33	3	7.1	Citizen-based/ hybrid	7	63.6	4	36.4	11	26.2
	Organizational sphere	1	100			1	2.4	Social movement	1	50	1	50	2	4.8
	Totals					17	40.4						25	59.6

No cases of individual agency in the public sphere were obtained, so this table does not include ENCI Types 5 and 6 referred to in Figure 2.

As shown in Figure 2, in both countries, the main motivation for ENCI initiatives is the contribution to the energy transition (e.g., ZERO or PEGADAS in Portugal; EOLPOP or Madrid 100% Sostenible in Spain), followed also in both cases as one of the second motivations the production and/or use of renewable energy (e.g., Som Energía, GoiEner in Spain; and EnergizAir and DecoProteste in Portugal). In Spain, the second main motivation was also found to be the recognition of the seriousness of climate change (e.g., Energia Comunitaria); while in Portugal, discontent that the energy transition is not going fast enough (e.g., EuroToptenAct). No cases have been found that have, as their main motivation, examples of previous initiatives initiated by other people, and only in one Spanish case (O Couso Project) the definition of their motivations was not explicit from the beginning.

In terms of the objectives/ambitions that guided the creation of these initiatives, Figure 3 highlights the promotion of energy saving (e.g., BEHAVE and TRIBE in Spain - although these initiatives were also implemented in Portugal; and EnergizAir in Portugal), followed in the Spanish case by energy justice (e.g., Energy Audits of Friends of the Earth Spain), and in the Portuguese case, by the reduction of the carbon footprint (e.g., EcoCommunities).

In relation to their level of approximation to passive/active and reformative/transformative forms, Figure 4 shows the positioning of the cases around these two values along a scale of 0–100 points. The general tendency is towards active ($M = 65.79$, $SD = 25.66$) and transformative ($M = 52.93$, $SD = 33.19$) forms. It was slightly higher the level of active participation of the Spanish citizen in ENCI initiatives ($M = 67.83$, $SD = 24.29$) compared to Portugal ($M = 61.57$, $SD = 28.65$), and the reverse for the outcomes desired, being slightly more transformative in Portuguese initiatives ($M = 53.93$, $SD = 34.09$) compared to Spanish ones ($M = 52.45$, $SD = 33.35$). Together, it is observed that the more active the initiatives aim to be in both countries, the greater their commitment to transformative outcomes ($r = 0.656$, $p < 0.001$), which is also observed through the fit line in Figure 4 representing the trend of the data based on the regression for each of the two countries.

In terms of the connection of these initiatives to the wider context, Figure 5 shows the differences in areas of action (private/public and individual-collective).

The main ENCI forms in both countries were the collective ones, with the *citizen-based/hybrid* type standing out, especially ECs and cooperatives (e.g., Pegadas Guimaraes, Coopernico, Valle de las Sensaciones, SomEnergía). These are actions that require a direct involvement of the citizenry, either in its less active and more dependent form on the organisation, as occurs in the reformative vision (e.g., BEHAVE, Luz en Casa Oaxaca, GoiEner), or by promoting radical changes where the citizen is empowered and deeply involved in the changes to be produced in the energy system, as occurs in the transformative perspective (e.g., TRIBE, Banc D'Energia). It should be noted that it is not a question of "all or nothing," but that there are different degrees, as can be seen in Figure 5.

In the field of individual actions, the reformative private ENCI forms (e.g., Solar Garden, Campanha On–Off) in which the citizen introduces changes in his or her consumption behaviour linked to the purposes of the transition stood out. These are changes that, although they maintain an idea of energy as a "commodity (supply, demand and price are the priority), they also represent necessary options on the road to the energy transition."

Also, some initiatives were represented in several of the ENCI typologies since their objectives include several actions. For example, in Portugal, the ZERO Association stands as a type of collective movement, which seeks to play an active role in institutional dialogue with the government, with the national and European Parliament and with the different political parties, as well as in regional and local communities, municipal councils and other stakeholders, such as associations and citizens' movements; but in addition to public action, the members of the association seek to raise awareness and influence in a properly structured and reasoned way, thus gaining credibility in the eyes of society and decision-makers. Another example is On–Off Campaign, which is situated between collective and individual action, since it focuses both on governmental practices that seek to raise awareness by providing individuals with information on consumption, and on individual practices in which each citizen introduces improvements in their consumption patterns at home. In Spain, #NoMásCortesdeLuz platform arose as a social protest movement of diverse actors who call for demonstrations in different cities for promoting energy democracy and social justice,

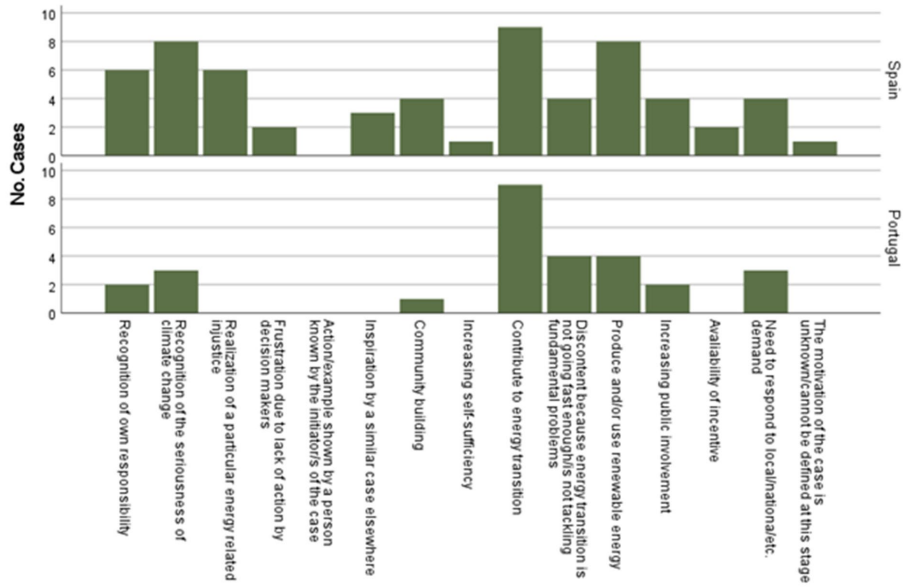

FIGURE 2
Main motivations for initiating the case in the Spanish and Portuguese ENCI initiatives. Own elaboration.

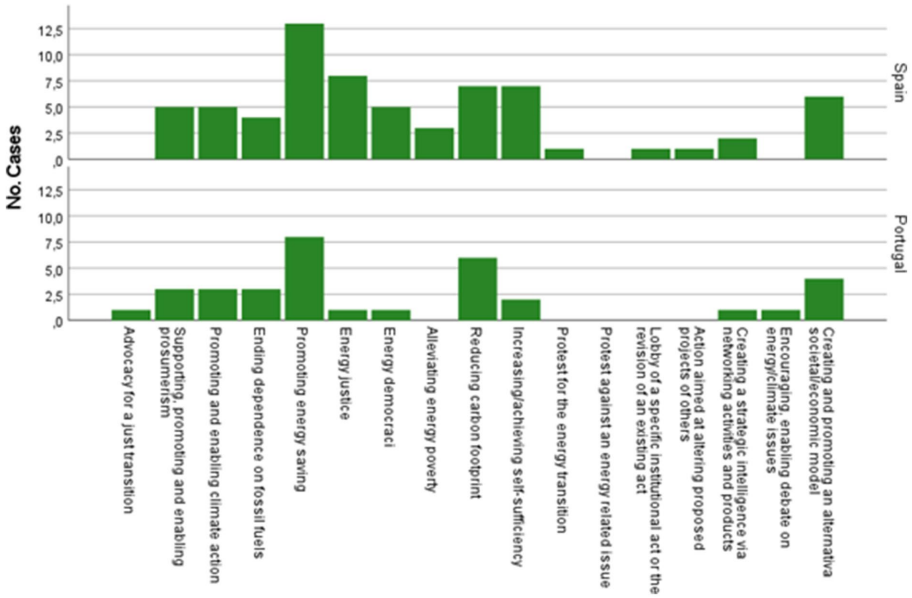

FIGURE 3
Main objectives/goals for initiating the case in the Spanish and Portuguese ENCI initiatives. Own elaboration.

but also refers to individual actors who are called to participate in the signing of the manifesto.

Finally, regarding the public-private distinction, two other elements define forms of organisation and initiatives closer to what is understood by ENCI, and those are represented graphically in Figure 6.

In the upper part of Figure 6, we refer to the level of involvement of citizens in the institutional sphere of the market and government is referred. Different levels of hybridisation, which still seem to be in incipient stages of development in Southern Europe stood out. Only 6.9% of the initiatives (Spain) reach the highest level, while in most cases in both countries they are in their lowest form. The lower part of Figure 6 shows the proportion of initiatives in which citizens have been shown to have effective power/control within the initiative. In a high proportion - although less than 50% - in both contexts, initiatives have been identified in which the citizen is given a voice, not only as an invited party to the deliberative processes, but as a central axis of the transformative process, sufficiently empowered to exercise control and to make their voice predominate over the rest (e.g., Pegadas Gimaraes; EcoVila).

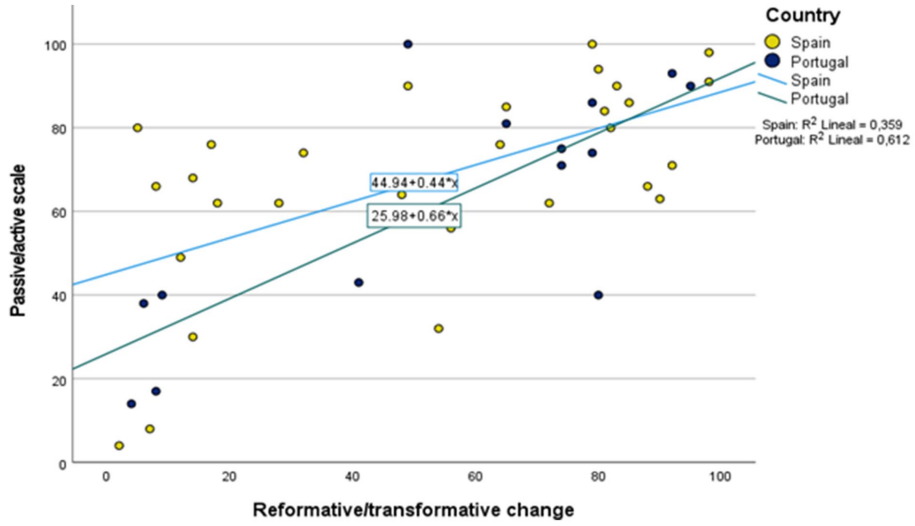

FIGURE 4
Characteristics of the Spanish and Portuguese cases in relation to their approach to active/passive and transformative/reformative forms of ENCI. Own elaboration.

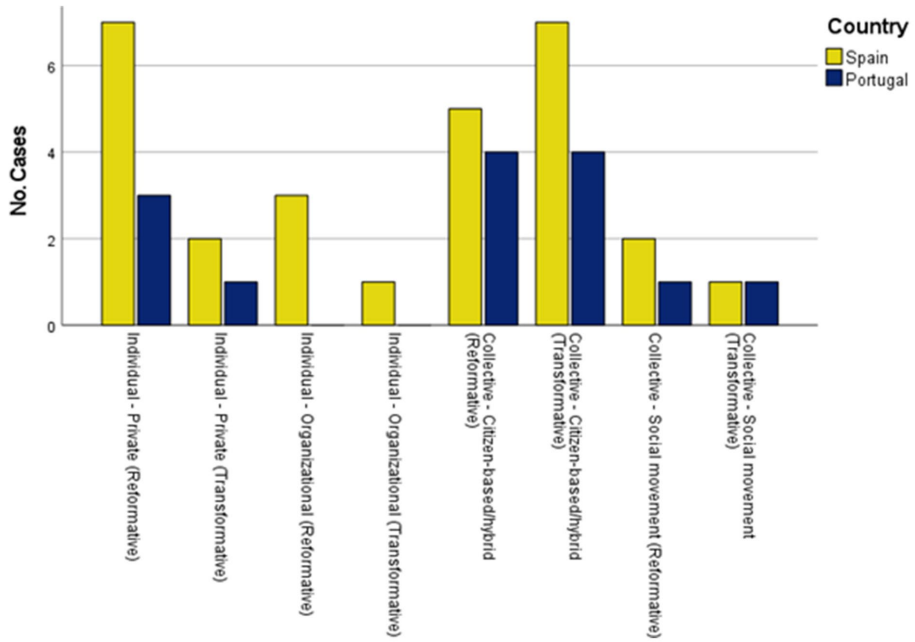

FIGURE 5
Main type of Spanish and Portuguese ENCI in relation to their private-public/individual-collective distinction. Own elaboration.

3.2. Results of the stakeholders' consultation workshop[2]

Considering the results of the initial mapping of initiatives close to ENCI in the Iberian Peninsula and the island territory, it was proposed to go further in validating the typology seeking potential drivers and barriers to their development, from the perspective of various stakeholders. The discussion revealed multiple facets of the concept of ENCI, as shown in Figure 7.

The discourse of stakeholders provided information on the different socio-cultural, political, and economic factors that underlie the development of ENCI types, and how the geographical context may favour or hinder certain forms.

Firstly, in coherence with current European policies that call for a reconceptualization of the role of the citizen, participants stated that a paradigm shift is taking place that can be empowering for individual ENCI types by placing "the citizen at the centre of everything, from a

2 The coding used for the quotations presented here refers to officials from local (A1), regional (A2) and a regional delegation of a national center (A3), representatives of an energy supply company (B1) and a small construction company (B2) and representatives of an R&D center (C1), and of a non-profit association (C2).

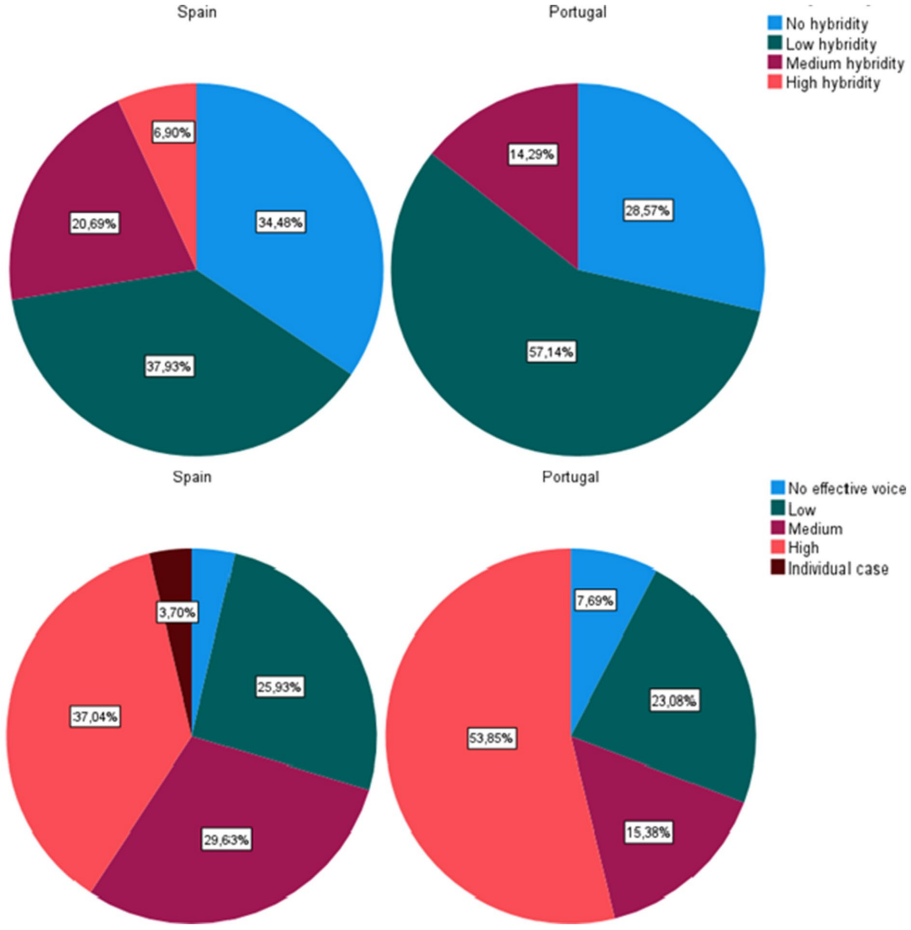

FIGURE 6
Distinction between Spanish and Portuguese ENCI according to their level of hybridity and effective citizen power/control. Own elaboration.

FIGURE 7
ENCI translations in the Galician context. The colour and size indicate the frequency of occurrence of the concepts.

more passive figure, more on the side-lines, to the centre" (A3). The energy citizen is defined as "a person or group of people who are aware of the energy impacts of their daily activity, or even their business" (C1), i.e., in their immediate context; but reference was also made to their key role in bringing about change in the wider energy system, through minimising the economic and environmental impact of energy production and consumption, challenging the current energy system, and as an agent of choice, with options and able to choose for themselves ["the citizen is a true citizen. You can choose, and you have a choice, and you have the ability to choose based on your choices"

(B1)]. Indeed, part of the discussion was also devoted to the concept of the individual energy citizen at the level of active energy consumer ["we are now seeing how this citizenship is being empowered and transformed from passive energy consumers to a term that I think is now quite widespread, which is prosumer" (C1)].

Along with the political factor, reference was made to the social factor, in terms of knowledge and access to information available to citizens ["there is misinformation about energy and options" (C2)]. The responsibility for keeping citizens informed and educated lies both with policy makers ["this pedagogy has to come from those who give grants" (B2)] and with citizens and their willingness to transform the current energy system ["everyone will have to become an energy citizen: individual citizens, neighbourhood communities, mountain communities, medium, small and large municipalities, autonomous regions, states and the world, and small, individual, large and very large companies" (A1)].

The economic factor has also been considered a key axis in promoting and limiting the development of ENCI types. Economic support is considered essential for the individual to become an active consumer ["when there are subsidies, people move. There are few people who have enough resources to isolate themselves, for example, if there is no subsidy" (B2)].

Moreover, the development of ENCI types in the Galician territory is not only conditioned by social and structural factors (political and economic), but a key aspect appears in this context: the geographical dimension. The ECs stood out for "the existence and heritage of mountain lands and the creation of joint mountain communities in which they joined forces to minimise the impacts of being isolated" with "public-private collaboration" (A1). The geographical dispersion of the territory, together with political interest, has had a positive impact on the emergence of this collective of ENCI types. Likewise, also derived from the socio-cultural interest it has been possible to recognise latent types, e.g., environmental awareness movements, were also referred to since "we are increasingly aware of what our activity implies and worries us" (A3). In the private sphere, they highlighted "the figure of the prosumer" (B1). It involves individual actions from *some citizens* (e.g., solar panels on the roof; heat pumps; house wrappers; or move to 100% mobility with an electric car…), through the business environment (e.g., membership of companies in industrial estates "through this traditional organizational form that was intended to look after their communal forests") or under the mediation of local government (e.g., public-private partnerships between companies in the port, with support from the municipality).

The incipient nature of many of the initiatives in a reformative typology was recognized ["what we see is the beginning of initiatives of this type in a phase that is super-embryonic despite the fact that there are already concrete grants or support funds" (C1); "the development of unique projects related to local energy communities" (A2)]. Furthermore, there was pointed out the existence of a base (or heritage) deeply rooted in Galicia of other collective initiatives that "as a social group that is already empowering itself and trying to generate its own energy" (C1) represent "the union of citizens, entities that generate, consume and manage their own energy, in principle, of renewable origin" (A2). Along with this, the role of small and medium-sized enterprises that act as intermediaries ["facilitators and managers for the beneficiary" (A2)] was mentioned, especially in matters of supporting bureaucratic processes that can be an obstacle to the more active involvement of citizens ["the bureaucratic part they demand from us is impossible" (B2)].

In short, energy citizenship is considered a key element in the transition towards a sustainable, fair, and democratic energy system ["precisely the future that awaits us. Energy, which is free, accessible to citizens, but we do not have to buy it, we do not have to manufacture it, we have it at our disposal at any time" (A1)]. Achieving greater energy democracy involves using the SI to find new economic models, new forms of coexistence compatible with a sustainable future that involve "all citizens, communities, small businesses, medium-sized businesses, large businesses" (B1), as well as social models that promote "energy sovereignty, savings and address the problem of energy poverty" (C2).

4. Discussion

The purpose of this study was to unpack the empirical manifestations of energy citizenship in the south of Europe. Through desktop research, case analysis and a regional workshop, the ENCI types in Spain and Portugal, examples based on the individual/collective and reformative/transformative typology, as well as facilitating and hindering factors in Galicia have been identified. These points, which respond to the specific objectives of the work, are discussed below.

In response to the first specific objective, the mapping showed a greater presence of initiatives that emerge from citizen interest in the Spanish and Portuguese context (e.g., cooperatives, social protest movements), as well as others that arise from the needs identified by public bodies. In the Spanish and Portuguese contexts, the concern of national and local governments to implement measures that are consistent with the guidelines established by Europe to achieve climate neutrality by 2050 is evident (European Commission, 2019). What these data provide us with is a clearer vision of the role being played jointly by citizens, who are active and interested in adopting a more active role in the energy transition, and political actors, who promote greater citizen participation in democratic and horizontal decision-making processes.

In Spain, the *recognition of the seriousness of climate change* and the *production and/or use of renewable energy* are the main motivations behind energy citizenship initiatives. These data are promising in light of the information provided in the report elaborated by the independent researcher and consultancy Delft (2016), which reveals the enormous potential of renewable projects in the hands of Spanish citizens, with 16.4 million people able to participate in the electricity sector thanks to renewable energies. The initiatives analysed in Spain and Portugal share the motivation to contribute to the energy transition ($n = 9$ cases each), with both countries being in an optimal situation to do so. According to the Energy Transition Index (World Economic Forum, 2021), which compares the energy system performance of different countries, both Spain and Portugal are in the ranking of advanced economies, ranking 17th, and 19th respectively, out of a total of 115 participating countries. This index is not only based on the idea of political and economic development of countries, but also considers the extent to which countries are prepared for the transition to a secure, sustainable, affordable, and reliable energy future. This considers both the design of policies and their social impact, as well as the trust that citizens place in institutions to achieve a just transition.

Thus, the recognition of the existence of socio-environmental problems, along with the trust in the responsible institutions and a willingness to invest in the energy transition are key to achieving

greater citizen engagement (Ideara, 2021). From such motivations derive objectives and ambitions such as the *promotion of energy savings, energy justice*, or *carbon footprint reduction efforts*. These results are comparable to those of Campos and Marín-González (2020) who highlighted the relevance given by Portuguese and Spanish initiatives (as well as others from other countries in territorial proximity such as France or Italy) - mainly collective, such as, e.g., local communities - to the link between energy justice and co-ownership in energy generation.

Regarding the second specific objective, a general trend towards active and transformative forms of energy citizenship was found. Specifically, the most active ENCI forms were found in Spain; however, less active and engaged forms, or even non-visible (latent) forms, should not be forgotten as they represent different levels of citizen participation, interest, and empowerment within an initiative and in the wider energy system (Pel et al., 2021). In this sense, the concepts used of low or high energy democracy, active or passive, and reformative or transformative energy citizenship are interpreted along a continuum, as opposed to an "all or nothing" perspective. Within this continuum, several initiatives (e.g., Zero, Smarter Together, La Flor de la Vida) have a high level of citizen participation, while in others the level of citizen participation was lower (e.g., DecoProteste, EcoCasa, Parque Eólico El Hierro). The vision guiding these initiatives is at the basis of these possible differences in levels of participation; from those that aim to implement measures and actions for citizens (e.g., educate and raise awareness on climate change, implement actions by engaging citizens) to those that do so with citizens (e.g., build a more cohesive world, deliver smart and inclusive solutions, contribute to improve self-efficiency). All of them can be meaningful and useful for different energy actors, depending on their individual possibilities (in terms of time, economic, social and knowledge resources, motivation, and interest) and collective possibilities (as a participant and/or member of an initiative) to act in the energy system by making their voice heard in the initiative and beyond it. What is clear is that the higher or lower level of participation have also been related to the reformative or transformative character of energy citizenship initiatives.

A wide look at the set of initiatives allows, therefore, to evidence different forms of citizen involvement, which may offer different results in terms of the capacity to transform the current energy system. Initiatives with a more transformative character and participatory governance structures were more prevalent in Portugal, especially collective initiatives (e.g., energy communities, cooperatives). Energy citizenship initiatives in the south of Europe focus on issues such as energy saving and efficiency, circular economy and the development of research and technological innovation in renewable energies (Campos and Marín-González, 2020). In Spain, there is evidence of an increasing desire to contribute to deep = and radical changes towards environmental sustainability, although reformative initiatives (focusing on incremental changes and less participatory) still predominate. Nevertheless, a problem of some initiatives that have a commitment to deep (transformative) environmental sustainability, shared by the (collective) citizenry, is that they tend to start before regulation is in place, which hinders or diminishes their chances of receiving the necessary economic and social support to develop effectively and/or durably over time (Capellán-Pérez et al., 2018).

Precisely, the analysis of economic and political factors, together with social and geographical factors, was the third goal of the present work. It was found that the appropriate climatic conditions for different renewable energies (e.g., wind), the geographical dispersion of territory and ownership (division in land ownership) and the existence of rural regions without many economic opportunities, but with strong social and cultural roots, have made energy communities to be seen as a very interesting solution by local populations and received the support of public administrations. Indeed, ENCI initiatives were seen as key in the transition from a *model of representative democracy* to a *model based on participatory democratic engagement*, as well as a shift from the idea of passive consumption to *prosumerism* (production and consumption of goods and services), especially when it comes to making improvements or designing living spaces that reduce carbon emissions or encourage self-consumption in individual dwellings. These findings are consistent with the decentralised democratisation model proposed by Thombs (2019), which showed that the democratisation of the social (political, economic, and civil spheres) can lead to democratic outcomes (participatory, associative, and deliberative processes), justice (in the distribution of cost-benefits, social representation, and access to decision-making) and ecological outcomes (reduction of energy use and GHG emissions). However, it has become evident how the development of ENCI initiatives can be constrained by issues such as rural communities' distrust of alternative land use initiatives, or concerns related to energy markets, instabilities, political systems, among others, which hinder the acceleration of energy transformations and ultimately affect citizens' decisions on their commitment to the transition towards democratic and socially responsible forms of energy.

The discourse of representatives of the Government, Business and intermediaries for the Civil Society has revealed the confrontation in relation to the responsibility for the slow development of these initiatives in the Galician territory. The business and social sector has criticised the lack of local regulation, and the insufficiency of urban planning and citizen information, while the local administration points out that what is lacking is a change of mentality and support from local agents, given the limitations that local governments have in terms of human, technical and economic resources. It is of great concern to note the reluctance of the population to trust public institutions (Ideara, 2021), especially if we consider that, as we pointed out in response to objective 1, a large part of the initiatives is promoted by public authorities. Additional data is provided by Eurobarometer (2022) No. 527 which refers to the lack of trust in regional, municipal, and local authorities (54% Spain; 49% Portugal) and in the government (57% Spain; 49% Portugal).

Hence the need to be cautious about urging citizens to take responsibility and raise expectations about their contribution to the energy transition, when they may not be able to do so, which can have a disempowering effect (Lennon et al., 2020). In the Galician case, there seems to be a strong interest of citizens to act in an energy sustainable way in their homes (e.g., solar panels, purchase of electric vehicles, or replacement of the boiler by heat pumps) and a huge potential for citizens to be autonomous and independent in their energy management and consumption. But when these individual forms are not backed up by proper regulation, and by capacity building and financial support from state/public institutions, success is limited.

5. Conclusion

ENCI refers to a broad, complex construction, loaded with interpretations dependent on political, social, cultural, and economic factors, and it is not possible to refer to a single type of initiatives or to

an *optimal* level of energy citizenship, but to varied forms influenced by elements of awareness, motivation and concern for the energy system and its consequences on climate change.

This study has sought to shed light on this question by showing that, under different political ideals of ENCIs, particular forms of active, engaged, and empowered citizenship are assumed. However, it is not possible to refer to a single type of ENCI initiatives or to an *optimal* level of energy citizenship, but rather to varied forms influenced by different sets of individual, social and political conditions. The mapping of initiatives in Spain and Portugal has revealed diverse manifestations of energy citizenship that, more overtly or latently, show a commitment to move towards a governance model where power and control are in the hands of citizens, where change occurs in the wider energy system, and where there is a strong commitment to sustainability, democracy, and energy justice. Achieving profound transformations in values, belief systems and relationships with the environment and between individuals will require, on the part of these initiatives, a continuous effort of creativity to offer innovative responses adapted to the relational and organisational conditions of each geographical context, together with the search for more active citizen participation in building consensus around the objectives and priorities of Spanish and Portuguese societies in the framework of the energy transition.

What can be observed in Southern Europe is an incipient development of citizen-based initiatives actively engaged in the development of profound changes in the energy system. In this respect, a predominance of collective forms and, to a lesser extent, incipient forms of individual and private reform actions were found. Regarding the classification of active-passive ENCI in this study, some caution is recommended in its interpretation so as not to run the risk of limiting our knowledge by "framing citizens' actions in a single category" (Pel et al., 2021, p. 20). On the contrary, under the different political ideals of the ENCIs, particular forms of active, engaged, and empowered citizenship are assumed. Similarly, different levels of deepening or questioning of existing structures have been observed between the initiatives analysed in Spain and Portugal. The existence of socio-environmental problems (Ideara, 2021; Linares et al., 2022) awakens in people feelings of indignation and injustice that can materialise in collective actions against those responsible for the environmental problem, for example, public authorities (Eurobarometer, 2022). Additionally, the study of the Galician region revealed the presence of facilitating and limiting factors at the political and economic, geographical, and socio-cultural levels. This has been key to a deeper understanding of the predominant presence of collective and reformative types in Southern Europe.

Some limitations deriving from the methodology employed should be highlighted. As one of the criteria for the mapping is the availability of sufficient information on the initiative, it is possible that many valuable initiatives have not been considered, and especially individual forms of energy citizenship were not sufficiently included. Future research should also more in-depth research on the mapped initiatives could delve deeper into the motives behind citizens creating or joining ENCI initiatives, the level to which they feel they have autonomy, capacity, and control over the energy decisions they make, as well as the resources available to them and conferred by the initiative itself to act in the wider system.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

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Conflict of interest

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

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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.2023.1112457/full#supplementary-material

References

Avelino, F., Dumitru, A., Cipolla, C., Kunze, I., and Wittmayer, J. (2020). Translocal empowerment in transformative social innovation networks. *Europ Plan Stud* 28, 955–977. doi: 10.1080/09654313.2019.1578339

Campos, I., and Marín-González, E. (2020). People in transition: energy citizenship, prosummerism and social movements in Europe. *Ener Res Soc Sci* 69:101718. doi: 10.1016/j.erss.2020.101718

Capellán-Pérez, I., Campos, A., and Teres-Zubiaga, J. (2018). Renewable energy cooperatives as an instrument towards the energy transition in Spain. *Ener Pol* 123, 215–229. doi: 10.1016/j.enpol.2018.08.064

Debourdeau, A., Schäfer, M., Pel, B., Kemp, R., Vadovics, E., and Dumitru, A. (2021). Conceptual Typology. EnergyPROSPECTS Deliverable 2.2, European Commission

Grant Agreement No. 101022492. Available at: https://www.energyprospects.eu/results/deliverables (Accessed July 31, 2023).

Defila, R., Di Giulio, A., and Ruesch Schweizer, C. (2018). Two souls are dwelling in my breast: uncovering how individuals in their dual role as consumer-citizen perceive future energy policies. *Ener Res Soc Sci* 35, 152–162. doi: 10.1016/j.erss.2017.10.021

Delft, CE (2016). The Potential for Energy Citizens in the European Union. Available at: http://bit.ly/energycitizenstudy (Accessed July 31, 2023).

Devine-Wright, P. (2007). "Energy citizenship: psychological aspects of evolution in sustainable energy technologies" in *Governing Technology for Sustainability*. ed. J. Murray (UK: Routledge), 63–86.

Eurobarometer (2022). Fairness Perceptions of the Green Transition – Spain. Available at: https://europa.eu/eurobarometer/surveys/detail/2672 (Accessed July 31, 2023).

European Commission (2019). The European green Deal. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1576150542719&uri=COM%3A2019%3A640%3AFIN (Accessed July 31, 2023).

European Commission (2020). Attitudes of Europeans Towards the Environment. Eur. Secur. 501. Available at: https://europa.eu/eurobarometer/surveys/detail/2257 (Accessed July 31, 2023).

European Commission (2021). Climate Change. Special Eurobarometer 513. Available at: https://europa.eu/eurobarometer/surveys/detail/2273 (Accessed July 31, 2023).

Hewitt, R. J., Bradley, N., Baggio, A., Barlagne, C., Ceglarz, A., Cremades, R., et al. (2019). Social innovation in community energy in Europe: a review of the evidence. *Front Energ Res* 7, 1–27. doi: 10.3389/fenrg.2019.00031

Ideara (2021). La Sociedad Española ante el Cambio Climático. Percepción y Comportamientos en la Población [Report]. Available at: https://accesoesee.idearainvestigacion.com/Informe_sociedad_espa%C3%B1ola_CC_2020.pdf (Accessed July 31, 2023).

Intergovernmental Panel on Climate Change (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

Jensen, C.L., Fahy, F., Goggins, G., Heaslip, E., Vadovics, E., Vadovics, K., et al. (2017). Comprehensive Open Access Dataset of Sustainable Energy Consumption Initiatives (SECIS), ENERGISE Deliverable 2. European Commission Grant Agreement No. 727642. Available at: https://helda.helsinki.fi/server/api/core/bitstreams/8d30bfa8-9dd7-48fe-91eb-b7983de3b5c1/content (Accessed July 31, 2023).

Lennon, B., Dunphy, N., Gaffney, C., Revez, A., Mullally, G., and O'Connor, P. (2020). Citizen or consumer? Reconsidering energy citizenship. *J Envir Pol Plan* 22, 184–197. doi: 10.1080/1523908X.2019.1680277

Linares, P., Romero, J. C., Rodríguez Matas, A. F., and Pérez Bravo, M. (2022). "La descarbonización del sistema energético español: retos y oportunidades" in *Informe España 2022*. eds. A. Coords, A. Blanco, J. A. Chueca, López-Ruiz and S. Mora (Spain: University of Comillas), 377–454.

Mullally, G., Dunphy, N., and O'Connor, P. (2018). Participative environmental policy integration in the Irish energy sector. *Env Sci Pol* 83, 71–78. doi: 10.1016/j.envsci.2018.02.007

Pel, B., Debourdeau, A., Kemp, R., Dumitru, A., Schäfer, M., Vadovics, E., et al. (2021). Conceptual Framework Energy Citizenship, EnergyPROSPECTS Deliverable 2.1, European Commission Grant Agreement No. 101022492. Available at: https://www.energyprospects.eu/results/deliverables (Accessed July 31, 2023).

Pel, B., Debourdeau, A., Kemp, R., Dumitru, A., Vadovics, E., Schäfer, M., et al. (2022a). Energy Citizenship; Ideals, Ideal Types, and Ideology in the Energy Transition, Conference: European forum for Studies of Policies for Research and Innovation (EU-SPRI), Utrecht (NL).

Pel, B., Fransolet, A., Debourdeau, A., Losada Puente, L., Vadovics, E., Schäfer, M., et al. (2022b). Regional Workshops: 'Translating Energy Citizenship', EnergyPROSPECTS Deliverable 2.3, European Commission Grant Agreement No. 101022492. Available at: https://www.energyprospects.eu/results/deliverables (Accessed July 31, 2023).

Ringholm, T. (2022). Energycitizens – conveyors of changing democratic institutions? *Cities* 126:103679:103678. doi: 10.1016/j.cities.2022.103678

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S. III, Lambin, E., et al. (2009). Planetary boundaries: exploring the safe operating space for humanity. *Ecol. Soc.* 14:32. doi: 10.5751/ES-03180-140232

Smith, A., Hargreaves, T., Hielscher, S., Martiskainen, M., and Seyfang, G. (2016). Making the most of community energies: three perspectives on grassroots innovation. *Env Plan A* 48, 407–432. doi: 10.1177/0308518X15597908

Soeiro, S., and Ferreira, M. (2020). Motivations for Integrating a Renewable Energy Community: Evidence for Spain and Portugal. 17th International Conference on the European Energy Market (EEM), 1–6.

Strasser, T., de Kraker, J., and Kemp, R. (2022). Network leadership for transformative capacity development: roles, practices and challenges. *Glob Sustain* 5, 1–12. doi: 10.1017/sus.2022.6

Thombs, R. P. (2019). When democracy meets energy transitions: a typology of social power and energy system scale. *Ener Res Soc Sci* 52, 159–168. doi: 10.1016/j.erss.2019.02.020

Vadovics, E., Vadovics, K., Zsemberovszky, L., Asenova, D., Damianova, Z., Hajdinjak, M., et al. (2022). Methodology for Meta-Analysis of Energy Citizenship, EnergyPROSPECTS Deliverable 3.1, European Commission Grant Agreement No. 101022492. Available at: https://www.energyprospects.eu/results/deliverables (Accessed July 31, 2023).

Van Wees, M., Pineda Revilla, B., Fitzgerald, H., Ahlers, D., Romero, N., Alpagut, B., et al. (2022). Energy citizenship in positive energy districts – towards a transdisciplinary approach to impact assessment. *Buildings* 12:186. doi: 10.3390/buildings12020186

Vita, G., Ivanova, D., Dumitru, A., García-Mira, R., Carrus, G., Stadler, K., et al. (2020). Happier with less? Members of European environmental grassroots initiatives reconcile lower carbon footprints with higher life satisfaction and income increases. *Ener Res Soc Sci* 60:101329. doi: 10.1016/j.erss.2019.101329

Wittmayer, J. M., Hielscher, S., Fraaije, M., Avelino, F., and Rogge, K. (2022). A typology for unpacking the diversity of social innovation in energy transitions. *Energ Res Soc Sci.* 88:102513. doi: 10.1016/j.erss.2022.102513

World Economic Forum (2021). Fostering Effective Energy Transition [Insight Report]. Available at: https://www3.weforum.org/docs/WEF_Fostering_Effective_Energy_Transition_2021.pdf (Accessed July 31, 2023).

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Buy solar, get cashback: do consumer subsidies described as promotions influence electricity choices?

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Introduction: Most countries want to make the transition to increased or even exclusive use of renewable energy. To achieve this goal, how can individuals be persuaded to use more renewable electricity? For example, does the way energy companies communicate so-called consumer subsidies matter in this regard, and if so, which communication strategy is best? For example, is a monetary promotion (e.g., cashback) better than a non-monetary one (e.g., gift)?

Methods: In a total of four studies (with a total of more than 1700 participants), we investigated what type of promotion most influenced the choice of a renewable energy product, varying, for example, the environmental friendliness of the renewable energy product.

Results: The monetary promotion (e.g., get $35 back through subsidies) appeared to be the most successful; it significantly increased the choice of the renewable electricity product (i.e., between 12–22%). However, this result was only evident when the subsidized renewable product was not the product already preferred by most individuals. Other measures, such as the willingness to pay (WTP), showed no differential effects.

Discussion: Overall, the observed pattern suggests that promoting renewable energy choices, is similar to promoting donations to a charity. Accordingly, the description of the consumer subsidy as a monetary promotion (i.e., cashback or negative labeling) is most effective in terms of promotion. However, the effect of monetary promotions seems to diminish if the subsidized product is already the product preferred by most consumers. Nevertheless, the use of monetary promotions can encourage the transition to renewable energy.

KEYWORDS

electricity product choices, consumer subsidies, incentive, solar electricity, gift

1. Introduction

Much has been said about the negative role of fossil fuels in *climate change* and that we must move away from its use to meet *climate targets* (IPCC, 2022). In addition, the war in Ukraine has highlighted the threat posed by global dependence on fossil fuels (Eurostat, 2022). While all of this may have encouraged a movement toward more *local renewable energy* generation (IEA, 2022), the majority of electricity consumed by individuals or households today still comes from coal and other fossil fuels (Ritchie et al., 2022).

How can governments and private institutions help increase the consumption of electricity from renewable energy sources? It is assumed that the more people switch to electricity from renewable energy sources, the higher the demand for electricity from renewable energy sources, which means that more electricity must be generated from renewable energy sources (Markard and Truffer, 2006). However, the question arises as to which interventions can be used to achieve this goal. So far, interventions have focused particularly on shaping the individual *decision-making* environment (see nudging approach by Thaler and Sunstein, 2008). For example, when renewable electricity is preselected "by default," it is more likely to be selected as a household electricity product (see Kühne et al., 2019). Although *defaults* within and outside the energy sector are considered very effective (Jachimowicz et al., 2019), other changes in the decision-making environment such as the way "consumer subsidies" are presented have hardly been investigated. So far, consumer subsidies have been applied mainly to fossil fuels to keep their price low. The question is, do consumer subsidies also work for renewable electricity and if so, how do they promote its choice?

Consumer subsidies are defined by United Nations Economic Commission for Europe as "… a government action that directly reduces the price of a fuel or energy service to consumers. A consumer subsidy may also take the form of a cross-subsidy, where a below-cost price to one category of consumers is offset by an above-cost price to another." (UNECE, 2003, p. 11). In that sense, individual choices for renewable energy could be encouraged by having private energy providers change the pricing of their products by offering fossil or nuclear energy at above-cost prices and renewable energy at below-cost prices. For example, the city of Zurich in Switzerland uses consumer subsidies to reduce the price of certified renewable electricity (e.g., solar) by 2 Rp. / kWh (Zürich, 2019). As in this case of the city of Zurich, it is usually not apparent to consumers that the price of the renewable electricity product has been reduced or that they are receiving subsidies[1].

However, marketing research has shown that if a product discount is described to the consumer in an apparent way, it has a major impact on product sales (see meta-analysis of Santini et al., 2016). Product promotions can be divided into two categories: *monetary promotions* such as rebates (in $ or %), and *non-monetary promotions* such as free gifts, free shipping, or increased package size. Monetary promotions, while proven to be more effective than non-monetary promotions in some studies (Gilbert and Jackaria, 2002; Alvarez Alvarez and Vázquez Casielles, 2005), are regarded with criticism because they affect the reference price (or quality, see Chandran and Morwitz, 2006) in the long run (that is, the price consumers expect or are willing to pay for a particular product, Darke and Chung, 2005). For example, Diamond and Campbell (1989) have shown that in a monetary promotion such as "detergent $12 cheaper - regular price $14" the discount is integrated into the purchase price, lowering the reference price. Specifically, the consumer expects a lower price for detergent in the future (e.g., $11). In contrast, in non-monetary promotions such as "get a free fabric softener sample when buying a detergent for $14," the free fabric softener is considered an "extra" and hence is not integrated into the purchase price. The assimilation-contrast hypothesis (Sherif and Hovland, 1961) offers one possible explanation for these effects. If the lower sales price of $12 is perceived as a reasonable substitute for the higher regular price of $14, the detergent will be perceived as a bargain (assimilation). In contrast, if the sales price, in this case for the additional fabric softener, is perceived as belonging to a different price category, the sales price is not perceived as a reduction of the regular price and therefore not assimilated (for an overview, see Mussweiler, 2003). Monetary and non-monetary promotions were found to produce different effects not only on sales but also on perceived *product quality* (Darke and Chung, 2005; Chandran and Morwitz, 2006; DelVecchio et al., 2006). While monetary promotions such as discounts led to lower perceptions of product quality, this was not observed for non-monetary promotions such as gifts. It should be noted, however, that in the meta-analysis by Santini et al. (2016) a positive impact on sales was observed, but no differential impact was observed between the two types of promotions.

The question is whether these findings can be transferred directly onto *electricity products*? In particular, can they help to persuade individuals or households to buy an electricity product made from renewable energy sources such as solar electricity? The answer to this question will depend largely on the similarity between the products (e.g., detergents and electricity products). In this respect, electricity products may differ from normal consumer goods in their quality (hereafter value[2])-price relationship.

In the case of consumer goods, a higher (lower) value (e.g., due to quality) is generally accompanied by a higher (lower) price. Hence, according to standard economics, the consumer should choose or buy a higher-valued product (detergent X) if (a) the value for the perceived product (V_x) exceeds that of the price (P_x), and (b) the value-price difference (V_X- P_x; the *benefit*) for the higher-value product (X) is larger than that difference (V_y- P_y) for the lower-valued product Y (see Formula 1; by Shampanier et al., 2007).

$$\text{(a) } V_X > P_X \text{ and (b) } V_X - P_X > V_Y - P_Y \quad (1)$$

A promotion, such as a discount, on the higher-valued product X, increases the likelihood that it will be purchased because the reduced price increases its "*benefit*." But the benefit can also be increased by, for example, a gift promotion. However, in the case of electricity products, the electricity that comes out of the socket is the same (i.e., has the same quality as a product dimension), regardless of whether it was generated from renewable or fossil energy. Hence, if consumers perceive the two electricity products of equal value, the net benefit for the renewable electricity product (despite the price reduction) is comparatively low compared to the one for fossil energy, and thus should not be chosen more often. Hence, promotions only work to the extent in which differences in value are perceived.

Furthermore, there is another, perhaps even more important, difference between consumer products (albeit environmentally friendly ones) and electricity products. For example, when you buy a

1 Consumers would need to look at the table where the different costs are separated. From the information in this table, it can be deduced that certified renewable electricity results in a refund on the grid taxes, which is a tacit way of subsidizing renewable electricity.

2 Standing for the overall quality of the product, which we refer to as value in the following to avoid confusion with quality as a product dimension.

consumer product such as an electric car (e.g., Tesla), you signal to those around you that you care about the environment (so-called "green to be seen" phenomenon, see Griskevicius et al., 2010; Brick et al., 2017). On the other hand, buying solar power is not observable by others (and therefore does not give you a green identity), which reduce its attractiveness and thus its purchase. Buying electricity from renewable sources is therefore more an act of conviction, that is, a sense of commitment that motivates (here "intrinsic motivation") the decision to support the shift toward greener energy production (see Van der Werff et al., 2013).

Therefore, this behavior may be considered more of a form of prosocial behavior (e.g., donating). Studies in the field of prosocial behavior have shown that incentives (extrinsic rewards) rather tend to *decrease* the desired intrinsically motivated behavior. For example, Gneezy and Rustichini (2000, or for similar results see Newman and Shen, 2012), found that schoolchildren who were given an incentive to collect charitable donations collected less money (see Deci et al.'s, 1999, for a meta-analysis on extrinsic rewards on intrinsically motivated behavior). One explanation is provided by the so-called overjustification hypothesis (Lepper et al., 1973), which assumes that once a person considers an intrinsically motivated activity (e.g., donating) as a means to another end (e.g., receiving a gift), that activity is no longer considered an end in itself. This results in the desired activity being shown less frequently[3] (see also Newman and Shen, 2012, for examples). Another explanation is the *effective hypothesis*, assuming that exhibiting a behavior associated with an incentive may send a negative signal to *third parties*, e.g., "others think I'm only doing this because of the gift" (see Bénabou and Tirole, 2006; Ariely et al., 2009). Ariely et al. (2009) also found that prosocial activities increased when a monetary incentive was provided, but only when the monetary incentive stayed private. Therefore, if the purchase of electricity products is considered an intrinsically motivated behavior, promotions should actually have a negative effect on its choice.

The above discussion of results can be satisfyingly reconciled through the "two worlds" people live in (see Heyman and Ariely, 2004; Ariely, 2008). One is a world where *market norms* prevail, such as when we buy a detergent. Here we expect to immediately receive a product worth the money we paid. The other is a world where *social norms* prevail, such as when we help a friend move house. In such a situation, we do not expect (immediate) reciprocation, nor do we expect to be paid (i.e., there is no financial reward involved). As long as we keep these two worlds separate, everything is fine (e.g., Gneezy and Rustichini, 2000; Heyman and Ariely, 2004), whereas introducing market norms into a social situation causes problems. For example, Gneezy and Rustichini (2000) showed that the introduction of a fine for parents who were late for picking up their children from daycare led to an increase in the number of children who were picked up late. While parents would feel guilty if the caregiver had to stay late if they themselves were late to pick up their child, after the introduction of a fine they would say to themselves, "I can be late because I am paying for the late pickup."

Investigating how (i.e., no, positive, or negative impact) promotions encourage the choice of renewable energy products, or rather, which promotions (e.g., gifts or rebates) are most effective in this regard, also provides us with valuable insights into which of two worlds (market or social) energy product choices fall into.

We manipulated the type of promotion (gift, cashback, donation, rebate, etc.) and the two electricity products participants could choose from (from products containing nuclear to pure solar products). We measured the choice of the electricity product, as well as the expected additional costs and willingness to pay (WTP) in order to better understand the underlying measures driving choice.

2. Study 1

In our first study, we investigated whether and how different types of promotions (e.g., a gift, cashback) influence solar electricity choice. Participants were able to choose between two products: an eco-electricity product and a solar electricity product. The products correspond to the situation in Switzerland, where many electricity providers no longer have fossil electricity in their products for households, as a rapid expansion of solar electricity use is a goal in Switzerland (see Paganini et al., 2022).

2.1. Method

2.1.1. Participants

321 participants aged 20 to 54 years old ($M_{age} = 26.0$; $SD_{age} = 5.24$; 64.5% female) from the ZHAW Zurich University of Applied Sciences (96%) and the greater area of Zurich (4%) took part in this computer-based online study. In terms of income, 55% of the participants earn less than CHF 2'000 per month. As incentive, participants could enter a raffle for an iPad (which a total of 78% did) or, if a student of the ZHAW School of Applied Psychology, receive course credit instead (which 12% overall did). All participants gave informed consent.

2.1.2. Stimulus material, procedure, and design

The *online study* began by asking participants to choose one preference from 3 *leisure time activities* (sports, culture or dine and drink). To disguise the real intent of this question, participants were then asked additional distracting questions (e.g., about sugar-sweetened beverages). Then the main part of the study began, in which participants were told as part of a cover story that they had moved to a new apartment and had to choose between two electricity products (see Figure 1), namely: an eco-electricity product (i.e., a mix of wind, hydro, biogas and solar electricity) with a price of 28 Rp. / kWh and a solar electricity product (i.e., 100% solar electricity). Depending on which condition (baseline, gift, cashback or choice) participants were randomly assigned to, the price of the solar electricity product was different. In the baseline condition, the price shown was net of subsidies (33 Rp. / kWh; see Figure 1B). In all other three intervention conditions, the original price (35 Rp. / kWh) was shown. However, the higher price was compensated by a specific

3 Note, we are focusing on promotions or rewards such as gifts which are conditional to showing an intrinsically motivated behavior. Unconditional gifts, which are given to everyone, might foster donation (for an overview see Newman and Shen, 2012).

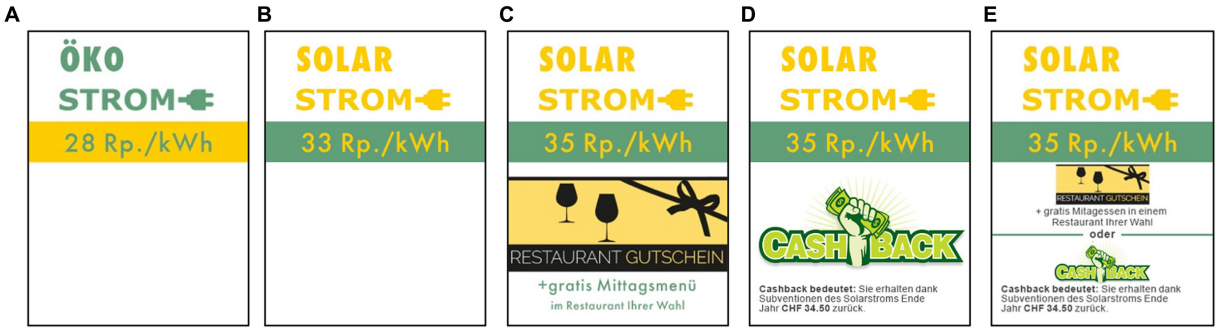

FIGURE 1
Electricity products used in Study 1, were people had to choose between an eco-electricity product **(A)** and a solar electricity product **(B–D)**. The solar electricity product differed in the conditions: baseline **(B)**, gift **(C)**, cashback **(D)**, and choice between gift and cashback **(E)**. For copyright reasons, the stimuli shown in the illustrations differ slightly from the original Stiumli. Original stimuli are available at https://www.pngall.com/de/cashback-png/download/30420, CC BY-NC.

"extra" (worth about CHF 35; rounded value). The gift condition was personalized based on the leisure activity chosen at the beginning (e.g., a free lunch in a restaurant; see Figure 1C)[4]. The cashback condition was a cash amount paid at the end of the year (see Figure 1D). Finally, the choice condition was a personalized gift or cash amount (see Figure 1E), depending on the participant's choice. After the participants had chosen an electricity product, they were asked a series of questions including: the reason for their choice (open question format), how much more an average Swiss citizen would have to pay to switch from an eco-electricity to a solar electricity product (in CHF per month), how much they would be willing to pay (WTP) for such a switch (in %), their energy behavior (this section included a control question for assessing participants' attention to the subject), their demographic data (e.g., age, income)[5], and their intrinsic/extrinsic motivation[6].

2.2. Results

2.2.1. Participants excluded

From the 349 participants who completed the study, 11 participants (3.2%) who answered the control question incorrectly and 3 participants (0.9%) that took part twice were excluded. Furthermore, 14 participants (4.0%), that needed more than 5 min or less than 5 s to complete the electricity product choice task, and those that needed more than 20 min to complete the whole study, were also excluded from the analysis.

2.2.2. Statistics

All statistical analyses were performed using R Statistical Software.

2.2.2.1. Electricity product choice task

A calculated probit regression model showed a significant main effect of condition, χ^2 (3) = 16.43, $p < 0.001$ (see Figure 2), that is, we find a differential effect of "condition" on the probability of choosing the solar electricity product (choice solar in; baseline: 14.8%, gift: 14.5%, cashback: 36.5%, choice: 30.3%). Tukey-adjusted post-hoc tests showed a significant difference between the baseline and the cashback condition ($z = 3.17$, $p < 0.01$; + 21.7%), as well as a marginal significant difference between the baseline and the choice ($z = 2.38$, $p = 0.08$; + 15.5%) condition. Furthermore, there was a significant difference between the gift and the choice condition ($z = 2.39$, $p = 0.08$; + 15.8%), and the gift and the cashback condition ($z = 3.17$, $p < 0.01$; + 22.0%). All other comparisons were insignificant (both $z < 0.85$, $p > 0.85$). Note that in the choice condition, 69.6% of participants decided in favor of the cashback.

2.2.2.2. Expected additional costs (in CHF per month) for switching

A total of 109 participants answered this question (the remaining participants stated that they "do not know").[7] Of these 109 participants, those who stated a monetary amount higher than CHF 200.- ($N = 8$) were excluded, as this amount is highly unrealistic (the actual costs are about CHF 10.-).

Although descriptive measures might suggest differences in the stated additional cost between the conditions [baseline: CHF 39.36 ($SD = 41.64$), gift: CHF 47.48 ($SD = 57.53$), cashback: CHF 37.29 ($SD = 39.55$), choice: CHF 46.00 ($SD = 54.45$)], a calculated 1-factorial ANOVA showed no significant main effect of condition, F (3, 97) = 0.27, $p = 0.84$.

4 The gifts were designed so that they would equal the amount of the cashback (CHF 34.50). The amount was calculated using the electricity consumption of a typical 2 person flat in Zurich multiplied by the direct subsidies for solar electricity (refund of grid charge=2 Rp./kWh).

5 The demographic data in Study 1 were (as an exception) collected at an earlier time point, that is, after the "distraction" questions.

6 In Studies 1–3, intrinsic motivation was assessed with three items from van der Werff et al. (2013) and extrinsic motivation with two adapted items from De Young (1986). However, statistical analysis did not reveal a stable pattern across studies, which we attribute to the lack of validity of the items used. We therefore decided not to report the associated results and to use a more elaborate approach to measuring motivation in Study 4.

7 In this article, switching costs are not about the fees incurred when switching, but about the higher monthly electricity costs incurred when switching to a more environmentally friendly product. In other words, expected switching costs refer to the expected price difference between the less and the more environmentally friendly product.

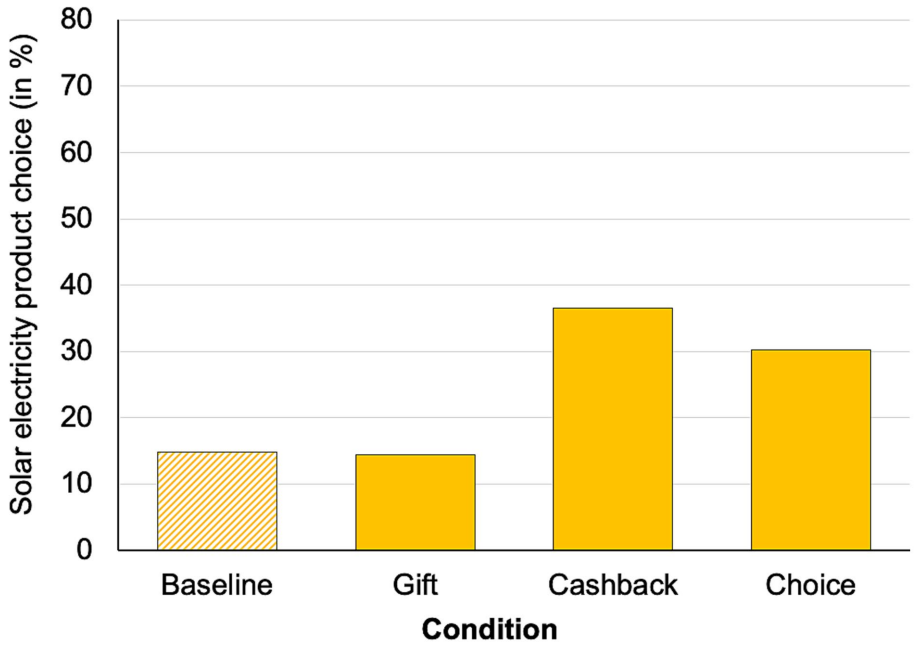

FIGURE 2
Percentage of solar electricity product choice.

2.2.2.3. WTP (in %) for switching

From the 321 participants, 4 participants who stated percentages of 200% or higher were excluded.

Again, although descriptive measures might suggest differences in the stated WTP between the conditions [baseline: 10.22% ($SD = 9.73$), gift: 11.82% ($SD = 14.40$), cashback: 14.86% ($SD = 15.01$), choice: 12.48% ($SD = 12.16$)] a calculated 1-factorial ANOVA again showed no significant main effect of condition, $F(3, 313) = 1.74$, $p = 0.16$.

2.2.3. Reasons for choosing an electricity product (eco or solar)

Participants' reasons for choosing the eco-electricity product were quite diverse, but the most frequently stated reason was that it was the cheaper product (140 statements), followed by the reason that they preferred a *mix of different resources* (71 statements) and the reason that they had concerns about the solar electricity product (37 statements). These concerns included the storage of solar electricity, the amount of sunshine in Switzerland, ecological impact (e.g., disposal of PV panels) and economic aspects. Interestingly, only a few participants mentioned that they did not like the gift (5 statements) or the cashback (1 statements); therefore this was rarely a reason for not choosing solar electricity power.

An equally diverse pattern of reasons was found among participants who chose the solar electricity product. However, almost all of the reasons made some kind of reference to it being the more environmentally friendly option. Again, a few participants stated that they chose the product because they liked the gift (2 statements) or the cashback (10 statements).

2.3. Discussion

The *cashback* seems to best promote the choice of solar electricity products. The almost identical effect of the choice can be explained by the fact that 3/4 of participants in this condition chose the cashback. Hence participants seem to prefer *monetary promotions*. We found no significant differences between conditions in terms of expected incremental costs or WTP, suggesting that the promotions at the very least did not have a negative impact on price expectations.

3. Study 2

In the second study, we wanted to take a closer look at the following two questions that arose from Study 1: (1) Did the gift option in Study 1 fail because it was not sufficiently personalized? In order to investigate this, we increased personalization of the gift. (2) Is the choice of electricity products a prosocial behavior? To investigate this, we replaced the choice condition with a *donation* condition, which should have no effect on the choice if the behavior is prosocial.

3.1. Method

3.1.1. Participants

362 participants aged 19 to 59 years old ($M_{age} = 26.1$; $SD_{age} = 5.92$; 59.4% female) from the ZHAW Zurich University of Applied Sciences (86.5%), the University of Basel (10.2%) and the greater area of Zurich (3.3%) took part in this computer-based online study. In terms of income, 58.6% of participants earn less than 2′000 CHF per month. As incentive, participants could enter a raffle for an iPad or a CHF 100 voucher for a grocery store (which a total of 83.7% did) or, if they were a student of the ZHAW School of Applied Psychology, they could choose to receive course credit instead (which 6.9% overall did). All participants gave informed consent.

3.1.2. Stimulus material, procedure, and design

The stimulus material, procedure and design were similar to Study 1 with the following exceptions: (1) The gift was more personalized. Therefore, to assess participants' preferred leisure activity, they first had to select one of three overarching categories (sports, leisure activities and shopping). Based on the selected category, they were shown 6 specific activities, such as hiking, swimming, snow sports, cycling, running, and fitness in the sports category. From these they then had to choose their preferred activity, (2) The electricity product options were replaced with basic electricity (i.e., a mix of hydro and nuclear electricity) at a price of 26 Rp. / kWh and eco-electricity (i.e., a mix of hydro and solar electricity) at its original price of 31 Rp. / kWh (i.e., 31 Rp. / kWh in the baseline). The design of the products was also changed (see Figure 3), (3) The choice condition was replaced with the donation condition. By choosing this product, participants were told, they were supporting a solar electricity project in Africa, and (4) Questions were added about how much the gift, cashback or donation is worth to them (in CHF) and how much they approve of it (on a 7-point scale; 1 = strongly disagree, 7 = strongly agree). Finally, the question from Study 1 about what an average Swiss citizen would have to pay to switch from basic to the eco-electricity product (in CHF) was supplemented with the question about how confident they were with their assessment on a 7-point scale (1 = very unsure, 7 = very confident). This question was added because most participants in Study 1 stated that they did not know how much such a switch would cost.

3.2. Results

3.2.1. Participants excluded

Out of the 404 participants who completed the study, 6 participants (1.5%) who answered the control question incorrectly and 22 participants (5.4%) who participated twice were excluded. Furthermore, 14 participants (3.5%), who needed more than 5 min or less than 5 s to complete the critical choice task, as well as those who needed more than 20 min to complete the entire study were excluded from the analysis.

3.2.2. Statistics

3.2.2.1. Electricity product choice task

In contrast to Study 1, a calculated probit regression model showed no significant main effect of condition (choice eco in; baseline: 69.5%, gift: 60.2%, cashback: 75.6%, donation: 66.3%, see Figure 4), χ^2 (3) = 5.21, p = 0.16.

3.2.2.2. Expected additional costs (in CHF per month) for switching

As in Study 1, participants who stated a monetary amount higher then 200 CHF (N = 14; leaving 348 participants) were excluded. Note, 73.9% of participants indicated that they were very to rather unsure about the expected costs.

Although descriptive measures here also might suggest differences in the stated additional costs between the conditions [baseline: 38.42 CHF (SD = 48.44), gift: 25.58 CHF (SD = 31.17) cashback: 36.45 CHF (SD = 41.69), donation: 30.32 CHF (SD = 36.57)], a calculated 1-factorial ANOVA again showed no significant main effect of condition, F (3, 344) = 1.96, p = 0.12.

3.2.2.3. WTP (in %) for switching

The descriptive measures indicate differences in the stated WTP between the conditions [baseline: 17.04% (SD = 11.28), gift: 19.06% (SD = 18.58), cashback: 24.44% (SD = 20.42), donation: 19.13% (SD = 16.39)] and here the 1-factorial ANOVA showed a significant main effect, F(3, 358) = 3.09, p < 0.05. Tukey adjusted post-hoc tests showed a difference between the baseline and the cashback condition, t(358) = 2.93, p < 0.05, but no other comparison (t < 2.15, p > 0.14).

3.2.2.4. Value (in CHF) of the promotion and approval

From the 267 participants in the 3 intervention conditions, 3 participants who stated a monetary amount higher than 200 CHF (actual value was 34.50 CHF) were excluded.

As indicated by the descriptive measures for the perceived value of the promotion [gift: 37.00 CHF (SD = 33.83), cashback: 28.55 CHF (SD = 32.60), donation: 21.17 CHF (SD = 41.25)], the 1-factorial ANOVA showed a main effect, F(2, 261) = 4.35, p < 0.05. The Tukey

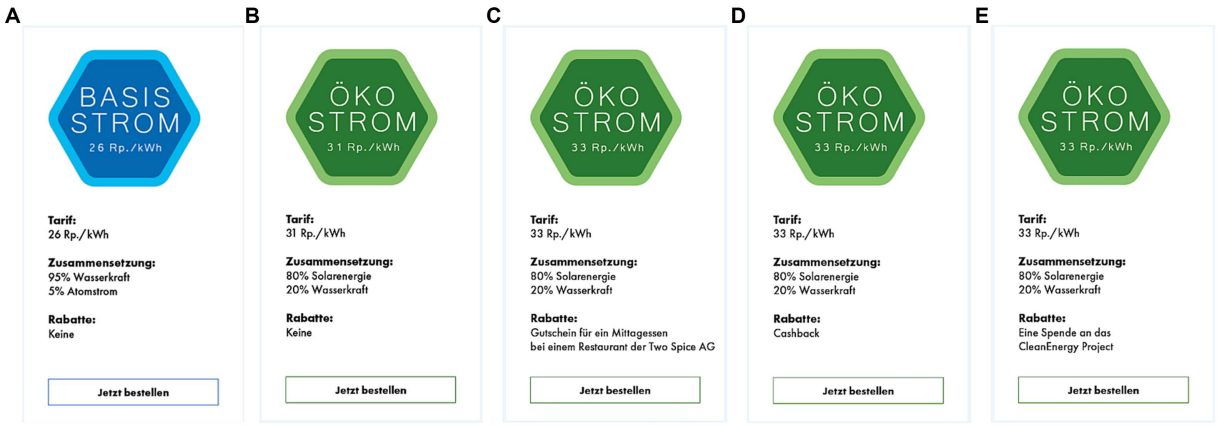

FIGURE 3
Electricity products used in Study 2, where people had to choose between a basic electricity product **(A)** and an eco-electricity product **(B–D)**. The eco-electricity product differed in the following conditions: baseline **(B)**, gift **(C)**, cashback **(D)**, and donation **(E)**. Situated above the products in the gift, cashback and donation condition was a banner highlighting the promotion of the eco-electricity product.

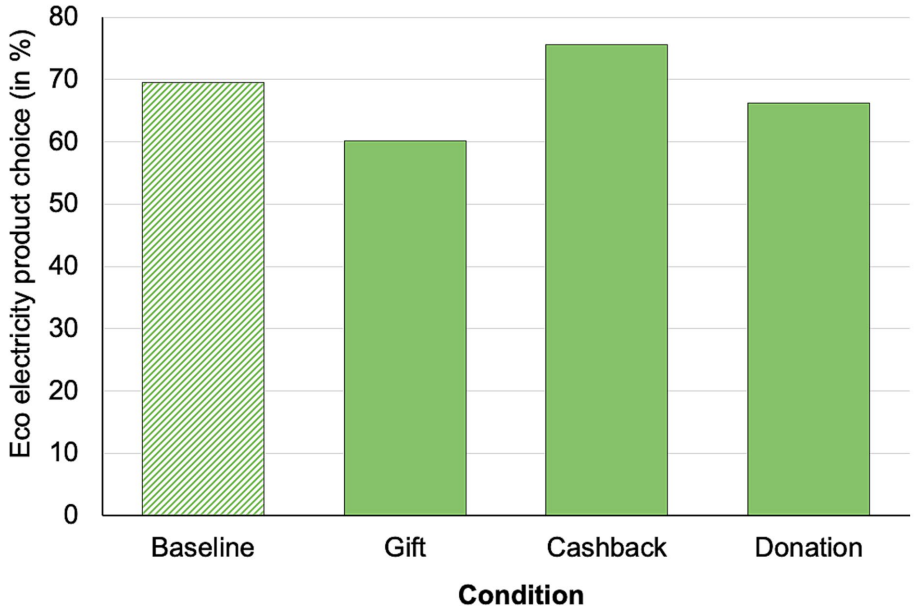

FIGURE 4
Percentage of eco-electricity product choice.

adjusted post-hoc test indicated a difference in the perceived value of the donation and the gift, $t(261) = 2.94$, $p < 0.05$, but no other comparison ($t < 1.59$, $p > 0.25$).

Similarly, regarding participants' approval of the promotion [gift: 3.55 ($SD = 1.85$), cashback: 4.47 ($SD = 1.85$), donation: 4.72 ($SD = 1.58$)], the 1-factorial ANOVA showed a main effect, $F(2, 261) = 11.48$, $p < 0.001$. The Tukey adjusted post-hoc tests showed a difference between the gift and the cashback, $t(261) = 3.59$, $p < 0.001$ and between the gift and the donation, $t(261) = 4.47$, $p < 0.001$, but not for the other comparison ($t < 0.90$, $p > 0.64$).

3.2.3. Open question: reason for choosing product

The reasons given for the choice were similar to those in Study 1. For example, the most common reason for choosing basic electricity was that it was cheaper (92 statements). Regarding the choice for eco-electricity: again, the reason given was that it was the more environmentally friendly option (159 statements). There were only a few participants who mentioned the promotions in a negative way, the cashback in particular was mentioned positively.

3.3. Discussion

Interestingly, in Study 2 none of the promotions had a different effect on participants' choice. This could be due to the electricity products that were used. The products in Study 2 are lower in terms of "environmentally friendliness[8]" than those in Study 1 and most people already chose the renewable option as presented in its baseline form.

8 Note, by a "more or less environmentally friendly" electricity product, we mean that it contributes more or less to the energy transition or to the exclusive use of renewable energy generation in Switzerland.

4. Study 3

In Study 1 the *cashback* has an effect. However, is there any way to make the cashback even more effective, by presenting (or framing) it differently? Studies have shown that presenting the rebate not as an absolute number (i.e., CHF saved), but as a relative one (i.e., % saved) is more effective than relative numbers in terms of perceived value of the promotion and purchase intention (see Della Bitta et al., 1981; or González et al., 2016). However, consumers are unaware of their annual electricity consumption or the price they are charged for it (see Clausen, 2008; Tabi et al., 2014; Kühne et al., 2019). This could lead to participants (in Studies 1 and 2) not correctly assessing the appropriateness of the cashback, which compromises the effectiveness of the cashback even though the rebate was presented in an absolute number. What if the cashback is presented not as an amount saved per year, but per unit consumed (here kWh) in an absolute number?

4.1. Method

4.1.1. Participants

655 participants aged 18 to 54 years old ($M_{age} = 24.4$; $SD_{age} = 5.07$; 61.7% female) from the ZHAW Zurich University of Applied Sciences (91.8%) the greater area of Zurich (8.2%) took part in this smartphone-based online study[9]. In respect to income, 59.1% of participants earn less

9 Studies 3 and 4 were conducted via mobile phones. Since, for example, about 50% of accommodation searches and bookings on Booking.com (2023) are made via mobile phones, this survey method ensures ecological validity. Studies that compared questionnaires using mobile phones and computers as survey methods found no or only minor differences (e.g., longer RT for mobile phones) between these methods (see De Bruijne and Wijnant, 2013; Schlosser and Mays, 2018).

than 2′000 CHF per month. As incentive, participants could choose to enter a raffle for one iPad (which a total of 90.4% did) or, if they were a student of the ZHAW School of Applied Psychology, they could choose to receive course credit instead (which 4.9% overall did). All participants gave informed consent.

4.1.2. Stimulus material, procedure, and design

The stimulus material, procedure and design were similar to those of Study 1 and 2 with the following exceptions: (1) The electricity product options were replaced with blue electricity (i.e., a mix of 95% hydropower and 5% biomass) at a price of 26 Rp./kWh and green electricity (i.e., a mix of 40% hydropower and 60% solar electricity) at an initial price of 31 Rp./kWh (i.e., 31 Rp./kWh in the baseline; see Figure 5). The former basic electricity product was made slightly more environmentally friendly and changed to the blue power product to avoid "ceiling effects" as observed in Study 2 (however, prices were not changed). (2) While the baseline and cashback conditions remained essentially unchanged (except that they were presented in a different layout), two new conditions were added: *reduced price* and *cents back* promotions. The reduced price condition is another control condition according to Della Bitta et al. (1981), which displays the regular price and the sale price and should fall below the previously used baseline condition in terms of performance. The cents back condition was identical to the cashback condition, but the reduction did not refer to the savings per year (CHF 34.50), but to the savings per unit (2 Rp. / kWh).

4.2. Results

4.2.1. Participants excluded

Out of the 733 participants who completed the study, 32 participants (4.4%) who answered the control question incorrectly were excluded. Furthermore, 46 participants (6.3%) who needed more than 5 min or less than 5 s to complete the critical choice task, as well as those who needed more than 20 min to complete the study were excluded from the analysis.

4.2.2. Statistics

4.2.2.1. Binary choice task

A calculated probit regression model showed a significant main effect of condition (choice eco in; baseline: 57.3%, cashback: 67.6%, reduced price: 52.1%, cents back: 56.9%, see Figure 6), χ^2 (3) = 8.79, $p < 0.05$. Tukey-adjusted post-hoc tests showed a significant difference between the reduced price and the cashback condition ($z = 2.80$, $p < 0.05$, + 15.5%). All other comparisons were insignificant (all $z < 2.05$, $p > 0.17$).

4.2.2.2. Expected additional costs (in CHF per month) for switching

As in the other studies, participants who stated a monetary amount higher than 200 CHF ($N = 47$; leaving 608 participants) were excluded. Note that 81.6% of participants indicated that they were very to rather unsure about the expected costs.

As in the other studies, descriptive measures showed large standard deviations in all conditions [baseline: 47.38 CHF ($SD = 46.36$), cashback: 37.10 CHF ($SD = 47.33$), reduced price: 42.19 CHF ($SD = 53.52$), cents-back: 39.67 CHF ($SD = 50.03$)] and the 1-factorial ANOVA showed no main effect of the condition, F (3, 604) = 1.38, $p = 0.25$.

4.2.2.3. WTP (in %) for switching

The descriptive measures indicated differences in the stated WTP between the conditions [baseline: 18.69% ($SD = 13.78$), cashback: 18.05% ($SD = 12.46$), reduced price: 15.70% ($SD = 16.12$), cents back:

FIGURE 5
Electricity products used in Study 3, where people had to choose between a blue electricity product **(A)** and an eco-electricity product **(B–D)**. The eco-electricity product differed in the conditions: baseline **(B)**, cashback **(C)**, reduced price **(D)**, and cents back **(E)**. Original stimuli are available at https://www.pngall.com/de/cashback-png/download/30420, CC BY-NC.

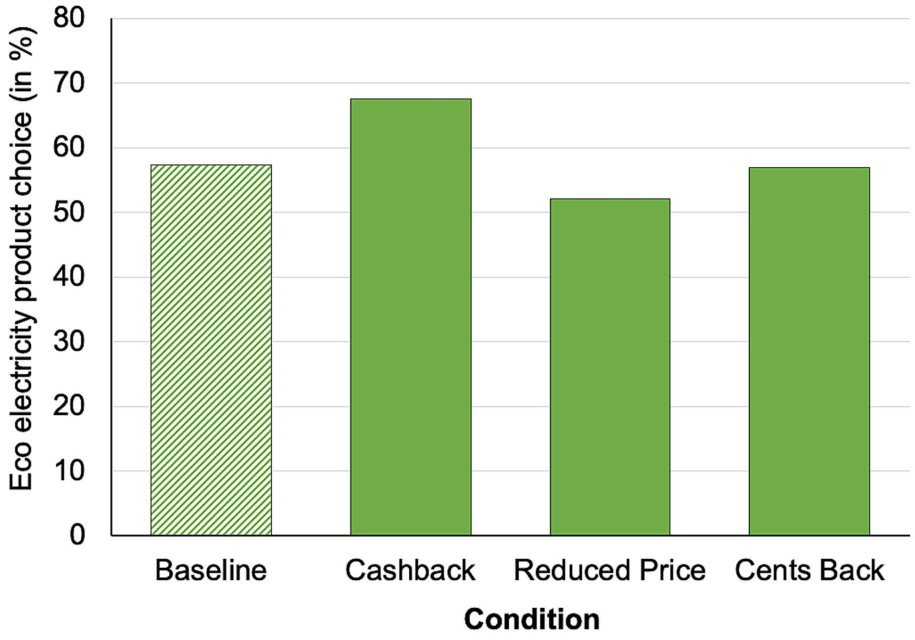

FIGURE 6
Percentage of eco-electricity product choices.

15.42% ($SD = 13.35$)] and the calculated 1-factorial ANOVA showed a significant main effect, $F(3, 650) = 2.74$, $p < 0.05$. The Tukey adjusted post-hoc test indicated that there is a marginal significant difference between the baseline and the cents back condition, $t(650) = 2.43$, $p = 0.07$. The other comparisons showed no difference ($t < 2.24$, $p > 0.11$).

4.2.2.4. Value (in CHF) of the rebate and approval

Out of the 463 participants in the 3 intervention conditions, 33 participants who stated a monetary amount higher than 200 CHF (actual value was 34.50 CHF) were excluded.

As indicated by the descriptive measures for the perceived value of the promotion [cashback: 34.80 CHF ($SD = 21.23$), reduced price: 42.29 CHF ($SD = 51.76$), cents back: 29.55 CHF ($SD = 46.37$)] The 1-factorial ANOVA showed a main effect for condition, $F(2, 427) = 3.22$, $p < 0.05$. The Tukey adjusted post-hoc tests showed a difference between the reduced price and the cents back condition, $t(427) = 2.53$, $p < 0.05$, but not for the other comparisons ($t < 1.60$, $p > 0.25$).

Regarding participants' approval of the promotion [cashback: 4.77 ($SD = 1.70$), reduced price: 4.55 ($SD = 1.73$), cents back: 4.37 ($SD = 1.84$)] the 1-factorial ANOVA showed no main effect for promotion, $F(2, 427) = 2.06$, $p = 0.13$.

4.2.3. Open question: reason for choosing product

This question produced similar results to Study 1 and Study 2, where price (208 statements) was the main reason for choosing the blue electricity product, and sustainability (143 statements) for choosing the eco-electricity product, respectively. All promotions were mentioned as reasons for choosing eco-electricity, but the cashback was mentioned most often.

4.3. Discussion

Study 3 replicated the results of Della Bitta et al. (1981) study that absolute price reductions affect choice more than relative reductions. However, as in their study, the differences did not reach significance. Cashback appears to be beneficial only when applied to savings per year. Probably, because it generates a number large enough to make the choice of a higher valued (or more expensive) product worthwhile.

5. Study 4

So far, the cashback (compared to the baseline) only had an effect in Study 1, in which participants had to choose between two products, one of which was solar electricity. The question is why? A possible explanation could be provided by the study of Lowe and Barnes (2012), who found a benefit of *monetary promotions* over *non-monetary promotions* not for regular products, but for innovative products (e.g., innovative batteries). In Switzerland, the so-called "regular" electricity product is renewable electricity, which most electricity providers such as the local provider in Zurich offer to households accordingly by default (i.e., blue electricity). Although around 60% of the electricity generated in Switzerland already comes from renewable sources such as hydropower, the share of solar electricity is only about 4% (BFE, 2022). Given Switzerland's declared goal of phasing out of nuclear energy, this number is too low! (see Paganini et al., 2022). Based on the aforementioned specifics of the Swiss electricity market, we assume that the (pure) solar power product used in Study 1 represents an innovative product. That solar electricity can be considered as an innovative product was also suggested by Hai (2019). To test whether solar electricity is perceived by participants as innovative and thus unfamiliar, we included relevant questions in Study 4.

Another possible explanation could be that, depending on the condition (baseline or cashback), different groups of people were targeted in terms of their motivation for environmentally friendly behavior, leading to differences in the choice of solar power product. For example, it is known that people who are rather *intrinsically* motivated exhibit more environmentally friendly behavior (see De Groot and Steg, 2010; Aitken et al., 2016; Masson and Otto, 2021). On the other hand, Van Dam and van Trijp (2016) claim that so-called *amotivated* people, rather accidentally, if at all, act environmentally friendly, respectively buy environmentally friendly products. Between these two poles of motivation (intrinsic motivation, amotivation) lies extrinsic motivation (see Deci and Ryan, 2000), under which the vast majority of people can be subsumed (see Van Dam and van Trijp, 2016). Since it is assumed that people with a more extrinsic motivation act economically rationally, environmentally friendly behavior – according to van Dam and van Trijp (2016) – can most likely be triggered by external regulation (at the individual or societal level), that is, by rewards or punishments. While our cashback is a regulatory measure that rewards more environmentally friendly choices, negative labeling, for example, can penalize less environmentally friendly choices. An example of negative labeling is the negative eco-label for food, which is only applied to products that are not organic (see Van Dam and De Jonge, 2015). To test whether primarily extrinsically motivated individuals respond to economic incentives (positive / negative), we replicate Study 1 but add a condition with a negative label and simultaneously assess participants' motivation.

5.1. Method

5.1.1. Participants

385 participants aged 18 to 53 years old ($M_{age} = 25.5$; $SD_{age} = 4.97$; 68.3% female) from the ZHAW Zurich University of Applied Sciences (98.4%) the greater area of Zurich (1.6%) took part in this smartphone-based online study. In respect to income, 63.9% of participants earn less than 2'000 CHF per month. As incentive, participants could choose to enter a raffle for vouchers (4 × 100 CHF) of a major Swiss grocery store (which a total of 95.8% did) or, if they were a student of the ZHAW School of Applied Psychology, they could choose to receive course credit instead (which 1.3% overall did). All participants gave informed consent.

5.1.2. Stimulus material, procedure and design

The stimulus material, procedure and design were similar to Study 1, with the following exceptions: (1) baseline, cashback and a third condition, called "negative label" was added (the other conditions differed only in their layout from Study 1; see Figure 7), regarding which participants were informed that the eco product was not subsidized, (2) Participants were asked to state their reasons for and against choosing solar electricity. Then, (3) participants had to indicate on a 7-point Likert scale how innovative they found the two products. The question (adapted from: Olshavsky and Spreng, 1996; Moreau et al., 2001; Lowe and Barnes, 2012) were: *How innovative is the electricity product? What influence would the use of the electricity product have on the energy transition? How different is the electricity product from other products you are currently familiar with?* Furthermore, (4) we assessed participant motivation using the MTES (Motivation Toward the Environment Scale; see Pelletier et al., 1998). The MTES items for "external regulation" were supplemented by 4 items. This, because the MTES items only capture the social dimension (e.g., to avoid criticism), but not the economic one as designated by Ryan and Deci (2020). The added 4 items therefore capture financial benefits and punishments as a source of external regulation. In total, participants had to answer 28 items using a sliding scale (0 = strongly disagree, 100 = strongly agree). Last, but not least, (6) participants were asked (at the end of the study) to indicate as precisely as possible the anticipated aim of the study.

5.2. Results

5.2.1. Participants excluded

Out of the 416 participants who completed the study, 9 participants (2.2%) who answered the control question incorrectly were excluded. Furthermore, 22 participants (5.3%) who needed more than 5 min or less than 5 s to complete the critical choice task, as well as those who needed more than 20 min to complete the study were excluded from the analysis.

5.2.2. Statistics

5.2.2.1. Binary choice task

A calculated probit regression model showed a significant main effect of condition (solar electricity choice in; baseline: 28.8%, cashback: 41.1%, negative label: 47.9%, see Figure 8), χ^2 (2) = 10.36, $p < 0.01$. Tukey-adjusted post-hoc tests showed a significant difference between the baseline and the negative label condition ($z = 3.13$, $p < 0.01$, + 19.1%) and a marginal significant difference between the baseline and the cashback condition ($z = 2.11$, $p = 0.09$, + 12.3%). However, no significant difference was found between the cashback and the negative label condition ($z = 1.07$, $p = 0.53$).

5.2.2.2. Expected additional costs (in CHF per month) for switching

As in the other studies, participants who stated a monetary amount higher than 200 CHF ($N = 19$; leaving 366 participants) were excluded.

As in the other studies, descriptive measures showed large standard deviations in all conditions [baseline: 47.41 CHF ($SD = 49.39$), cashback: 46.55 CHF ($SD = 53.07$), negative label: 34.05 CHF ($SD = 41.92$)]. A 1-factorial ANOVA showed a marginal main effect of the condition, $F(2, 363) = 2.78$, $p = 0.06$. Thereby the Tukey adjusted post-hoc test indicated a marginal difference between the baseline and negative label condition $t(650) = 2.13$, $p = 0.06$. The other comparisons showed no significant difference ($t < 1.99$, $p > 0.11$).

5.2.2.3. WTP (in %) for switching

The descriptive measures indicate that there are no differences in reported WTP between conditions [baseline: 10.32% ($SD = 9.29$), cashback: 12.83% ($SD = 12.66$), negative label: 12.09% ($SD = 10.61$)], which is confirmed by the non-significant main effect, $F(2, 382) = 1.88$, $p = 0.15$, of a calculated 1-factorial ANOVA.

5.2.2.4. Value (in CHF) of the rebate and approval

Out of the 246 participants in the 2 intervention conditions, 3 participants who stated a monetary amount higher than 200 CHF (actual value was 34.50 CHF) were excluded.

As already evident from the descriptive measures on the perceived value of the two promotions [cashback: 35.32 CHF

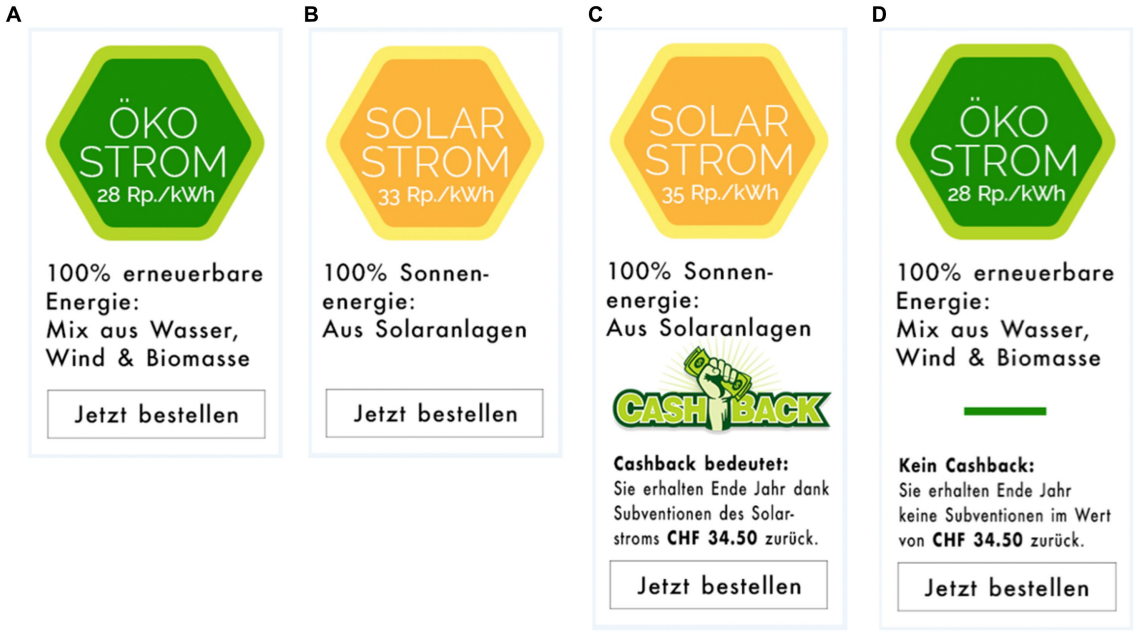

FIGURE 7
Electricity products used in Study 4, where people had to choose between an eco-electricity product **(A,D)** and a solar electricity product **(B,C)**. The products chosen from differed in the conditions: baseline **(A,B)**, cashback **(A,C)** and negative labeling **(B,D)**. Original stimuli are available at https://www.pngall.com/de/cashback-png/download/30420, CC BY-NC.

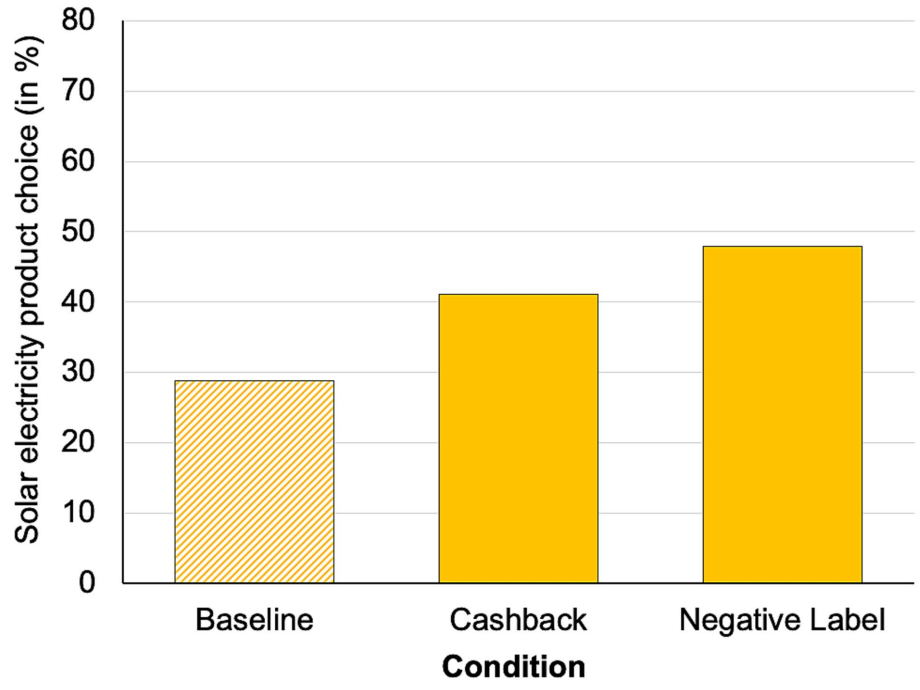

FIGURE 8
Percentage of solar electricity product choices.

(*SD* = 16.93), negative label: 35.79 CHF (*SD* = 12.32)], a t-test showed no significant difference between them, $t(231) = 1.08$, $p = 0.28$.

Regarding participants' approval of the two promotion [cashback: 5.10 (*SD* = 1.42), negative label: 3.61 (*SD* = 1.77)], a t-test showed a significant difference between them, $t(231) = 7.34$, $p < 0.01$. There was more approval of the cashback than the negative label.

Participants were asked if the promotion affected their decision making [cashback: 3.47 (*SD* = 2.00), negative label: 2.99 (*SD* = 1.88)]. The t-test showed a significant difference; $t(231) = 2.37$, $p < 0.05$, indicating, that participants in the cashback condition perceived that their decision was more affected by the promotion than the participants in the negative label condition.

5.2.2.5. Innovativeness of the electricity products

As the descriptive measures indicate (eco: $M = 4.38$, $SD = 1.09$; solar: $M = 4.37$, $SD = 1.12$), there was no difference in perceived innovativeness of the two products, $t(384) = 0.03$, $p = 0.98$.

5.2.2.6. Motivation and electricity product choice

In order to investigate possible (interaction) effects[10] of motivation with condition on choice, the first step was to see which subscales - according to the results of a hierarchical cluster analysis - could be grouped together[11]. The dendrogram showed a clustering in 2 dimensions. Dimension 1 contains the more internal styles of regulation (hereafter referred to as "internal regulation"): intrinsic regulation, integrated regulation, identified regulation, and introjected regulation. Dimension 2 on the other hand, contains the external and non-regulatory styles (hereafter referred to as "external/non-regulation"): external regulation (original items plus incentive items) and amotivation. The items loaded very well on these two dimensions of motivation (alpha internal regulation = 0.92, alpha external/non-regulation = 0.70).

In a second step, we calculated a probit regression model with choice as the dependent variable and condition, as well as internal and external/non-regulation as predictors. The model showed a significant main effect for condition, $\chi^2(2, 382) = 10.36$, $p < 0.01$, *internal regulation*, $\chi^2(1, 381) = 4.60$, $p < 0.05$, and a marginal effect for *external/non-regulation*, $\chi^2(1, 380) = 2.89$, $p = 0.09$. However, none of the interaction effects were significant ($\chi^2 < 3.85$; $p > 0.14$).

To get a clearer picture, we looked at the Pearson correlations for each condition separately. There was a significant correlation of internal regulation with solar electricity choice in the baseline ($r = 0.19$, $p < 0.05$) and marginal significant correlations between external/non-regulation and solar electricity choice in the cashback ($r = 0.16$, $p = 0.07$) and in the negative label condition ($r = 0.15$, $p = 0.10$). The other correlations were non-significant ($r < 0.11$, $p > 0.22$).

5.2.3. Open question: reason for choosing or not choosing solar

Again, price (149 statements) was the main reason for not choosing the solar electricity product, followed by a preference for a mix of electricity sources (66 statements) and concerns about solar electricity (46 statements). The cashback or subsidies were mentioned most often (48 statements) as a reason to choose the solar electricity product, followed by sustainability (30 statements).

5.2.4. Open question: anticipated aim of the study

84% of participants indicated that the goal of the study was to collect some kind of environmental data (e.g., motivations). 11% of the participants stated that they had no idea about the underlying aim of the study or mentioned topics that had nothing to do with it (e.g., concentration). Just 5% "almost" correctly captured the goal of the study (e.g., test the impact of cashback, test nudging techniques, or similar statements).

5.3. Discussion

The results of Study 4 are a replication of the results of Study 1, but with the additional finding that the negative label, like the cashback, encourages the choice of environmentally friendly electricity products. In view of our results, the hypothesis that the different results in Studies 1–3 are due to the degree of innovation of the solar electricity product can be rather excluded. The second explanation, that motivation might play a role in the choice, seems to fit better. It appears that – in the baseline condition – participants with high intrinsic motivation were more likely to choose the solar power product (the environmentally friendlier option), consistent with the literature (see De Groot and Steg, 2010; Aitken et al., 2016; Masson and Otto, 2021). On the other hand, intrinsically motivated participants seem to be deterred by the cashback and negative label; at the same time, however, these can attract more participants with external motivation to purchase solar electricity, relatively speaking.

6. General discussion and conclusion

Overall, the *cashback* and the *negative label*, both monetary promotions, increased the choice of the more environmentally friendly electricity product by up to 21.7%. A result that is consistent with the finding that *monetary promotions* increase sales more than non-monetary ones in the short term (see Gilbert and Jackaria, 2002; but see the meta-analysis by Santini et al., 2016, for a different result).

Yet, what made these monetary promotions successful? Our first hypothesis was: Its placement on an innovative product (here: solar electricity). Although we cannot completely rule out this hypothesis, the cause is probably different. A closer look at the studies (1 and 4) in which the monetary promotions were effective shows that in these, the proportion of participants who choosing the environmentally friendlier option was very small compared to the other studies (2 and 3). This may suggest that in Studies 1 and 4 we may have created a *conflict* (e.g., of internal goals or values) in the sense that the option preferred by participants was not also the most environmentally friendly. Along these lines, Venema et al. (2020) showed that a nudge – in this case, a social norm ("previously 66% rejected and 34% chose meat") – led to meat rejection only among participants who signaled that they were ambivalent about meat consumption in general. Other studies also show that nudges are not effective for people with clear preferences (see Theotokis and Manganari, 2015; Trudel et al., 2015; Venema et al., 2019). Returning to our studies: cashback and negative labels can also be viewed as "nudges," that is, small changes in the decision architecture (see Thaler and Sunstein, 2008) that steer

10 Pearson correlations of the motivational subscales with solar electricity choice are shown in the Supplementary Table S1. We found significant correlations for the subscales: intrinsic regulation ($r = 0.10$, $p < 0.05$), integrated regulation ($r = 0.13$, $p < 0.01$) and external regulation ($r = 0.14$, $p < 0.01$). The correlations of the MTES show a good consistency with the correlations reported by other authors (De Groot and Steg, 2010; Masson and Otto, 2021).

11 Note, in past studies subscales of the SDT were sometimes collapsed to build brother motivation subscales (e.g., Koestner et al., 2008; Masson and Otto, 2021).

people's decisions in a particular direction. Therefore, they should be effective primarily in conflict situations, which they are. Our second explanation was that extrinsically motivated people in particular are open to monetary promotions. Indeed, the correlations indicate that participants with high external motivation were more likely to switch to solar electricity in the monetary promotion conditions (cashback and negative label) than in the baseline. In contrast, highly intrinsically motivated participants appear to be deterred by the monetary promotions. That extrinsic rewards undermine intrinsic motivation is consistent with the findings of Deci et al. (1999).

Despite the success of the monetary promotions, are there more effective ones? Now both, cashback and negative label are a type of *rebate* (albeit a small one of 6%). Participants pay more for the renewable electricity per month, but get some of the money back at the end of the year (therefore in our case they can be classified as a nudge). In the domain of donation (e.g., for a charity) rebates are a common measure to increase charity giving: suppose you donate $200 to a charity, and you get a 50% rebate. In this case you would get half of the donated money, $100, returned to you by a third party (for example, the government, through a tax cut at the end of the year). However, rebates have shown to be less effective than so-called matching subsidies (Eckel and Grossman, 2003, 2008; Davis et al., 2005[12]). In the case of *matching subsidies*, if you donate, for example, $100 to a charity, a third party adds a donation of the same amount ($100). Note that with the rebates and the matching subsidies, you end up paying the same amount, $100 (since you got $100 back in the first example). Yet people seem to donate more with matching subsidies (Davis et al., 2005; Eckel and Grossman, 2008). These findings can be explained with the so-called "isolation effect." In the "donation" problem, information from multiple dimensions, such as the direct consequences for the donor (amount of money donated) or the indirect consequences for the donor or charity (part of the donation is returned), must be integrated. The isolation effect assumes that people tend to disaggregate the dimensions of a multidimensional problem and focus only on the dimension that most directly affects them or that they can control (see Davis, 2006). In the above example, people focus on the amount donated, e.g., $200 under the rebate scheme and $100 under the offset scheme, rather than the total amount donated (e.g., $200). Future studies should therefore investigate whether matching subsidies in the renewable energy sector are more effective than cashback incentives.

At this point, one could critically argue that our results are not generalizable to middle- or high-income individuals, as about half of our participants can be classified as low-income (below CHF 2,000 per month). However, since Blakely et al. (2011) and An (2013), for example, found no relationship between price discounts and household income (or even education) in the food sector, no differential effect is expected with respect to electricity product choice. It could be, however, that home ownership (about 36% in Switzerland, BFS, 2023) is a mediator/moderator between income and electricity product choice.

Last, but not least: Into which world (market norm, social norm) do energy product choices fall? Since the gift had no effect, but the monetary incentive not only influenced extrinsic motivation[13], but also promoted the choice of environmentally friendly products, we conclude that people do not view energy products differently from common goods (such as detergents) and therefore operate in a *market world* (Ariely, 2008).

Thus, our results appear to be consistent with those found in the donation literature. In this regard, studies showed that small gifts decrease the amount of donation, while monetary incentives increase it (Eckel and Grossman, 2008; Newman and Shen, 2012). Accordingly, donors, are sensitive to changes in their donation price (e.g., due to tax benefits, see Vesterlund, 2006). Therefore, the donation of money, which, however, is to be distinguished from, for example, voluntary work for a charitable purpose, is also to be assigned to the market world.

With respect to the other measures, such as expected switching costs, WTP, and value of promotion, no clear pattern emerged, or consistency with the choice pattern (see Della Bitta et al. (1981), for similar results).

In summary, cashbacks and negative labels are effective in promoting subsidized renewable electricity. However, this is true only if the subsidized product is not the preferred option in the choice situation. Hence, energy providers could use the cashback to accelerate the transition to renewable electricity and thus increase their contribution toward fighting the climate crisis.

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 approval was not required for the studies involving humans because it does not fall within the scope of the Human Research Act of the local legislation. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

SK and ER made an equal substantial, direct and intellectual contribution in all stages of the work. All authors contributed to the article and approved the submitted version.

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12 It should be noted that countries differ in terms of the administrative burden of tax deductions for donations, which may reduce the impact of such subsidies (see Peter and Huber, 2021).

13 We found that intrinsically motivated people are generally more likely to choose renewable electricity products, a result consistent with research by de Groot and Steg (2010).

Conflict of interest

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

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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.2023.1155556/full#supplementary-material

References

Aitken, N. M., Pelletier, L. G., and Baxter, D. E. (2016). Doing the difficult stuff: influence of self-determined motivation toward the environment on transportation proenvironmental behavior. *Ecopsychology* 8, 153–162. doi: 10.1089/eco.2015.0079

Alvarez Alvarez, B., and Vázquez Casielles, R. (2005). Consumer evaluations of sales promotion: the effect on brand choice. *Eur. J. Mark.* 39, 54–70. doi: 10.1108/03090560510572016

An, R. (2013). Effectiveness of subsidies in promoting healthy food purchases and consumption: a review of field experiments. *Public Health Nutr.* 16, 1215–1228. doi: 10.1017/S1368980012004715

Ariely, D. (2008). *Predictably irrational*. The hidden forces that shape our decisions. Harper.

Ariely, D., Bracha, A., and Meier, S. (2009). Doing good or doing well? Image motivation and monetary incentives in behaving prosocially. *Am. Econ. Rev.* 99, 544–555. doi: 10.1257/aer.99.1.544

Bénabou, R., and Tirole, J. (2006). Incentives and prosocial behavior. *Am. Econ. Rev.* 96, 1652–1678. doi: 10.1257/aer.96.5.1652

BFE. (2022). Schweizerische Elektrizitätsstatistik 2021. Available at: https://www.bfe.admin.ch/bfe/en/home/versorgung/statistik-und-geodaten/energiestatistiken/elektrizitaetsstatistik.exturl.html/aHR0cHM6Ly9wdWJkYi5iZmUuYWRtaW4uY2gvZGUvcHVibGljYX/Rpb24vZG93bmxvYWQvMTA5NDI=.html (Accessed March 20, 2023).

BFS. (2023). Mieter / Eigentümer. Available at: https://www.bfs.admin.ch/bfs/de/home/statistiken/bau-wohnungswesen/wohnungen/wohnverhaeltnisse/mieter-eigentuemer.html (Accessed July 13, 2023).

Blakely, T., Mhurchu, C. N., Jiang, Y., Matoe, L., Funaki-Tahifote, M., Eyles, H. C., et al. (2011). Do effects of price discounts and nutrition education on food purchases vary by ethnicity, income and education? Results from a randomised, controlled trial. *J. Epidemiol. Community Health* 65, 902–908. doi: 10.1136/jech.2010.118588

Booking.com (2023). Mobile rate. Available at: https://partner.booking.com/en-gb/solutions/mobile-rate (Accessed July 22, 2023).

Brick, C., Sherman, D. K., and Kim, H. S. (2017). "Green to be seen" and "brown to keep down": visibility moderates the effect of identity on pro-environmental behavior. *J. Environ. Psychol.* 51, 226–238. doi: 10.1016/j.jenvp.2017.04.004

Chandran, S., and Morwitz, V. G. (2006). The price of "free"-dom: consumer sensitivity to promotions with negative contextual influences. *J. Consum. Res.* 33, 384–392. doi: 10.1086/508439

Clausen, J., (2008). Betreiber von Solarwärmeanlagen und Ökostromkunden in der Klimaschutzregion Hannover. Available at: https://www.borderstep.de/wp-content/uploads/2014/07/Clausen-Betreiber_von_Solarwaermeanlagen_und_Oekostromkunden_in_der_Klimaschutzregion_Hannover-2008.pdf (Accessed January 26, 2023).

Darke, P. R., and Chung, C. M. (2005). Effects of pricing and promotion on consumer perceptions: it depends on how you frame it. *J. Retailing* 81, 35–47. doi: 10.1016/j.jretai.2005.01.002

Davis, D. D. (2006). Rebate subsidies, matching subsidies and isolation effects. *Judgm. Decis. Mak.* 1, 13–22. doi: 10.1017/S1930297500000310

Davis, D. D., Millner, E. L., and Reilly, R. J. (2005). Subsidy schemes and charitable contributions: a closer look. *Exp. Econ.* 8:85106. doi: 10.1007/s10683-005-0867-y

De Bruijne, M., and Wijnant, A. (2013). Comparing survey results obtained via mobile devices and computers: An experiment with a mobile web survey on a heterogeneous group of mobile devices versus a computer-assisted web survey. *Soc. Sci. Comput. Rev.* 31, 482–504. doi: 10.1177/0894439313483976

De Groot, J. I., and Steg, L. (2010). Relationships between value orientations, self-determined motivational types and pro-environmental behavioural intentions. *J. Environ. Psychol.* 30, 368–378. doi: 10.1016/j.jenvp.2010.04.002

De Young, R. (1986). Encouraging environmentally appropriate behavior: the role of intrinsic motivation. *J. Environ. Systems.* 15:281292. doi: 10.2190/3FWV-4WM0-R6MC-2URB

Deci, E. L., Koestner, R., and Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychol. Bull.* 125, 627–668. doi: 10.1037/0033-2909.125.6.627

Deci, E. L., and Ryan, R. M. (2000). The" what" and" why" of goal pursuits: human needs and the self-determination of behavior. *Psychol. Inq.* 11, 227–268. doi: 10.1207/S15327965PLI1104_01

Della Bitta, A. J., Monroe, K. B., and McGinnis, J. M. (1981). Consumer perceptions of comparative price advertisements. *J. Marketing Res.* 18, 416–427. doi: 10.1177/00222437810180040

DelVecchio, D., Henard, D. H., and Freling, T. H. (2006). The effect of sales promotion on post-promotion brand preference: a meta-analysis. *J. Retailing* 82, 203–213. doi: 10.1016/j.jretai.2005.10.001

Diamond, W. D., and Campbell, L. (1989). The framing of sales promotions: effects on reference price change. *ACR N. Am. Adv.* 16, 241–247.

Eckel, C. C., and Grossman, P. J. (2003). Rebate versus matching: does how we subsidize charitable contributions matter? *J. Public Econ.* 87, 681–701. doi: 10.1016/S0047-2727(01)00094-9

Eckel, C. C., and Grossman, P. J. (2008). Subsidizing charitable contributions: a natural field experiment comparing matching and rebate subsidies. *Exp. Econ.* 11:234252. doi: 10.1007/s10683-008-9198-0

Eurostat (2022). Electricity and gas prices in the first half of 2022. Available at: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20221031-1 (Accessed January 27, 2023).

Gilbert, D. C., and Jackaria, N. (2002). The efficacy of sales promotions in UK supermarkets: a consumer view. *Int. J. Retail Distrib. Manag.* 30, 315–322. doi: 10.1108/09590550210429522

Gneezy, U., and Rustichini, A. (2000). A fine is a price. *J. Leg. Stud.* 29, 1–17. doi: 10.1086/468061

González, E. M., Esteva, E., Roggeveen, A. L., and Grewal, D. (2016). Amount off versus percentage off—when does it matter? *J. Bus. Res.* 69, 1022–1027. doi: 10.1016/j.jbusres.2015.08.014

Griskevicius, V., Tybur, J. M., and Van den Bergh, B. (2010). Going green to be seen: status, reputation, and conspicuous conservation. *J. Pers. Soc. Psychol.* 98:392. doi: 10.1037/a0017346

Hai, M. A. (2019). Rethinking the social acceptance of solar energy: exploring" states of willingness" in Finland. *Energy Res. Soc. Sci.* 51, 96–106. doi: 10.1016/j.erss.2018.12.013

Heyman, J., and Ariely, D. (2004). Effort for payment: a tale of two markets. *Psychol. Sci.* 15, 787–793. doi: 10.1111/j.0956-7976.2004.00757.x

IEA. (2022). Renewable power's growth is being turbocharged as countries seek to strengthen energy security. Available at: https://www.iea.org/news/renewable-power-s-growth-is-being-turbocharged-as-countries-seek-to-strengthen-energy-security (Accessed January 27, 2023).

IPCC. (2022). Climate change 2022 mitigation of climate change. Available at: https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_FullReport.pdf (Accessed January 25, 2023).

Jachimowicz, J. M., Duncan, S., Weber, E. U., and Johnson, E. J. (2019). When and why defaults influence decisions: a meta-analysis of default effects. *Behav. Public Policy* 3, 159–186. doi: 10.1017/bpp.2018.43

Koestner, R., Otis, N., Powers, T. A., Pelletier, L., and Gagnon, H. (2008). Autonomous motivation, controlled motivation, and goal progress. *J. Pers.* 76, 1201–1230. doi: 10.1111/j.1467-6494.2008.00519.x

Kühne, S. J., Reijnen, E., and Crameri, A. (2019). When too few is bad for the environment. *Swiss J. Psychol.* 79, 35–41. doi: 10.1024/1421-0185/a000232

Lepper, M. R., Greene, D., and Nisbett, R. E. (1973). Undermining children's intrinsic interest with extrinsic reward: a test of the" overjustification" hypothesis. *J. Pers. Soc. Psychol.* 28, 129–137. doi: 10.1037/h0035519

Lowe, B., and Barnes, B. R. (2012). Consumer perceptions of monetary and non-monetary introductory promotions for new products. *J. Mark. Manag.* 28, 629–651. doi: 10.1080/0267257X.2011.560889

Markard, J., and Truffer, B. (2006). The promotional impacts of green power products on renewable energy sources: direct and indirect eco-effects. *Energ Policy* 34, 306–321. doi: 10.1016/j.enpol.2004.08.005

Masson, T., and Otto, S. (2021). Explaining the difference between the predictive power of value orientations and self-determined motivation for proenvironmental behavior. *J. Environ. Psychol.* 73:101555. doi: 10.1016/j.jenvp.2021.101555

Moreau, C. P., Lehmann, D. R., and Markman, A. B. (2001). Entrenched knowledge structures and consumer response to new products. *J. Mark. Res.* 38, 14–29. doi: 10.1509/jmkr.38.1.14.18836

Mussweiler, T. (2003). Comparison processes in social judgment: mechanisms and consequences. *Psychol. Rev.* 110, 472–489. doi: 10.1037/0033-295X.110.3.472

Newman, G. E., and Shen, Y. J. (2012). The counterintuitive effects of thank-you gifts on charitable giving. *J. Econ. Psychol.* 33, 973–983. doi: 10.1016/j.joep.2012.05.002

Olshavsky, R. W., and Spreng, R. A. (1996). An exploratory study of the innovation evaluation process. *J. Prod. Innovat. Manag.* 13, 512–529. doi: 10.1016/S0737-6782(96)00037-9

Paganini, M., Oesch, J., Graustück, M., and Jochem, C. (2022). *Muss bald jedes Dach ein Solardach sein?* Neue Zürcher Zeitung. Available at: https://www.nzz.ch/wirtschaft/muss-bald-jedes-dach-ein-solardach-sein-ld.1696357 ().

Pelletier, L. G., Tuson, K. M., Green-Demers, I., Noels, K., and Beaton, A. M. (1998). Why are you doing things for the environment? The motivation toward the environment scale (mtes). *J. Appl. Soc. Psychol.* 28, 437–468. doi: 10.1111/j.1559-1816.1998.tb01714.x

Peter, H., and Huber, G. L. (2021). *The Routledge handbook of taxation and philanthropy*. Abingdon: Routledge.

Ritchie, H., Roser, M., and Rosado, P. (2022). Energy. Available at: https://ourworldindata.org/energy (Accessed January 27, 2023).

Ryan, R. M., and Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: definitions, theory, practices, and future directions. *Contemp. Educ. Psychol.* 61:101860. doi: 10.1016/j.cedpsych.2020.101860

Santini, F. D. O., Vieira, V. A., Sampaio, C. H., and Perin, M. G. (2016). Meta-analysis of the long-and short-term effects of sales promotions on consumer behavior. *J. Promot. Manag.* 22, 425–442. doi: 10.1080/10496491.2016.1154921

Schlosser, S., and Mays, A. (2018). Mobile and dirty: does using mobile devices affect the data quality and the response process of online surveys? *Soc. Sci. Comput. Rev.* 36, 212–230. doi: 10.1177/0894439317698437

Shampanier, K., Mazar, N., and Ariely, D. (2007). Zero as a special price: the true value of free products. *Mark. Sci.* 26, 742–757. doi: 10.1287/mksc.1060.0254

Sherif, M., and Hovland, C. I. (1961). *Social judgment: Assimilation and contrast effects in communication and attitude change*. New Haven, CT: Yale University Press.

Tabi, A., Hille, S. L., and Wüstenhagen, R. (2014). What makes people seal the green power deal? Customer segmentation based on choice experiment in Germany. *Ecol. Econ.* 107, 206–215. doi: 10.1016/j.ecolecon.2014.09.004

Thaler, R. H., and Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. New Haven, CT: Yale University Press.

Theotokis, A., and Manganari, E. (2015). The impact of choice architecture on sustainable consumer behavior: the role of guilt. *J. Bus. Ethics* 131, 423–437. doi: 10.1007/s10551-014-2287-4

Trudel, R., Murray, K. B., Kim, S., and Chen, S. (2015). The impact of traffic light color-coding on food health perceptions and choice. *J. Exp. Psychol.: Applied* 21:255. doi: 10.1037/xap0000049

UNECE. (2003). Guidelines on reforming energy pricing and subsidies. Available at: http://www.unece.org/energy/pub/Rfrm_EnerPricesSubsid_92.1.016357.5.pdf (Accessed January 25, 2023).

Van Dam, Y. K., and De Jonge, J. (2015). The positive side of negative labelling. *J. Consum. Policy* 38, 19–38. doi: 10.1007/s10603-014-9274-0

Van Dam, Y. K., and van Trijp, H. (2016). Interventions to encourage sustainable consumption. *Apsctract* 10, 51–58. doi: 10.22004/ag.econ.250219

Van der Werff, E., Steg, L., and Keizer, K. (2013). It is a moral issue: the relationship between environmental self-identity, obligation-based intrinsic motivation and pro-environmental behaviour. *Glob. Environ. Change* 23, 1258–1265. doi: 10.1016/j.gloenvcha.2013.07.018

Venema, T. A., Kroese, F. M., Benjamins, J. S., and De Ridder, D. T. (2020). When in doubt, follow the crowd? Responsiveness to social proof nudges in the absence of clear preferences. *Front. Psychol.* 11:1385. doi: 10.3389/fpsyg.2020.01385

Venema, T. A., Kroese, F. M., De Vet, E., and De Ridder, D. T. (2019). The one that I want: strong personal preferences render the center-stage nudge redundant. *Food Qual. Prefer.* 78:103744. doi: 10.1016/j.foodqual.2019.103744

Vesterlund, L. (2006) in *'Why do people give' in the nonprofit sector: A research handbook*. eds. W. W. Powell and R. Steinberg (New Haven, CT: Yale University Press), 168–190.

Zürich, S. (2019). Rückvergütung für Strom aus naturemade star-zertifizierten Produktionsanlagen. Available at: https://www.ewz.ch/dam/ewz/meinewz/Dokumentencenter/energietarife2021ZH/R%C3%BCckverg%C3%BCtung%20f%C3%BCr%20Strom%20aus%20naturemade%20star%20ZH.pdf (Accessed January 25, 2023).

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How different types of environmentalists are perceived: changing perceptions by the feature

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Introduction: Previous research found stereotypes of environmentalists as barriers to public engagement and identification with environmentalism. Yet, there is limited understanding of the distinct attributes of an environmentalist that influence public perceptions and self-identification. In our research, we address this knowledge gap by analyzing reactions to a range of fictional environmentalist profiles.

Methods: We investigated how multiple features of these profiles (e.g., gender, occupation, type of pro-environmentalism) influenced stereotypes (such as competence, friendliness, and trustworthiness), perceived typicality, and participants' self-identification with the described profiles, using a novel conjoint experiment approach with 678 US residents.

Results: We found that profiles described as women, Asians, working as a cleaner or office clerk, and politically moderate or liberal, exhibiting private to moderate environmental behaviors and global environmental concerns, were generally perceived as more typical for environmentalists. Moreover, participants most identified with profiles depicted as women, in a cleaner occupation, and exhibiting private pro-environmental behaviors. Atypical profile descriptions, based on prior research, enhanced participants' impressions only when associated with private pro-environmental behaviors or the cleaner occupation.

Discussion: We introduce new avenues in impression formation research and the use of conjoint analyses in psychological research; moreover, we contribute valuable input to the environmental movement regarding message framing considering the source and content relative to the targeted audience.

KEYWORDS

environmentalists, stereotypes, conjoint experiment, social identity, US residents

1. Introduction

Environmentalism has become one of the most polarizing and politicized issues in the United States today (Feygina et al., 2010; McCright and Dunlap, 2011; Pew Research Center, 2020). In 2021, only 41% of US citizens identified as "environmentalists," a stark decline from 78% in 1991 (Gallup, 2021). Beyond the increasingly polarizing political debate on environmental issues in the United States, one explanation for the decreasing identification focuses on an increase in negative stereotyping (e.g., being aggressive, stubborn, or eccentric) against people who think of themselves as environmentalists or environmentally conscious (Stewart and Clark, 2011; Bashir et al., 2013; Klas et al., 2019). Further, US ethnic and racial minorities as well as economically disadvantaged

groups are, contrary to their actual concern, perceived by the US society as least concerned about the environment and continue to be poorly represented in environmental organizations (Pearson and Schuldt, 2014; Taylor, 2014; Hiltner, 2019). This underrepresentation is particularly troubling since these marginalized and economically challenged communities bear a disproportionate burden of environmental risks (Mohai et al., 2009; Timmons Roberts et al., 2018). Termed as a "diversity crisis" (Pearson and Schuldt, 2014, p. 1034), this imbalance stems from enduring inequalities such as those in opportunities and education, coupled with unconscious biases in hiring practices and stereotypes, particularly portraying racial-ethnic minority groups as unconcerned (Taylor, 2014; Hiltner, 2019).

Based on previous research, an environmentalist can be defined as someone dedicated to protecting and enhancing the environment through different avenues, such as conservation or preservation (Tesch and Kempton, 2004; Bashir, 2010; Klas, 2016). In this study, we assumed that preexisting negative perceptions and stereotypes toward environmentalists prevent the general public from identifying, engaging, or supporting them (Bashir et al., 2013; Pearson et al., 2018). By mapping the underlying perceptions and impressions that US residents have of environmentalists (e.g., concerning competence, friendliness, and trustworthiness), we aimed to understand how people relate, both positively and negatively, to specific attributes associated with environmentalists. Moreover, we explored to what extent people's personal characteristics (e.g., political orientation, social class) affect their perceptions of environmentalists. Gaining more knowledge on these patterns contributes to the literature on environmentalist stereotyping and enhances our understanding of strategies to boost diversity among members and garner broader public support for environmental movements.

Previous research connected climate change and environmental justice[1] research with socio-psychological approaches through the study of intergroup processes in the United States (Pearson and Schuldt, 2018; Swim and Bloodhart, 2018). For example (negative), stereotypes toward environmentalists were identified as barriers to social change (Bashir et al., 2013), and people preferred pro-environmental messages coming from members of the same political party (Bolsen et al., 2019). Based on this research, Stenhouse and Heinrich (2019) applied a conjoint analysis to examine individuals' inclinations toward various personal attributes of climate activists and to determine how responses varied based on political party affiliation. However, their study did not delve into the stereotypic associations related to environmentalists, the factors driving identification with them, or the influence of perceivers' own characteristics. In the present study, we applied a conjoint analysis through a multidimensional rating experiment. Our goal was to investigate patterns of public impressions, perceptions of the prototypical environmentalist, and individuals' identification with environmentalists. Crucially, we sought to understand the interplay between multiple identity dimensions of environmentalists on participants. These dimensions included social class, race/ethnicity, and political orientation.

More precisely, the study aims at understanding which attribute values of fictitious environmentalists (a) inform stereotypical dimensions (e.g., competence, warmth, and morality), (b) are considered more typical of environmentalists, (c) and elicit more self-identification of participants with environmentalists. It also aims at expanding previous research on environmentalists that deviate from stereotypical depictions (i.e., that are atypical according to stereotype-literature), testing whether the presentation of environmentalists with attributes inconsistent with these stereotypes (as opposed to consistent attributes) enhances positive impressions and identification with them.

2. Literature review

In the following, a comprehensive theoretical foundation for our study will be provided, offering insights into how the dimensions of stereotypes, group identities, self-categorizations, and broader cultural norms interplay to shape public engagement with the environmental movement.

Stereotypes represent generalized beliefs about specific groups (Stangor and Lange, 1994). There is some consensus in the literature suggesting that these beliefs are primarily shaped along two dimensions. Specifically, research on the *Stereotype Content Model* (SCM; Fiske et al., 2002) has shown that positive and negative evaluations of other people and groups can be assessed through the two dimensions *warmth* (i.e., being warm, sociable, friendly) and *competence* (i.e., being competent, agentic, intelligent). Different dimension combinations result in distinct intergroup emotions (e.g., pity, envy, admiration, and contempt) and, consequently, in different forms of prejudices. By examining the content of people's perceptions of different groups (highlighted by characteristics like age, gender, occupation, ethnicity, race), Fiske et al. (2002) mapped prevalent societal patterns and tendencies in stereotyping. For example, they showed that men were primarily perceived as competent but not warm leading to feelings of admiration and envy. In contrast, women were seen as both competent and warm resulting in admiration. In terms of race and ethnicity, Fiske et al. found distinct stereotyping patterns in the United States. For example, racial-ethnic minority groups like Hispanics, Native Americans, and Black individuals were typically perceived as moderately warm and competent. Asians were stereotypically seen as competent but lacking in warmth, while Whites were generally perceived as both highly warm and competent. Stereotypically, higher status is often associated with competence, while competition tends to correlate with a low level of warmth perceptions. This provides the basis for understanding how certain groups might be liked or disliked, and respected or disrespected.

The SCM could help explain why certain environmentalists are perceived as more typical or more likable. For instance, Eckes (2002) found that women were frequently stereotyped as warm but not as competent, whereas men were perceived as competent but not warm. Also, when considering political stereotypes, individuals who identify as politically liberal are often perceived as warm but not competent. Hence, if environmentalists are described as women or politically

1 Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. This goal will be achieved when everyone enjoys the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work (United States Environmental Protection Agency, US EPA 2016).

liberal, they might be perceived as warm (friendly, nurturing) but not necessarily as competent. When considering racial stereotypes, Lin et al. (2005) found that Asians are often stereotyped as competent but not as warm in American society. Conversely, environmentalists described as Asians might be viewed as more competent but lacking in warmth. These perceptions may significantly influence the audience's inclination to identify with and support the environmental movement. Occupational stereotypes, such as those from Durante et al. (2013) which explored 37 countries, further highlight how certain professions, when viewed as social groups, are often stereotyped in terms of warmth and competence, which in turn affects the perceptions of environmentalists affiliated with these professions.

Nevertheless, attributions of warmth and/or competence are shaped not only by individuals' sociodemographic characteristics, but also by the extent of their engagement in pro-environmental activities with which they are associated (Bashir, 2010; Bashir et al., 2013; Castro et al., 2017). Using the SCM framework by Fiske et al., 2002, Castro et al. (2017) found that fictitious individuals expressing strong or radical environmentalism were stereotyped as less warm, though they were still regarded as equally competent. In comparison, those who engaged in private environmental actions (e.g., organic purchase, recycling, water, and energy saving) were positively evaluated on both dimensions. In a related study examining the discourse of environmentalists, participants preferred a concessional yes-but approach (Castro et al., 2017). This preference underscores a tendency toward more moderate and conciliatory pro-environmental stances. However, it is worth noting that the authors did not incorporate identity markers, like gender when characterizing the fictitious individuals.

Moreover, there is an increasing interest in a third dimension of stereotype content. In particular, the stereotypes traditionally categorized under warmth not only encompass friendliness and sociability, but also trustworthiness, which includes aspects like honesty, sincerity, and morality. Notably, these aspects have been demonstrated to be orthogonal (Leach et al., 2007; Ellemers et al., 2013; Landy et al., 2016). Such studies indicate that environmentalists are deemed more trustworthy or moral when they adopt a radical discourse compared to a moderate one. Their perceived warmth hinges on the societal consensus surrounding the discourse topic, while their perceived competence remains constant (Castro and Rosa, 2023). Intriguingly, younger environmentalists are not perceived as lacking in competence or warmth compared to their older counterparts. However, they are considered less trustworthy (Farinha and Rosa, 2022). Therefore, the present study extends this previous research by examining the influence of multiple personal attributes of environmentalists (e.g., gender identity, race/ethnicity, political orientation) on participants' perception and their identification with them.

Together, these studies provide ample support for the application of the SCM to understand how different characteristics of environmentalists might influence their perception in terms of warmth and competence and, subsequently, the willingness of individuals to engage and identify with the environmental movement.

In terms of identification processes, stereotypes can play an important role. Stereotypes are mental constructs that often deviate from the true characteristics of the ideal or average group member. Instead of providing a comprehensive or accurate portrayal, they can sometimes offer a distorted, overly simplistic, or even negative view of a social category (Hilton and von Hippel, 1996). Previous research on stereotypes associated with environmentalists has revealed a range of positive and negative perceptions held by the general public. Research has shown that positive attitudes toward the prototypical environmentalist, as well as identifying as an environmentalist, are linked to pro-environmental behaviors and policy preferences (Ratliff et al., 2017; Brick and Lai, 2018). Given this, stereotypes might help explain the social barriers some societal groups face when considering identification with or engagement in the environmental movement (Bashir et al., 2013; Swim and Bloodhart, 2018; Klas et al., 2019). The Social Identity Theory (SIT) posits that individuals derive a portion of their self-concept from the social groups they belong to, leading to a bias toward in-group members and discrimination against out-group members (Tajfel and Turner, 1979). This theory is particularly relevant to our study as it highlights how people's identification with the profiles of environmentalists might be influenced by their own group memberships. For instance, if participants see themselves as part of a "liberal" group, they might be more inclined to identify with environmentalists that are also politically liberal. SIT can therefore offer insights into how stereotypes and social identities interplay in shaping public engagement with environmentalism. For example, individuals avoid affiliating (which is a form of identification) with environmentalists when they perceive them as militant/aggressive or eccentric/unconventional (Bashir et al., 2013). This is in line with the findings of Klas et al. (2019) illustrating that behaviors at an individual/private level (e.g., recycling) can be perceived more positively (e.g., as valuing nature), whereas collective actions or other public sphere behaviors (e.g., demonstrations) are judged negatively (e.g., as aggressive and stubborn). SIT involves processes of categorization (how we see ourselves as members of a given group), identification (the emotional significance of that membership) and social comparison [how well or worse-off is the own group (ingroup) compared to other (out-groups)]. The Self Categorization Theory (SCT; Turner et al., 1987) deals precisely with categorization processes and brings forward how important typicality is: people have a representation (prototype) of what a typical group member is for any given social group, and group members can differ in the extent to which they are typical of the group.

Perceptions of environmentalists may vary depending on different attributes and which traits are typically associated with members of this social category. Considering that these perceptions are mostly negative (and, thus, social comparison processes are not in their favor), they represent possible reasons why people refuse to identify with environmentalists or to participate in pro-environmental behaviors, as well as why environmentalists might hold back on public engagement and advocacy. In the US context, environmentalists are among the most politicized groups and they are typically associated with the Democratic party and left-wing ideology (Merkley and Stecula, 2018). Studies showed that individuals who are concerned about the environment or engage in environmentally conscious behaviors are typically perceived as more feminine (Brough et al., 2016; Swim and Bloodhart, 2018). Pearson et al. (2018) found that the typical perception of environmentalists among diverse societal groups in the United States included the features of White and highly educated. However, when contrasting these perceptions to the reported self-identification of people from different racial-ethnic groups, results revealed that minority groups (e.g., Latinos/as and Asian Americans) identified themselves more as environmentalists

than Whites. Pearson et al. describe this phenomenon as an *environmental belief paradox*, meaning the tendency to (self-) stereotype, misperceive, and underestimate low-income and underrepresented groups' identification with environmentalists, when those groups are most concerned and vulnerable to negative environmental impacts. The environmental belief paradox can be reduced by exposing diverse participants to images and descriptions of racially diverse (vs. non-diverse) members of environmental organizations (Pearson et al., 2018). Pearson et al. explained this effect through the presence of diversity cues as enhancing the perceptions of inclusion and belonging among the underrepresented study participants (Purdie-Vaughns et al., 2008).

Bashir et al. (2013) showed that typical environmentalists were associated with militancy and eccentricity, resulting in a reduced receptiveness toward activists and the social and behavioral changes for which they advocated. Interestingly, these results were less pronounced for portrayals of environmentalists depicted with descriptions that challenge conventional activist group stereotypes (e.g., being pleasant and approachable). Such portrayals elicited more positive responses and a heightened willingness to associate with them. Thus, it is not just the group membership that influences participants' impressions, it also influences the degree to which environmentalists align with or deviate from the currently prevailing group stereotypes. Building on this research, our study integrates various profile attributes deemed atypical in existing literature. We aim to examine whether perceptions of these environmentalists are more favorable compared to typical profiles. For instance, we introduced the non-binary gender identity as one of the descriptive attributes of environmentalists.

Lastly, our study suggests a strong influence of cultural stereotypes and social norms on people's impressions and self-identification with environmentalists. This framework considers that the broader cultural context, including societal stereotypes about certain professions, genders, or ethnicities, play a significant role in shaping perceptions. In our study, the inclusion of stereotypes related to women, Asians, or specific occupations indicative of social class (e.g., working as cleaners or office clerks) could contribute making these profiles appear as more typical or relatable environmentalists. Similarly, the norms associated with political ideologies might affect how typical or likable an environmentalist is perceived, affecting people's willingness to engage with environmentalism. If participants show tendencies to self-identify most with environmentalists at particular attribute levels, this may be understood as *self-defining* and *self-investing* components of identification (Leach et al., 2008). In this respect, participants may perceive themselves (i.e., individual self-stereotyping) and their ingroup (i.e., in-group homogeneity) as similar to the environmentalists described in a certain way. According to Leach et al. (2008), participants may: (1) feel positively toward these environmentalists (i.e., *satisfaction*); (2) feel a sense of belonging and attachment to certain profiles (i.e., *solidarity*); and (3) perceive them as central to their self-concept, thus, being more aware of ingroup threats (i.e., *centrality*).

Pioneering a new line of research, Stenhouse and Heinrich (2019) presented numerous profile variations and simultaneously tested many attribute factors through the application of a conjoint experiment. They discovered that the most significant effects were linked to the activists' viewpoints on climate change, the frequency with which they pressured others to act on climate change, their stance on gun control, and their party affiliation. They concluded that to enhance the general public's appeal toward climate activists, they should be depicted as friendly and non-militant. While Stenhouse and Heinrich (2019) expanded our understanding of public perceptions of environmentalists, they did not consider other identity-relevant dimensions in their research.

Thus, people's impressions and stereotypes of environmentalists can be influenced by various factors including their labels, attribute traits, or actions (Bashir et al., 2013; Castro et al., 2017; Klas et al., 2019). The present study contributes to the social identity and stereotype literature by examining public impressions and evaluations of environmentalists along the stereotype dimensions of competence, warmth, and morality. Moreover, we aim to assess participants' self-identification with environmentalists and their perceptions of environmentalists' typicality based on various attributes.

By incorporating and analyzing multiple relevant identity dimensions of environmentalists (e.g., gender, social class, race/ethnicity, political orientation), this study takes an intersectional approach (American Psychological Association, 2017). To conduct a one-by-one examination of multiple factors, we apply an experimental approach (with systematic variation and randomization)—that is, *conjoint analysis* (Hainmueller et al., 2014). Conjoint analyses allow the merger of directional expectations for some attributes and an exploratory approach for others. As we aim to examine a large number of identity factors as well as the often-ambiguous nature of impressions and stereotypes, we derived some directional hypotheses to address our research aims.

Drawing from existing literature on attributes associated with environmentalists, we anticipate that while female and White environmentalists will be perceived as both warm and competent, those who are Asian, male, or associated with high-status occupations will be seen as competent but not necessarily warm (H1.1a). Concerning the actions of environmentalists, we anticipate that those described as more radical will be perceived as less warm albeit equally competent. In contrast, environmentalists characterized by private pro-environmental behaviors will likely be viewed warmer while maintaining a similar level of perceived competence (H1.1b). Generally, environmentalists that could be perceived as eccentric or confrontational will likely be viewed negatively (H1.1c). Furthermore, we expect that White female environmentalists of middle social status with liberal political orientation, especially those who are more radically active, will be most frequently perceived as typical environmentalists (H1.2). Moreover, we expect that participants will most likely identify themselves with environmentalists that show private pro-environmental behaviors (H1.3). In terms of positive impressions and identification with environmentalists based on their typicality, and similar to Bashir et al. (2013) results, we expect to find positive effects across all dependent variables through the inclusion of stereotype-inconsistent attributes (H2).

The presented hypotheses are examined with a sample of US residents; therefore, the present study provides new insights into the perceptions of environmentalists in the United States. Figure 1 shows the profile attribute values representing the independent variables (IV); the participants' evaluations were assigned as dependent variables (DV).

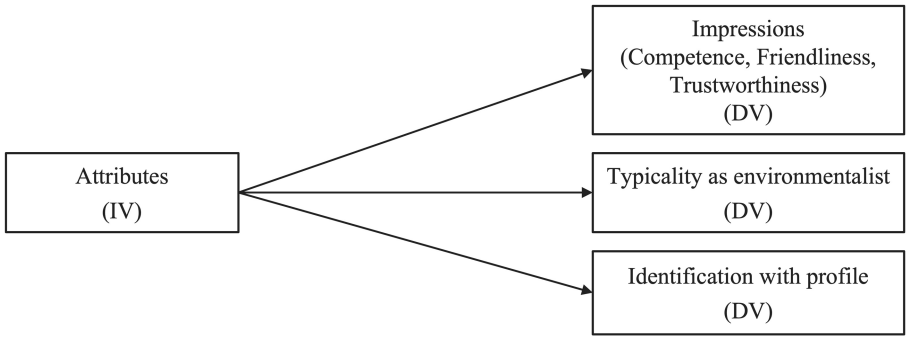

FIGURE 1
Simple study model indicating the influence of environmentalists' profile attributes on participants' impressions, perceived typicality as environmentalist, and self-identification.

3. Materials and methods

3.1. Conjoint analysis

Conjoint experimental designs, originally developed by Luce and Tukey (1964), have been traditionally used in marketing research but recently introduced to the field of political science as well (e.g., Doherty et al., 2019; Knudsen and Johannesson, 2019; Carey et al., 2020). Applied to psychological research, this approach allows the investigation of people's responses to a multitude of complex and interacting influences. Like vignettes, conjoint designs describe a product or person, subsequently referred to as *profile*, based on the different characteristics presented to respondents in a table format (Stenhouse and Heinrich, 2019). *Attributes* refer to the name of features or characteristics that describe the profiles, consisting of *levels* or *values* representing the different choices for each attribute (Qualtrics XM support, 2021). The two profiles are generated completely at random assigning "a value for each attribute, and the order of attributes randomized as well" (Stenhouse and Heinrich, 2019, p. 344). In a conventional experimental approach in psychology, different experimental conditions are presented to participants or separate groups. However, in conjoint experiments, fully randomized attribute orders and values are presented to each individual participant (Stenhouse and Heinrich, 2019). Hence, this method does not require experimental participant subgroups or separate conditions.

Being a multidimensional choice or rating experiment, this method allows a fully randomized factorial and between-subjects design that simultaneously tests the influence of various factors on participants' evaluations of environmentalists' profile descriptions. These evaluations are used to calculate the participants' impressions and tendencies within individual profile attributes as well as group differences between the participants (Leeper et al., 2020). Furthermore, the use of conjoint analysis allows for a detailed examination of individual effects, accommodating both directional hypotheses and exploratory questions, making it well-suited for our research objectives. In summary, conjoint analysis has shown to be a functional, practical, and efficient method that has not yet received adequate attention in psychological research. For more information on the statistical analysis of conjoint designs, the assumptions of conjoint analysis, and the method's strengths and benefits, please see the Supplementary materials.

3.2. Participants

For the present study, we recruited 1,452 US residents. Our target sample size followed the recommendations and model-based statistical power calculations for conjoint designs by Stefanelli and Lukac (2020), requiring a minimum of $N = 620$ participants to ensure adequate statistical power ($1 - ß = 0.80$). We recruited our sample via convenience sampling (e.g., in social media groups, private social, and academic networks) and the Amazon Mechanical Turk (MTurk) crowdsourcing platform, adhering to recommended practices (Black, 2021).[2] Participants either received the option of qualifying to win a $50 gift certificate (convenience sample) or compensation of $2 for their completed participation (MTurk sample). To prevent respondents from being unconscientious during the survey, participation qualifications and control questions were integrated into the questionnaire.

Participant responses were collected between April 13 and May 20, 2021. Out of the original 1,452 responses, 774 were removed due to incomplete survey responses, failed attention checks, and rapid completion (under 5 mins), leaving $N = 678$ valid responses for statistical analysis. From those, $n = 364$ (53.7%) were recruited through convenience sampling and $n = 314$ (46.3%) through Amazon MTurk. Separate analyses were conducted for each sample as detailed in the results section and subsequently discussed. Participants were between 18 and 85 years of age ($M = 34.26$, $SD = 12.16$). The gender distribution was as follows: of the total sample, 317 participants (46.8%) identified as female, 352 (51.9%) as male, three (0.4%) as agender or non-binary, one (0.1%) chose "prefer not to say," and five (0.7%) did not provide a response. Participants' religiosity was assessed using a scale from 1 (Not religious at all) to 7 (Very religious), yielding a mean score of 3.89 ($SD = 2.20$). Their political orientation was gauged on a scale ranging from 1 (Strongly liberal) to 7 (Strongly conservative), with an average score of 3.65 ($SD = 1.86$). Comprehensive socio-demographic details are provided in Table 1.

2 Further details in Supplementary materials.

TABLE 1 Socio-demographic data with sample sizes and percentages.

Sociodemographic category	Sample size and percentage of participants	
	n	%
Race/ethnicity		
White/Caucasian	503	74.2
Black or African American	65	9.6
Hispanic or Latino	52	7.7
Asian or Asian American	32	4.7
Middle Eastern	1	0.1
American Indian or Alaska Native	9	1.3
Multi-ethnic/multiracial (accumulated)	15	2.2
Prefer not to say	1	0.1
Self-assessed social class		
Lower class	92	13.6
Middle class	525	77.4
Upper class	61	9.0
Yearly household income		
Less than $10,000	31	4.6
$10,000–$29,999	84	12.4
$30,000–$49,999	148	21.8
$50,000–$69,999	136	20.1
$70,000–$89,999	88	13.0
$90,000–$119,999	65	9.6
$120,000–$149,999	42	6.2
$150,000–$179,999	27	4.0
$180,000–$209,999	13	1.9
More than $210,000	30	4.4
Didn't respond	14	2.1

3.3. Procedure

The study was carried out in accordance with the declaration of Helsinki regarding research with human beings. The local ethics committee approved the research (information omitted for blind review) and pre-registered on AsPredicted.org.

The applied conjoint analysis was constructed and administrated as a 25-min online questionnaire via the Qualtrics survey platform (Qualtrics, 2005). After responding to an informed consent, the participants were presented with separate conjoint modules describing a total of eight environmentalist profiles in a table format. Throughout the study, we provided participants with our operational definition of environmentalists as described previously. As is standard in conjoint designs, these descriptions were fully randomized. Subsequently, participants evaluated them based on their impressions, perceived typicality as environmentalists, and the degree of self-identification participants felt with them. Aside from the conjoint variables, participants' socio-demographic data and their attitudes regarding environmentalism were recorded. Finally, participants were fully debriefed and given the option to leave comments.

3.4. Materials

The acquired survey data encompassed the independent, dependent, and subgroup variables within the examined model. The provided experiment incorporated four conjoint modules. Each module featured a conjoint table that described two fictitious environmentalist profiles (A and B see Figure 2). The profiles were characterized by nine attributes each falling within specified categories. These attributes were randomly ordered with values chosen from a pool of potential attribute levels as independent variables (IVs). The conjoint table was followed by five rating tasks to capture participants' impressions (on the dimensions of competence, warmth, and morality), typicality of environmentalists, and self-identification with the profiles as dependent variables (DVs). Furthermore, socio-demographic data, as well as environmental standpoint and optional identity variables were assessed for further possible analyses. The online survey was developed using HTML and JavaScript coding to create the conjoint experiment.[3]

3.4.1. Stimuli

The profile attributes and attribute values[4] were selected based on previous research related to stereotypes of people who engage in pro-environmental behaviors or are labeled as environmentalists. To approximate a realistic portrayal of an environmentalist, the profile descriptions incorporated attribute categories such as "Age," "Gender identity," "Race/Ethnicity," "Occupation," "Religiosity," "Political orientation," "Type of pro-environmental behavior," "Main environmental concern," and "Argumentation style." Due to design restrictions imposed by statistical power calculations (Stefanelli and Lukac, 2020), the maximum number of values per attribute was limited to four. The chosen values were designed to encompass both stereotype-consistent and stereotype-inconsistent descriptions. The full text of the profile attributes and their values are provided below in Table 2. On another note, for a traditional experimental setup, the factorial structure for the independent variables would consist of a $3\times3\times3\times4\times3\times3\times3\times2\times2$ (multiplied attribute values) design including a total of 11,664 experimental conditions. In turn, the application of a conjoint experiment allowed the testing of all these factors within one experimental condition with a substantially reduced sample size.

Age and Gender Identity. Three age (e.g., 23) and gender identity (e.g., woman and non-binary) values were included representing different social groups in US society. To the best of our knowledge, the "non-binary" gender identity has not been previously explored in the literature on environmentalist stereotypes.

Race/Ethnicity and Occupation. As reviewed previously, traits related to race, ethnicity, and socio-economic status are relevant dimensions associated with existing public perceptions of environmentalists (Pearson et al., 2018). Unfortunately, due to sample size considerations and power, only the four largest racial

3 See Supplementary materials for further details, the full questionnaire, as well as the HTML and JavaScript coding.

4 For clarification, *Attributes* refer to the name of features or characteristics that describe the profiles. These attributes consist of *levels* or *values* representing the different choices for each attribute.

	Environmentalist A	Environmentalist B
Main environmental concern	Global environmental problems (e.g., climate change, depletion of the ozone layer, destruction of wildlife and forests, droughts & floodings)	Global environmental problems (e.g., climate change, depletion of the ozone layer, destruction of wildlife and forests, droughts & floodings)
Age	64	42
Type of pro-environmental behavior	Writes political representatives on environmental regulation issues. Signs petitions on environmental protection. Promotes pro-environmental behaviors to family and friends and by sharing information through social media.	Actively involved in environmental protection groups. Frequently participates in demonstrations, civil disobedience, or other direct actions aiming to influence environmental politics.
Occupation	Cleaner	Corporate CEO
Religiosity	Moderately religious	Not religious
Race/Ethnicity	Black/African American	Hispanic/Latinx
Argumentation style	We are already doing something positive, but we also need changes from large economic groups.	We are already doing something positive, but we also need changes from large economic groups.
Gender	Woman	Man
Political orientation	Moderate	Moderate

FIGURE 2
Example conjoint table describing two environmentalists **(A,B)**.

and ethnic groups in the United States could be included (US Census Bureau, 2019). The selection of occupation aimed to signify socio-economic status. This approach was adopted to avoid random combinations of multiple socio-economic variables, which might have produced implausible profile descriptions (for instance, a doctor possessing only a high school degree). Such inconsistencies could potentially lead to participant confusion, as highlighted by Hainmueller et al. (2014).

Religiosity and Political Orientation. Religion or religiosity, while a significant factor in shaping social identity in the United States (Arbuckle, 2017), has yet to be extensively explored in the context of environmentalist stereotype literature. Again, to avoid unusual attribute combinations and to keep the limit of four levels for each attribute, we chose to include three levels of religiosity (not, moderately, and very religious) instead of religious affiliation. Moreover, political orientation representing one of the most significant and polarizing factors influencing US residents' views on environmentalism, was included with three distinct values (liberal, moderate, and conservative; Merkley and Stecula, 2018).

Type of Pro-Environmental Behavior and Main Environmental Concern. People's understanding and impressions of environmentalists are influenced by the nature of the pro-environmental behaviors they exhibit. Therefore, the inclusion of three distinct behavioral descriptions (indicating radical, moderate, and private behaviors) for environmentalists was intended to provoke varied responses. Furthermore, diverse people have different environmental concerns and therefore might align more with global or local concerns (Mohai and Bryant, 1998). Both forms of environmental concern were included as attribute values.

Argumentation Style. Environmentalists' discourse can have radical and moderate argumentative styles (see Uzelgun et al., 2015; Castro et al., 2017; Castro and Rosa, 2023). We included environmentalists' argumentation style via two distinct messages. One used a moderate and concessional "yes-but" discourse, suggesting that while significant efforts are underway, they remain insufficient. In contrast, the second employed a more confrontational and non-compromising "no-no" discourse, emphasizing the need for immediate and radical action.

3.4.2. Measures

After being presented with the conjoint tables containing the above-explained stimuli, participants were asked to rate their impressions of the described environmentalists on a 7-point Likert scale ("1 = Strongly disagree" to "7 = Strongly agree"). As is standard for conjoint experiments (Hair, 2014), the participants' impressions were measured using single-item constructs. The specific measures used in the questionnaire are available in the Supplementary materials.

Stereotypical Impressions. Using the dimensions established by Fiske et al. (2002) and Leach et al. (2007), participants' impressions were assessed in terms of competence, warmth, and morality. Participants were asked to indicate their level of agreement or disagreement regarding whether the presented profiles were "friendly" (representing warmth), "competent" (representing competence), and "trustworthy" (representing morality). In the following, the measure

TABLE 2 Full text of all profile attributes (variables) and attribute values (levels).

Attribute	Value
Age	23
	42
	64
Gender identity	Woman
	Man
	Non-binary
Race/ethnicity	White
	Black/African American
	Hispanic/Latinx
	Asian
Occupation	Office clerk
	Corporate CEO
	Cleaner
Religiosity	Not religious
	Moderately religious
	Very religious
Political orientation	Liberal
	Moderate
	Conservative
Type of pro-environmental behavior	Actively involved in environmental protection groups. Frequently participates in demonstrations, civil disobedience, or other direct actions aiming to influence environmental politics.
	Writes political representatives on environmental regulation issues and signs petitions on environmental protection. Promotes pro-environmental behaviors and shares information with family, friends, and through social media.
	Prefers purchasing environmentally friendly goods, such as local organic food, or recycled products. Separates garbage at home and uses (natural) resources responsibly, like avoids wasting food, energy, or water, or drives less by car.
Main environmental concern	Global environmental problems (e.g., climate change, depletion of the ozone layer, destruction of wildlife and forests, droughts & floodings)
	Neighborhood environmental problems (e.g., too much trash & noise, lack of access to natural areas or grocery stores, proximity to polluting industrial sites)
Argumentation style	What we are doing is not enough. We need fundamental changes from large economic groups.
	We are already doing something positive, but we also need changes from large economic groups.

"friendliness" refers to the dimension warmth and the measure "trustworthiness" to the dimension morality.

(Proto)Typicality and Self-Identification. Participants were asked to indicate their level of agreement or disagreement concerning the typicality of the presented profile as an environmentalist, as well as their personal identification with them.

Environmentalism, Socio-demographic Data, and Other Identity Variables. Participants provided information regarding their own environmental beliefs, socio-demographic details, and affiliations with other groups. Their perspective on environmentalism was assessed through how strongly they identified as an environmentalist, their personal level of concern about environmental issues, their own pro-environmental actions, and which environmental problem they deemed most important. The assessed socio-demographic questions concerned the participants' self-assessed social class, race/ethnicity, age, gender identification, religious affiliation, religiosity, education, yearly household income, and political orientation.

3.5. Statistical analyses

For the statistical analyses, the dataset was prepared in SPSS, version 27.0 (IBM Corp., 2020). All hypotheses were then tested via conjoint analysis in R using the Cregg package (Leeper, 2020). Following the recommendation of Hainmueller et al. (2014), we conducted diagnostic checks to confirm that the assumptions for conjoint analyses were met (see Supplementary materials). Furthermore, external validity was ensured beforehand by assessing whether random attribute combinations could produce implausible profile descriptions. The generated randomization code was also put in place to avoid any unintended effects from the order of attributes.

First, we computed the Marginal Means (MMs) for each attribute value. These MMs represent the average ratings from all participants for each value, marginalized over all profile attributes. This approach offers insights into the estimates and patterns of participants' impressions as recommended by Leeper (2020). Additionally,

we formally tested for differences within one attribute category (between the attribute values' MMs) by running omnibus *F*-tests using nested model comparisons. Unfortunately, the Cregg package (Leeper, 2020) did not provide the option of multiple comparisons for more than two levels/values; therefore, we could not simultaneously estimate the differences between all attribute values.

Then, we computed the average Marginal Component Effects (AMCEs). These indicate the effect sizes of each attribute value both within and in relation to its own attribute category. The AMCE values are calculated through the differences between all marginal means of one attribute category averaged by the marginal mean of the reference value. We applied values that were consistent with prior stereotype-literature (e.g., young, female, radical) as reference values for the AMCE calculations. Hence, the AMCEs provided patterns of participants' impressions relative and conditional to the selected reference values as a baseline for each conjoint attribute. Moreover, their confidence intervals (CIs) indicated if there was a significant difference between stereotype-inconsistent and -consistent values.

4. Results

The results of the effects on profile attributes are presented visually by plots as well as through omnibus F-tests, with only significant results being reported. The exact numerical estimates, standard errors, and z-scores, as well as an overview of the descriptive statistics and correlations, can be found in the Supplementary materials.

Testing for differences between the two sample groups (MTurk sample and convenience sample), pairwise comparisons showed differences in the dependent variables: competence $F(18, 5{,}388) = 1.71$, $p = 0.03$, friendliness $F(18, 5{,}388) = 3.77$, $p < 0.001$, trustworthiness $F(18, 5{,}388) = 3.74$, $p < 0.001$ and typicality $F(18, 5{,}388) = 1.87$, $p = 0.01$. This limitation is discussed below.

Figure 3 displays the results of the marginal means of the profile ratings for competence, friendliness, and trustworthiness, and Figure 4 displays the results of the ratings on profiles' typicality as environmentalists and participants' self-identification with the profiles. In each graphic, dots represent the marginal means, which are the estimates for every attribute value averaged across all participants. The horizontal lines on either side of the dots are the upper and lower limits of the mean dispersion. The x-axis units are the original scale points for each dependent variable.

Tendencies are visible in the ratings of the profiles' competence, friendliness, and trustworthiness, and they vary in relation to the given profile attribute values within the given range (MMmin = 5.0, MMmax = 5.5). As shown in Table 3, significant mean differences between the values were found for some environmentalists' attribute categories, suggesting that the environmentalists' profiles were perceived more positively or more negatively when described with the listed profile attributes.

Most positive environmentalist profile. Environmentalists described as younger (most friendly), as a woman (most competent, friendly, and trustworthy), as a corporate CEO (only most competent), as politically moderate (most trustworthy), and as privately pro-environmental (most friendly and trustworthy).

Most negative environmentalist profile. Environmentalists described as older (least friendly), as non-binary (least competent, friendly, and trustworthy), working as a cleaner (least competent), as politically conservative (least trustworthy), and as radically pro-environmental (least friendly and trustworthy).

As seen in Figure 4, tendencies are visible in the ratings of environmentalists' typicality (MMmin = 4.7, MMmax = 5.2) and participants' self-identification with the profiles (MMmin = 4.5, MMmax = 4.9), which vary in relation to the profile attribute values in the given range. As shown in Table 4, significant mean differences between the values were found within the following environmentalists' attribute categories on the outcome typicality as environmentalist and participants' self-identification with the environmentalists' profiles. This suggests that our sample perceived the presented profiles as most typical for environmentalists or identified most or least with them when described with the listed profile attributes.

Profiles most typical for environmentalists. Environmentalists described as woman, as Asian, working as a cleaner or an office clerk, as politically moderate or liberal, as privately pro-environmentally active, as well as with a mainly global environmental concern were described as most typical for environmentalists.

Profiles least typical for environmentalists. Environmentalists described as non-binary, as Hispanic/Latino or Black/African American, working as a corporate CEO, as politically conservative, as radically pro-environmentally active, and with a mainly local environmental concern.

Strongest self-identification with environmentalists. Participants identified more strongly with environmentalists that were described as woman, working as a cleaner, and with privately pro-environmental behavior.

Weakest self-identification with environmentalists. Participants identified weakest with environmentalists that were described as non-binary, as corporate CEO, and with radical pro-environmental behavior.

To compare attribute values, that in previous literature were found to be stereotypic for environmentalists with attribute values that have not been identified as such, we calculated AMCEs. In the following, AMCEs are reported for each profile's attribute value calculated for the measures of competence, friendliness, and trustworthiness (Figure 5), as well as the profiles' typicality as environmentalists and the participants' self-identification with the profiles (Figure 6). Here, the x-axis units indicate the sizes of the AMCEs (not the original scale points). Moreover, the dots represent the estimated AMCEs per attribute value relative to the baseline/reference value (located on the vertical line in the plots), and the bars on either side of these dots are the 95%-Confidence Intervals (CI) for the effects. When the CI does not include the x-axis' zero point, the effect of the attribute value is significantly different from the reference value. As mentioned earlier, for this study, we chose values that are consistent with the findings of previous stereotype literature as reference values (x-axis' zero point). Given this context, a significant effect (when the CI not including x-axis zero point) indicates a distinction in participants' evaluations between stereotype-consistent and stereotype-inconsistent information. The position of the bars indicates whether the attribute value was evaluated more positively or negatively compared to the reference value. The visualized tendencies look similar to the previous plots but differ in the way that the calculated estimates are all relative to the reference value of the given attribute category, thus they can only be compared within that category.

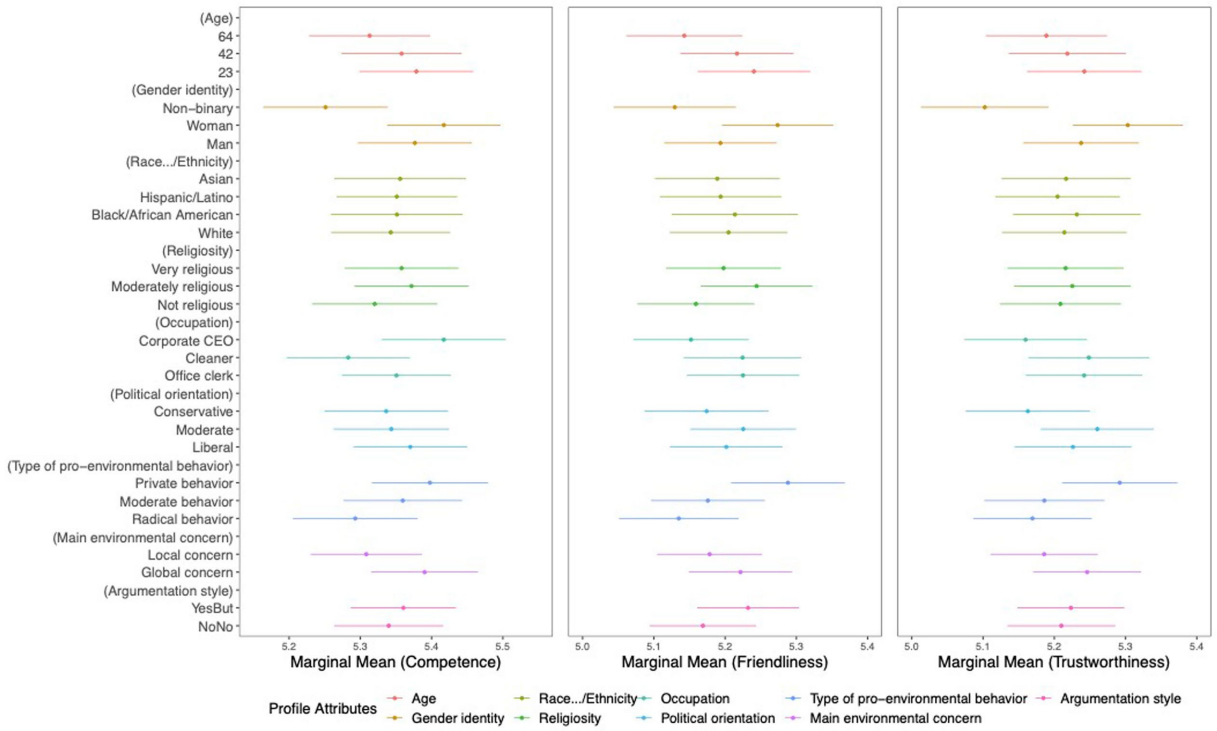

FIGURE 3
Marginal mean estimates for each attribute value on the profile ratings for competence, friendliness, and trustworthiness. The x-axis units are the original scale points for each dependent variable.

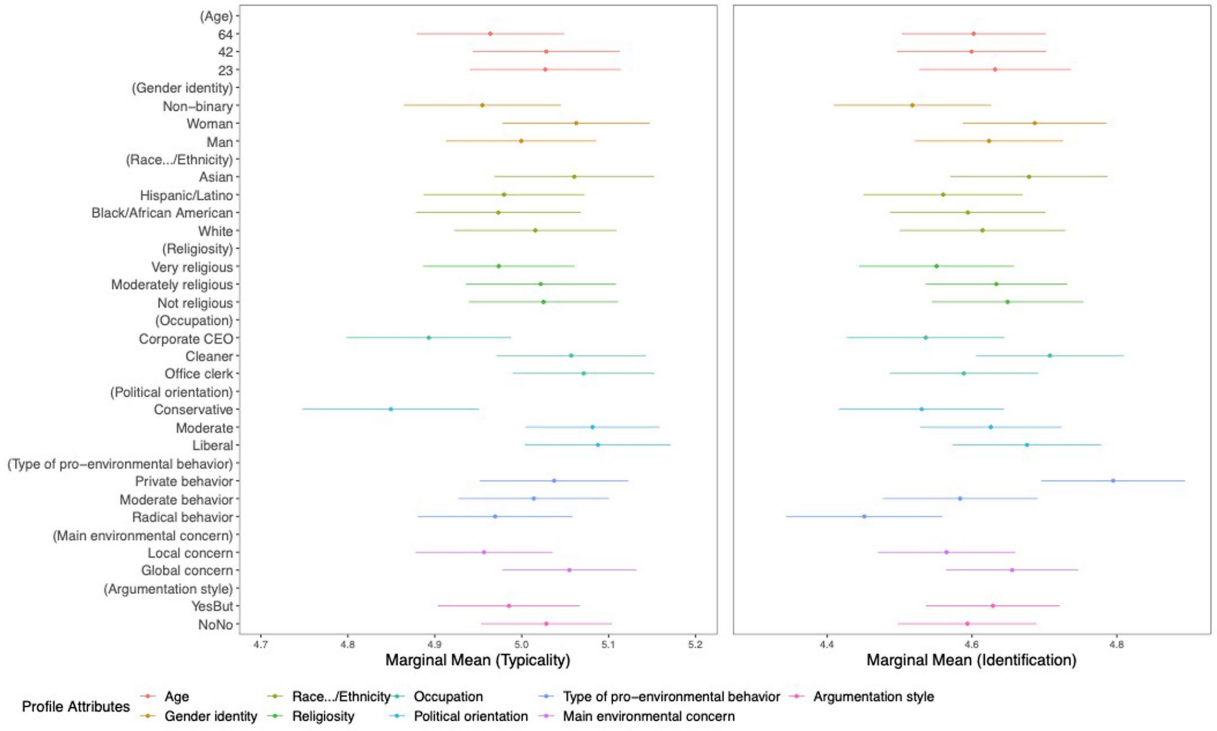

FIGURE 4
Marginal mean estimates for each attribute value on the profile ratings for typicality as environmentalist and self-identification with the profiles. The x-axis units are the original scale points for each dependent variable.

TABLE 3 Significant mean differences between the values by environmentalists' attribute categories.

Variables	Competence	Friendliness	Trustworthiness
Age	–	$F(4, 5{,}418) = 3.22$, $p = 0.012$	–
Gender identity	$F(4, 5{,}418) = 5.68$, $p < 0.001$	$F(4, 5{,}418) = 5.86$, $p < 0.001$	$F(4, 5{,}418) = 7.78$, $p < 0.001$
Occupation	$F(4, 5{,}418) = 3.04$, $p = 0.012$	–	–
Political orientation	–	–	$F(4, 5{,}418) = 3.09$, $p = 0.015$
Type of pro-environmental behaviors	–	$F(4, 5{,}418) = 4.87$, $p < 0.001$	$F(4, 5{,}418) = 3.63$, $p = 0.006$

TABLE 4 Significant mean differences between the values by environmentalists' attribute categories.

Variables	Typicality	Self-identification
Age	–	–
Gender identity	$F(4, 5{,}418) = 2.93$, $p = 0.020$	$F(4, 5{,}418) = 3.13$, $p = 0.014$
Race/ethnicity	$F(6, 5{,}414) = 2.37$, $p = 0.027$	–
Occupation	$F(4, 5{,}418) = 4.59$, $p = 0.001$	$F(4, 5{,}418) = 2.69$, $p = 0.029$
Political orientation	$F(4, 5{,}418) = 9.30$, $p < 0.001$	–
Type of pro-environmental behaviors	$F(4, 5{,}418) = 2.60$, $p = 0.034$	$F(4, 5{,}418) = 11.71$, $p < 0.001$
Main environmental concern	$F(2, 5{,}418) = 3.24$, $p = 0.039$	–

From the calculations (see Supplementary materials) and visualizations (see Figures 5, 6) of the AMCEs, the descriptions of environmentalists with stereotype-inconsistent attribute values shown in Table 5, were perceived significantly more positively and negatively.

5. Discussion

The present study sought to broaden our understanding of how public perceives environmentalists as a social category in the US Environmentalists are strongly stereotyped and politicized yet remain an understudied social category. Aiming at identifying the social identity factors that influence public impressions of and self-identification with environmentalists, we wanted to answer (1) which identity factors of fictitious environmentalist profiles led a sample of US residents (1.1) to perceive them as competent, friendly, and trustworthy (1.2) to see them as typical for environmentalists, and (1.3) to self-identify with them. Lastly, building on the work of Bashir et al. (2013) and Stenhouse and Heinrich (2019), we sought to further explore atypical environmentalists (2). Specifically, we analyzed whether fictitious profiles described with attributes that deviate from (vs. align with) established stereotypes would enhance positive impressions of, and self-identification with, these environmentalists.

5.1. Effects on perceptions of the profiles' competence, warmth (friendliness), and morality (trustworthiness)

Overall, our results correspond with our expectations and prior stereotype literature (e.g., Stereotype Content Model; Fiske et al., 2002). For example (H1.1), environmentalist profiles ascribed as women were generally perceived as friendlier and more trustworthy and competent than the other gender identities. However, this is contrary to the findings of Fiske et al. (2002), where men are usually perceived as more competent than women. In light of the SCM quadrants (Fiske et al., 2002), our study reveals admiration for environmentalist women. It is essential to note that a direct comparison of our findings with the SCM's observations on women is constrained because of the differing measurement methods and the environmental focus of our profile descriptions. Therefore, more research is needed in applying the SCM. By contrast, non-binary profiles were rated the lowest among all three stereotype dimensions. Bearing in mind that the social concept of non-binary gender identity is relatively new (Matsuno and Budge, 2017), our findings could be explained through participants perceiving non-binary environmentalists as unconventional and eccentric. Although eccentricity had been found as a typical trait of environmentalists (Bashir et al., 2013), combining two already unconventional and stereotyped identity dimensions, namely environmentalists and non-binary gender, seemed to have elicited the least positive impressions among participants. Broadening the knowledge in this field, Stenhouse and Heinrich (2019) investigated the mediating role of perceiving environmental activists as eccentric, militant, and friendly; they, too, used a conjoint design and found eccentricity to be least important in increasing the attraction to activists. Our results may align with Stenhouse and Heinrich's findings as the unconventional non-binary profiles did not improve our participants' impressions.

Profiles with the high-status occupation as corporate CEO were rated as most competent compared to working as cleaners and office clerks, but not as friendly or trustworthy. These findings correspond to previous research showing that higher status levels predicted higher competence, but competition predicted lower warmth/friendliness (Fiske et al., 2002). In another instance, Fiske and Dupree (2014) found similar effects regarding climate scientists. For a communicator to effectively capture attention and establish credibility, they must not

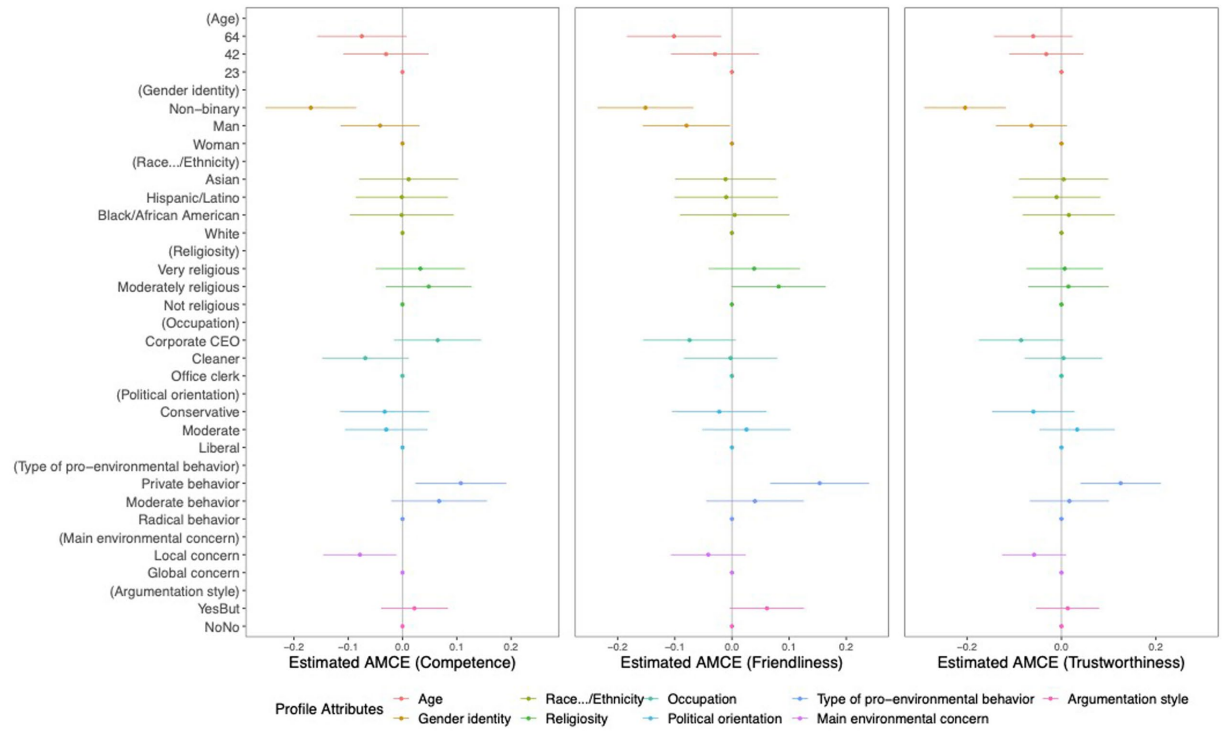

FIGURE 5
Average marginal component effect estimates for each attribute value on the profile ratings for competence, friendliness, and trustworthiness. The x-axis units indicate the sizes of the AMCEs.

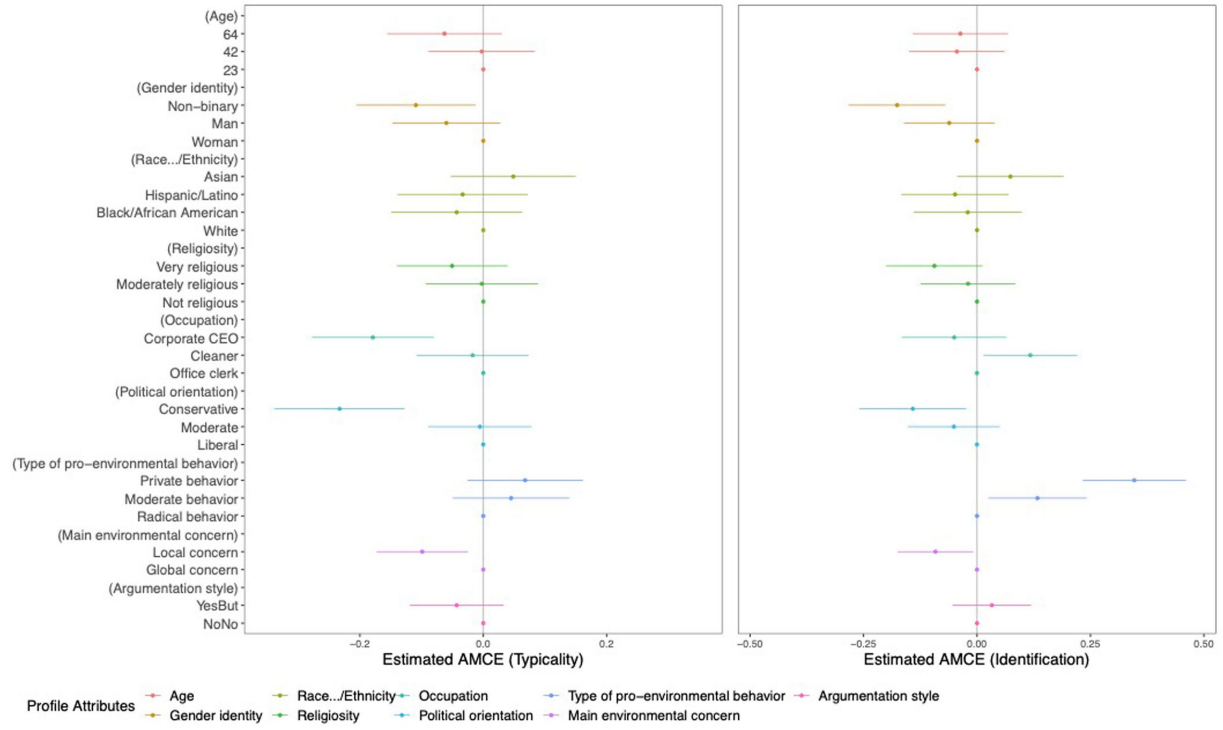

FIGURE 6
Average marginal component effect estimates for each attribute value on the profile ratings for typicality as environmentalist and self-identification with the profiles. The x-axis units indicate the sizes of the AMCEs.

TABLE 5 Attribute values of environmentalist profiles evaluated more positively or negatively compared to reference values identified by previous stereotype literature.

Attribute categories	Attribute values evaluated more positively compared to attribute values consistent with stereotype literature	Attribute values evaluated more negatively compared to attribute values consistent with stereotype literature
Age (Reference value: 23 years old)	–	64 years (friendliness, $p < 0.001$)
Gender identity (Reference value: woman)	–	non-binary (competence, $p < 0.001$; friendliness, $p < 0.001$; trustworthiness, $p < 0.001$; typicality, $p < 0.001$; self-identification, $p < 0.001$) and man (friendliness, $p = 0.041$)
Occupation (Reference value: office clerk)	working as cleaner (self-identification, $p < 0.001$)	as corporate CEO (typicality, $p < 0.001$)
Political orientation (Reference value: liberal)	–	conservative (typicality, $p < 0.001$; self-identification, $p < 0.001$)
Type of pro-environmental behaviors (Reference value: radical)	private (competence, $p = 0.012$; friendliness, $p < 0.001$; trustworthiness, $p = 0.004$; self-identification, $p < 0.001$) and moderate (self-identification, $p < 0.001$)	–
Main environmental concern (Reference value: global)	–	local (competence, $p = 0.023$; typicality, $p < 0.001$; self-identification, $p < 0.001$)

only display expertise (e.g., competence) but also be perceived as both warm and trustworthy (see also Castro and Rosa, 2023). In light of these findings and when applied to our study, the environmentalist profile that most closely resembled a credible communicator was that of a female office clerk.

Our survey participants viewed young environmentalists as friendly compared to older environmentalists. In contrast to previous literature (Fiske et al., 2002), our participants tended to rate young environmentalists overall more positively than older ones. More specifically, profiles of older environmentalists were perceived as neither friendly nor competent. This perception aligns with the SCM by Fiske et al. (2002), where groups viewed as low in both warmth and competence elicit feelings of contempt. Further, considering the average age of participants was $M = 34.26$, this observed bias may be rooted in potential intergenerational tensions, reflecting prejudices often held by younger individuals toward their elder counterparts, as posited by North and Fiske (2012, 2013). Younger people evaluate older adults low on the dimensions of warmth and competence because they may see them as a passive social group (North and Fiske, 2012). Such perceptions might be reinforced through ingroup favoritism (Brewer, 2007). Further empirical investigations are required to address any of these possible explanations.

Highly relevant to the US context is the perception of environmentalists' political orientation. Respectively, environmentalists with moderate political views were perceived as most trustworthy, and conservatives as least trustworthy. Interestingly, environmentalists with a liberal political orientation were considered most competent but not as friendly compared to political moderates. Overall, participants saw profiles with moderate political views as the most friendly and trustworthy but perceived conservative profiles as the least competent and friendly. As a possible explanation, discussed below, both liberals and conservatives perceived profiles from the ideologically dissimilar group as less friendly and trustworthy. Hence, political moderates who did not pose a threat to either of them were generally preferred (Brandt et al., 2014).

In the US context, race and ethnicity are also particularly relevant: However, our findings did not align with our initial predictions. Contrary to our expectations based on Fiske et al. (2002), White profiles were not perceived as the friendliest and most competent, and Asian profiles were not viewed as solely competent without warmth. Instead, our participants rated profiles based on various racial and ethnic characteristics. Their perceptions in terms of competence, friendliness, and trustworthiness were consistent across these profiles. Nevertheless, also here we need to highlight that Fiske et al. (2002) assessed general perceptions whereas our results specifically refer to how environmentalists are perceived. Further research is needed to replicate our results and to directly compare them with Fiske et al. (2002) findings. Nevertheless, our results could have been influenced by the current debate on systemic racism, the Black Lives Matter movement, and ongoing social tensions in the United States, shifting toward more neutral perceptions across different racial and ethnic groups (Sawyer and Gampa, 2018). Although contrary to our expectations, these results offer hope for actual social change and societal improvements in the United States.

More in line with prior research (Castro et al., 2017; Klas et al., 2019; Castro and Rosa, 2023), survey participants perceived environmentalists with private pro-environmental behaviors as most friendly and trustworthy. But those with moderate pro-environmental behaviors were still perceived more positively than those with radical ones. This finding could be explained by the fact that moderate pro-environmental behavior still had an activist nature (e.g., attribute "Writes political representatives"). Contrary to our expectations and existing literature, our sample perceived environmentalists with radical behaviors as the least competent (Castro et al., 2017; Castro and Rosa 2023). Thus, these findings suggest that the general public tends to disapprove of actions perceived as radical or militant, like demonstrations (Klas et al., 2019). Our findings align with prior research, suggesting that activists with radical discourse may face penalties in terms of perceived warmth, though not necessarily on the competence dimension (Castro et al., 2017; Castro and Rosa, 2023). As further evidence of this, we noted that environmentalists using a conciliatory argumentation style, as opposed to a confrontational one, were viewed as more competent and friendly, albeit without significant differences. In this respect, and based on our results, the lesser environmentalists were described as ostentatious and demonstrative,

the more positively they were perceived. Therefore, environmentalists keep facing the *activist dilemma* (Feinberg et al., 2017) in which raising public awareness ends up reducing public support.

In conclusion, our US sample perceived environmentalist profiles most favorably – in terms of competence, friendliness, and trustworthiness, when they were described as young, female, office clerks, with a moderate political orientation, and who engage in pro-environmentally activities primarily on a private level. This aligns with Fiske and Dupree (2014) findings which emphasize credibility as a blend of one's expertise (i.e., competence) and their genuine motivation to be truthful (i.e., warmth/trustworthiness). Consequently, the traits identified in our study suggest specific characteristics that render an environmentalist more credible in the eyes of the public, marked by perceptions of competence, friendliness, and trustworthiness. This, in turn, can potentially amplify the public's attention toward them. We recommend further research to investigate this relationship.

5.2. Effects on perceptions of the profiles' typicality as environmentalists

The findings of our study largely supported our expectations regarding which attribute values our sample would identify as typical for environmentalists (H1.2). For example, women were perceived as more typical environmentalists compared to men and non-binary profiles. In terms of race Asians were viewed as the most typical environmentalists, followed by Whites. This aligns with prior studies that link pro-environmental behaviors and heightened environmental concerns to feminine traits (Brough et al., 2016; Swim and Geiger, 2018). This relationship might be attributed to overlapping traits commonly associated with women and environmentalism. Historically, pro-environmentalism has been understood as a caring stance (Rome, 2006) and caretaking has been stereotypically linked to female gender roles (Eagly et al., 2000). Consequently, in comparison to women, men were less frequently perceived as typical environmentalists. However, they were still rated more typical than those with a non-binary gender identity. This could be attributed to the still emerging societal recognition and perceived novelty of non-binary genders (Matsuno and Budge, 2017).

Contrary to our expectations, profiles of Asians individuals were perceived as more typical for environmentalists than those of White individuals. This is surprising given that in previous studies Asian individuals were perceived as being less environmentally concerned than Whites, though they were rated more concerned than other US racial-ethnic minority groups (Pearson et al., 2018). Our results may indicate a shift in the public's perception of the prevailing image of an environmentalist, thereby broadening our current knowledge. As such, status predicted competence (SCM; Fiske et al., 2002) and the environmentalist identity was seen as related to higher social status (Pearson et al., 2018). Consequently, Asian Americans, who have been stereotyped as highly competent, may be considered more typically aligned with environmentalists. However, such a shift in prototypicality, along with the explanation provided here, should be investigated in future research.

Significant variations in perceptions of typicality emerged concerning environmentalists' occupations and political orientations. Based on the study by Pearson et al. (2018), we expected profiles of middle-class social status to be perceived as most typical for environmentalists. Accordingly, we found that profiles with the occupation office clerks (representing middle social status) were viewed as most typical. However, contrary to previous literature, people working as cleaners (representing lower social status) were perceived as equally typical. Moreover, corporate CEO profiles were seen as least typical for environmentalists. In this regard, our findings extend previous literature (Pearson et al., 2018) suggesting that occupations indicative of lower social status are not inherently deemed atypical for environmentalists or those environmentally conscious. Furthermore, positions associated with the upper social class jobs, such as corporate CEOs, may be perceived by the public as implausible representations of environmentalists. Similarly, profiles described with conservative political leaning were perceived as less representative of environmentalists in comparison to those with liberal and moderate orientation. These results are in line with previous research indicating that environmentalists are generally associated with left-leaning ideologies or political orientation (Merkley and Stecula, 2018).

Concerning the environmental attributes of the profiles, our results do not support our assumptions that radical pro-environmental behaviors would be perceived as more typical for environmentalists than moderate or private actions (Bashir, 2010; Bashir et al., 2013). Drawing insights from social cognition research on impression formation (Fiske and Neuberg, 1990), it is argued that people's information processing is a blend of cognitive and motivated. Hence, while our participants showed a clear preference for private pro-environmental actions (see the previous section), these intrinsic motives might have also influenced their perceptions of what is typical.

Participants also viewed environmentalist profiles emphasizing global environmental concerns as more typical compared to those focused on local concerns. Previous research has shown that vulnerable US population segments, particularly People of Color (POC), tend to prioritize local and human-oriented environmental challenges more than the White population (Mohai and Bryant, 1998; Song et al., 2020). Hence, having a mostly White/Caucasians (74.2%) study sample may explain that profiles with local environmental concerns were perceived as less typical for environmentalists. Nevertheless, further analyses would need to be conducted to confirm a possible of the vulnerable and low-status populations' concerns by more privileged societal groups in the United States (Mohai et al., 2009; Timmons Roberts et al., 2018).

To summarize our findings on the participants' perception of typicality for environmentalists, the perceptions that corporate CEOs and political conservatives are the least typical environmentalists stand out as some of the most novel results.[5]

5.3. Effects on participants' self-identification with profiles

Concerning H1.3, our results revealed a notably stronger identifications with female environmentalists as opposed to

5 From the survey comments, we could comprehend to which extent participants perceived environmentalists as highly unrealistic when described as corporate CEOs and political conservatives.

non-binary profiles. Further, participants most strongly identified with environmentalists described as cleaners, to a lesser degree with those labeled as corporate CEOs or office clerks. Additionally, profiles highlighting private pro-environmental behaviors also particularly resonated with our sample.

Since we did not measure other components of self-identification (e.g., self-defining and self-investing as per Leach et al., 2008), we cannot explain in detail how participants' tendencies to self-identify with certain environmentalist profiles derived. Based on the calculated marginal means, our participants generally did not identify strongly with the presented profiles (see results). This could be due to oversimplified profile descriptions or the measure itself. Future research should delve deeper into nuanced identity facets. However, the level of self-identification with specific environmentalists remains vital in practice, as these profiles may hold greater influence.

5.4. Effects of attribute values atypical according to stereotype literature

Building on Bashir et al. (2013) work into atypical environmentalist profiles, we further analyzed the differences between profiles showcasing stereotype-consistent attribute values (e.g., liberal) and those exhibiting stereotype-inconsistent attribute values (e.g., conservative). In our results (H2), we observed both positive (as expected) and negative effects on participants' judgments of and self-identification with environmentalists.[6]

Profiles of environmentalists with attribute values that deviate from existing stereotypes showed *positive effects* by being perceived as more competent, friendly, and trustworthy, compared to profiles that align with radical (stereotype-consistent) behaviors. Despite literature suggesting radical pro-environmental behaviors as characteristic of environmentalists, our participants predominantly viewed private behaviors as the more typical manifestation (also see in "Effects on perceptions of the profiles' typicality as environmentalists"). In line with this relationship, participants preferred to self-identify with environmentalists described through private or moderate pro-environmental behaviors rather than through radical ones. Surprisingly, participants' self-identification with environmentalists was higher when the profiles were described as cleaners instead of as office clerks (stereotype-consistent).

Contrary to what Bashir et al. (2013) suggested, our study also uncovered *negative effects* of stereotype-inconsistent traits on participants' perceptions. Specifically, attributes portraying environmentalists as non-binary, male, with an age of 64 years, corporate CEOs, political conservatives, or primarily concerned with local environmental issues led to diminished ratings in terms of competence, friendliness, trustworthiness, perceived typicality, and participants' identification with the profiles. Thus, we conclude that environmentalists are generally preferred when they are only individually or privately active (Castro et al., 2017; Klas et al., 2019) – that is, environmentalists that do not challenge the status quo. Earlier studies have highlighted that activists, often termed as "moral rebels," are perceived by certain segments of society as a "threat to society" (Hoffarth and Hodson, 2016, p. 40). They are viewed as challengers to the prevailing societal conventions (Lindblom and Jacobsson, 2014), or as entities that threatening people's positive self-perceptions (Monin et al., 2008). Moreover, our findings suggest that descriptions that are atypical according to stereotype-literature do not necessarily correspond with a better impression of environmentalists.

Our findings may direct future research toward investigating the effects of stereotype-inconsistent environmentalists on impression formation. More specifically, research should investigate how stereotype strength (Allen et al., 2009) and stereotype incongruency (Sekaquaptewa and Espinoza, 2004) influence impression processing.

5.5. Limitations and future research

Owing to its novel methodological approach to psychological research, this study presents some limitations. Due to sample size restrictions and statistical power calculations (Stefanelli and Lukac, 2020), our conjoint tables presented a limited number of profile attributes aimed at artificially describing environmentalists. These constraints may have influenced participants' perception of the described environmentalists in terms of realism. Future research could expand the range and diversity of profile attributes presented in the conjoint tables incorporating a wider array of characteristics that are relevant to environmentalists. This will contribute to a more comprehensive and authentic depiction of environmentalists.

Participant recruitment was accomplished using a combination of sampling approaches, including convenience sampling and paid crowdsourcing. Subsequent group comparisons indicated notable distinctions between the MTurk and convenience sample, raising concerns regarding the potential applicability of our findings to the wider US population. We recommend that future researchers test our hypothesis using a representative sample of US population in order to enhance the generalizability of these findings. Moreover, we need to acknowledge that with the novel methodological approach, we cannot definitively determine whether the observed differences were due to variations in the sample or actual shifts in people's views. Due to methodological differences that exist between our research and prior studies, we urge readers to wary caution when deriving comparisons.

Given the limited analyses options provided by the Cregg R package (Leeper, 2020), our reporting was restricted to causal interpretations derived from pairwise comparisons via omnibus F-tests and visual plots. Unfortunately, we were unable to incorporate statistical control for covariates or to test the influence of multiple moderating effects and their interactions. In future studies, researchers should consider employing a more comprehensive analysis approach that allows for statistical control of covariates and the examination of multiple moderating effects and their interactions.

6. Contributions and concluding remarks

Our study opens new directions regarding impression formation research and the application of conjoint analyses in

6 These discussed findings refer to the significant differences found between attribute values that are consistent vs. inconsistent with previous literature. Moreover, the overall patterns are similar to those addressed in the previous section.

psychology. For instance, we extend scientific knowledge on identity dimension-specific perceptions of environmentalists (Pearson et al., 2018) in the United States. Specifically for stereotype content literature (Fiske et al., 2002; Leach et al., 2007; Stenhouse and Heinrich, 2019), our findings demonstrate the potential of conjoint analyses by integrating questions on people's stereotypical judgments via the dimensions of competence, friendliness, and trustworthiness. Moreover, we contribute to previous literature on perceptions of different types of environmentalists (Castro et al., 2017) by mapping the influence of multiple personal attributes (e.g., gender identity, race/ethnicity, political orientation). We contribute further to environmentalist prototype research (Ratliff et al., 2017) by revealing which attribute values were perceived by our sample as most typical. Additionally, we examined the impact of environmentalist descriptions that deviated from established norms in prior literature (Bashir et al., 2013). These level-by-level results provide valuable implications for research on environmental identity (Brick and Lai, 2018).

Our research extends Stenhouse and Heinrich (2019) application of conjoint designs through the application of new attributes and measures. In regard to the ongoing political debates and diminishing public support for environmental causes in the United States, our findings provide environmental movements with valuable input on how to access the public attention through positive and credible images of environmentalists (Fiske and Dupree, 2014) and through intentional message framing customized to the targeted audience (Maxwell and Miller, 2016; Pearson et al., 2018). Using these insights, public portrayals of and interactions with environmentalists can be tailored to align with desired perceptions and target audiences. This offers valuable insights to the environmental movement regarding message source and content to resonate with the targeted audience. Our data indicates that the public tends to favor environmentalists who engage in private sustainable behaviors (Castro et al., 2017). This poses a fundamental problem: while environmentalists are driven to elevate public consciousness about environmental protection and challenge environmental misuse, they face backlash for being perceived as overly aggressive in challenging the status quo. This places them in an "activist's dilemma" (Feinberg et al., 2017), a paradox where their well-meaning actions inadvertently lead to unintended consequences (Bashir et al., 2013).

In summary, environmental movements need intermediaries who can foster discussions and facilitate consensus within the public sphere. Our findings offer insights on how these intermediaries should be portrayed and perceived to effectively champion pro-environmental causes. We draw from our applied conjoint analysis findings that our participants related most to and judged most positively those environmentalists who were described as women, Asian, working as cleaners, political moderates, with private pro-environmental behaviors, and mainly global environmental concerns. That said, environmentalists occupying a middle ground may be more successful in reaching a diverse range of people and avoid losing further public support. We aspire that, in due time, environmental protection will transcend its polarizing and politicized stature in the United States and that people from all backgrounds will feel included enough to identify (again) with *environmentalists*.

Data availability statement

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

Ethics statement

The study involving humans was approved by the local ethics committee at Iscte-IUL. The study was conducted in accordance with the local legislation and institutional requirement. The participants provided their written informed consent to participate in this study.

Author contributions

KK and MR conceived and designed the study. KK adapted all coding, created the questionnaire, collected the data, analyzed the data, and wrote an initial draft based on the results. MR and MO critically revised the draft manuscript and made important changes in content. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1125617 /full#supplementary-material

SUPPLEMENTARY PRESENTATION 1
Further information on conjoint analysis.

SUPPLEMENTARY PRESENTATION 2
Recruitment messages.

SUPPLEMENTARY PRESENTATION 3
Coding of conjoint table in Qualtrics.

SUPPLEMENTARY PRESENTATION 4
Online Qualtrics questionnaire.

SUPPLEMENTARY PRESENTATION 5
Display frequencies-descriptives-correlations.

SUPPLEMENTARY PRESENTATION 6
Further results of the conjoint analyses.

References

Allen, T. J., Sherman, J. W., Conrey, F. R., and Stroessner, S. J. (2009). Stereotype strength and attentional Bias: preference for confirming versus disconfirming information depends on processing capacity. *J. Exp. Soc. Psychol.* 45, 1081–1087. doi: 10.1016/j.jesp.2009.06.002

American Psychological Association. (2017). *Multicultural guidelines: an ecological approach to context, identity, and intersectionality*. American Psychological Association: Washington.

Arbuckle, M. B. (2017). The interaction of religion, political ideology, and concern about climate change in the United States. *Soc. Nat. Resour.* 30, 177–194. doi: 10.1080/08941920.2016.1209267

Bashir, N. Y. (2010). *Green Doesnt always make good impressions: evaluations of different types of environmentalists*. University of Toronto: Canada.

Bashir, N. Y., Lockwood, P., Chasteen, A. L., Nadolny, D., and Noyes, I. (2013). The ironic impact of activists: negative stereotypes reduce social change influence: the ironic impact of activists. *Eur. J. Soc. Psychol.* 43, 614–626. doi: 10.1002/ejsp.1983

Black, J. (2021). Tips on using MTurk with Qualtrics. Wild World of Research. Available at: https://jessicaeblack.org/research/tips-on-using-mturk-with-qualtrics/.

Bolsen, T., Palm, R., and Kingsland, J. T. (2019). Counteracting climate science politicization with effective frames and imagery. *Sci. Commun.* 41, 147–171. doi: 10.1177/1075547019834565

Brandt, M. J., Reyna, C., Chambers, J. R., Crawford, J. T., and Wetherell, G. (2014). The ideological-conflict hypothesis: intolerance among both liberals and conservatives. *Curr. Dir. Psychol. Sci.* 23, 27–34. doi: 10.1177/0963721413510932

Brewer, M. B. (2007). "The social psychology of intergroup relations: social categorization, ingroup bias, and outgroup prejudice" in *Social psychology: Handbook of basic principles*. eds. A. W. Kruglanski and E. T. Higgins (New York, NY, US: The Guilford Press), 695–715.

Brick, C., and Lai, C. K. (2018). Explicit (but not implicit) environmentalist identity predicts pro-environmental behavior and policy preferences. *J. Environ. Psychol.* 58, 8–17. doi: 10.1016/j.jenvp.2018.07.003

Brough, A. R., Wilkie, J. E. B., Ma, J., Isaac, M. S., and Gal, D. (2016). Is eco-friendly unmanly? The green-feminine stereotype and its effect on sustainable consumption. *J. Consum. Res.* 43, 567–582. doi: 10.1093/jcr/ucw044

Carey, J. M., Carman, K. R., Clayton, K. P., Horiuchi, Y., Htun, M., and Ortiz, B. (2020). Who wants to hire a more diverse faculty? A conjoint analysis of faculty and student preferences for gender and racial/ethnic diversity. *Politics, Groups, Ident.* 8, 535–553. doi: 10.1080/21565503.2018.1491866

Castro, P., and Rosa, M. (2023). Understanding the paradoxical effects of (environmental) activists and their discourses: when and how are they penalized for seeking change? *Environ. Commun.*, 1–19. doi: 10.1080/17524032.2023.2241652

Castro, P., Uzelgun, M. A., and Bertoldo, R. (2017). "Climate change activism between weak and strong environmentalism: advocating social change with moderate argumentation strategies?", in *The social psychology of everyday politics*, Eds. H. Caroline and A. Eleni (London: Routledge), 146–162.

Doherty, D., Dowling, C. M., and Miller, M. G. (2019). Do local party chairs think women and minority candidates can win? Evidence from a conjoint experiment. *J. Polit.* 81, 1282–1297. doi: 10.1086/704698

Durante, F., Fiske, S. T., Kervyn, N., Cuddy, A. J., Akande, A., Adetoun, B. E., et al. (2013). Nations' income inequality predicts ambivalence in stereotype content: how societies mind the gap. *Br. J. Soc. Psychol.* 52, 726–746. doi: 10.1111/bjso.12005

Eagly, A. H., Wood, W., and Diekman, A. B. (2000). "Social role theory of sex differences and similarities: a current appraisal" in *The developmental social psychology of gender* (Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers), 123–174.

Eckes, T. (2002). Paternalistic and envious gender stereotypes: testing predictions from the stereotype content model. *Sex Roles* 47, 99–114. doi: 10.1023/A:1021020920715

Ellemers, N., Pagliaro, S., and Barreto, M. (2013). Morality and behavioural regulation in groups: a social identity approach. *Eur. Rev. Soc. Psychol.* 24, 160–193. doi: 10.1080/10463283.2013.841490

Farinha, C., and Rosa, M. (2022). Just chill! An experimental approach to stereotypical attributions regarding young activists. *Sociol. Sci.* 11:427. doi: 10.3390/socsci11100427

Feinberg, M., Willer, R., and Kovacheff, C. (2017). *Extreme protest tactics reduce popular support for social movements*. Rochester, NY: Social Science Research Network.

Feygina, I., Jost, J. T., and Goldsmith, R. E. (2010). System justification, the denial of global warming, and the possibility of system-sanctioned change. *Personal. Soc. Psychol. Bull.* 36, 326–338. doi: 10.1177/0146167209351435

Fiske, S. T., Cuddy, A. J. C., Glick, P., and Xu, J. (2002). A model of (often mixed) stereotype content: competence and warmth respectively follow from perceived status and competition. *J. Pers. Soc. Psychol.* 82, 878–902. doi: 10.1037/0022-3514.82.6.878

Fiske, S. T., and Dupree, C. (2014). Gaining trust as well as respect in communicating to motivated audiences about science topics. *Proc. Natl. Acad. Sci.* 111, 13593–13597. doi: 10.1073/pnas.1317505111

Fiske, S. T., and Neuberg, S. L. (1990). A continuum of impression formation, from category-based to individuating processes: influences of information and motivation on attention and interpretation. *Adv. Exp. Soc. Psychol.* 23, 1–74. doi: 10.1016/S0065-2601(08)60317-2

Gallup. (2021). Four in 10 Americans say they are environmentalists. Gallup Available at: https://news.gallup.com/poll/348227/one-four-americans-say-environmentalists.aspx.

Hainmueller, J., Hopkins, D. J., and Yamamoto, T. (2014). Causal inference in conjoint analysis: understanding multidimensional choices via stated preference experiments. *Polit. Anal.* 22, 1–30. doi: 10.1093/pan/mpt024

Hair, J. F. ed. (2014). *Multivariate data analysis. 7th edn*. Harlow: Pearson.

Hiltner, S. (2019). Who cares about the environment? *Behav. Sci.* 6. Available at: https://behavioralscientist.org/what-does-someone-who-cares-about-the-environment-look-like/

Hilton, J. L., and von Hippel, W. (1996). Stereotypes. *Annu. Rev. Psychol.* 47, 237–271. doi: 10.1146/annurev.psych.47.1.237

Hoffarth, M. R., and Hodson, G. (2016). Green on the outside, red on the inside: perceived environmentalist threat as a factor explaining political polarization of climate change. *J. Environ. Psychol.* 45, 40–49. doi: 10.1016/j.jenvp.2015.11.002

IBM Corp. (2020). *IBM SPSS statistics for Macintosh*.

Klas, A. (2016). *Pro-environmentalism- environmentalist social identity, environmentalist stereotypes, and green consumerism engagement*.

Klas, A., Zinkiewicz, L., Zhou, J., and Clarke, E. J. R. (2019). "Not all environmentalists are like that …": unpacking the negative and positive beliefs and perceptions of environmentalists. *Environ. Commun.* 13, 879–893. doi: 10.1080/17524032.2018.1488755

Knudsen, E., and Johannesson, M. P. (2019). Beyond the limits of survey experiments: how conjoint designs advance causal inference in political communication research. *Polit. Commun.* 36, 259–271. doi: 10.1080/10584609.2018.1493009

Landy, J. F., Piazza, J., and Goodwin, G. P. (2016). When it's bad to be friendly and smart: the desirability of sociability and competence depends on morality. *Pers. Soc. Psychol. Bull.* 42, 1272–1290. doi: 10.1177/0146167216655984

Leach, C. W., Ellemers, N., and Barreto, M. (2007). Group virtue: the importance of morality (vs. competence and sociability) in the positive evaluation of in-groups. *J. Pers. Soc. Psychol.* 93, 234–249. doi: 10.1037/0022-3514.93.2.234

Leach, C. W., van Zomeren, M., Zebel, S., Vliek, M. L. W., Pennekamp, S. F., Doosje, B., et al. (2008). Group-level self-definition and self-investment: a hierarchical (multicomponent) model of in-group identification. *J. Pers. Soc. Psychol.* 95, 144–165. doi: 10.1037/0022-3514.95.1.144

Leeper, T. J. (2020). Cregg: simple conjoint analyses and visualization. Available at: https://cloud.r-project.org/web/packages/cregg/index.html.

Leeper, T. J., Hobolt, S. B., and Tilley, J. (2020). Measuring subgroup preferences in conjoint experiments. *Polit. Anal.* 28, 207–221. doi: 10.1017/pan.2019.30

Lindblom, J., and Jacobsson, K. (2014). A deviance perspective on social movements: the case of animal rights activism. *Deviant Behav.* 35, 133–151. doi: 10.1080/01639625.2013.834751

Lin, M. H., Kwan, V. S., Cheung, A., and Fiske, S. T. (2005). Stereotype content model explains prejudice for an envied outgroup: scale of anti-Asian American stereotypes. *Personal. Soc. Psychol. Bull.* 31, 34–47. doi: 10.1177/0146167204271320

Luce, R. D., and Tukey, J. W. (1964). Simultaneous conjoint measurement: a new type of fundamental measurement. *J. Math. Psychol.* 1, 1–27. doi: 10.1016/0022-2496(64)90015-X

Matsuno, E., and Budge, S. L. (2017). Non-binary/genderqueer identities: a critical review of the literature. *Curr. Sex. Health Rep.* 9, 116–120. doi: 10.1007/s11930-017-0111-8

Maxwell, R., and Miller, T. (2016). The propaganda machine behind the controversy over climate science: can you spot the lie in this title? *Am. Behav. Sci.* 60, 288–304. doi: 10.1177/0002764215613405

McCright, A. M., and Dunlap, R. E. (2011). The politicization of climate change and polarization in the American Public's views of global warming, 2001–2010. *Sociol. Q.* 52, 155–194. doi: 10.1111/j.1533-8525.2011.01198.x

Merkley, E., and Stecula, D. A. (2018). Party elites or manufactured doubt? The informational context of climate change polarization. *Sci. Commun.* 40, 258–274. doi: 10.1177/1075547018760334

Mohai, P., and Bryant, B. (1998). Is there a "race" effect on concern for environmental quality? *Public Opin. Q.* 62:475. doi: 10.1086/297858

Mohai, P., Pellow, D., and Roberts, J. T. (2009). Environmental justice. *Annu. Rev. Environ. Resour.* 34, 405–430. doi: 10.1146/annurev-environ-082508-094348

Monin, B., Sawyer, P. J., and Marquez, M. J. (2008). The rejection of moral rebels: resenting those who do the right thing. *J. Pers. Soc. Psychol.* 95, 76–93. doi: 10.1037/0022-3514.95.1.76

North, M. S., and Fiske, S. T. (2012). An inconvenienced youth? Ageism and its potential intergenerational roots. *Psychol. Bull.* 138, 982–997. doi: 10.1037/a0027843

North, M. S., and Fiske, S. T. (2013). A prescriptive, intergenerational-tension ageism scale: succession, identity, and consumption (SIC). *Psychol. Assess.* 25, 706–713. doi: 10.1037/a0032367

Pearson, A. R., and Schuldt, J. P. (2014). Facing the diversity crisis in climate science. *Nat. Clim. Chang.* 4, 1039–1042. doi: 10.1038/nclimate2415

Pearson, A. R., and Schuldt, J. P. (2018). Climate change and intergroup relations: psychological insights, synergies, and future prospects. *Group Process. Intergroup Relat.* 21, 373–388. doi: 10.1177/1368430217747750

Pearson, A. R., Schuldt, J. P., Romero-Canyas, R., Ballew, M. T., and Larson-Konar, D. (2018). Diverse segments of the US public underestimate the environmental concerns of minority and low-income Americans. *Proc. Natl. Acad. Sci. U. S. A.* 115, 12429–12434. doi: 10.1073/pnas.1804698115

Pew Research Center. (2020). Environmental protection rises on the Public's policy agenda. Washington, D.C. Available at: https://www.pewresearch.org/politics/2020/02/13/as-economic-concerns-recede-environmental-protection-rises-on-the-publics-policy-agenda/.

Purdie-Vaughns, V., Steele, C. M., Davies, P. G., Ditlmann, R., and Crosby, J. R. (2008). Social identity contingencies: how diversity cues signal threat or safety for African Americans in mainstream institutions. *J. Pers. Soc. Psychol.* 94, 615–630. doi: 10.1037/0022-3514.94.4.615

Qualtrics. (2005). Available at: https://www.qualtrics.com/blog/citing-qualtrics/

Qualtrics XM support. (2021). Understanding feature and levels. Getting Started with Conjoints. Available at: https://www.qualtrics.com/support/conjoint-project/getting-started-conjoints/getting-started-choice-based/step-1-defining-conjoint-features-levels/.

Ratliff, K. A., Howell, J. L., and Redford, L. (2017). Attitudes toward the prototypical environmentalist predict environmentally friendly behavior. *J. Environ. Psychol.* 51, 132–140. doi: 10.1016/j.jenvp.2017.03.009

Rome, A. (2006). 'Political hermaphrodites': gender and environmental reform in progressive America. *Environ. Hist.* 11, 440–463. doi: 10.1093/envhis/11.3.440

Sawyer, J., and Gampa, A. (2018). Implicit and explicit racial attitudes changed during Black lives matter. *Personal. Soc. Psychol. Bull.* 44, 1039–1059. doi: 10.1177/0146167218757454

Sekaquaptewa, D., and Espinoza, P. (2004). Biased processing of stereotype-incongruency is greater for low than high status groups. *J. Exp. Soc. Psychol.* 40, 128–135. doi: 10.1016/S0022-1031(03)00093-3

Song, H., Lewis, N. A., Ballew, M. T., Bravo, M., Davydova, J., Gao, H. O., et al. (2020). What counts as an "environmental" issue? Differences in issue conceptualization by race, ethnicity, and socioeconomic status. *J. Environ. Psychol.* 68:101404. doi: 10.1016/j.jenvp.2020.101404

Stangor, C., and Lange, J. (1994). Mental representations of social groups: advances in understanding stereotypes and stereotyping. *Adv. Exp. Soc. Psychol.* 26, 357–416. doi: 10.1016/S0065-2601(08)60157-4

Stefanelli, A., and Lukac, M. (2020). Subjects, trials, and levels: statistical power in conjoint experiments. *SocArXiv*. doi: 10.31235/osf.io/spkcy

Stenhouse, N., and Heinrich, R. (2019). Breaking negative stereotypes of climate activists: a conjoint experiment. *Sci. Commun.* 41, 339–368. doi: 10.1177/1075547019848766

Stewart, J., and Clark, T. (2011). Lessons from south park: a comic corrective to environmental puritanism. *Environ. Commun.* 5, 320–336. doi: 10.1080/17524032.2011.584545

Swim, J. K., and Bloodhart, B. (2018). The intergroup foundations of climate change justice. *Group Process. Intergroup Relat.* 21, 472–496. doi: 10.1177/1368430217745366

Swim, J. K., and Geiger, N. (2018). The gendered nature of stereotypes about climate change opinion groups. *Group Process. Intergroup Relat.* 21, 438–456. doi: 10.1177/1368430217747406

Tajfel, H., and Turner, J. C. (1979). "An integrative theory of intergroup conflict" in *Organizational identity: a reader*. eds. W. G. Austin and S. Worchel (England: University of Bristol)

Taylor, D. E. (2014). The state of diversity in environmental organizations. Green 2.0 working group. Available at: https://diversegreen.org/wp-content/uploads/2021/01/FullReport_Green2.0_FINAL.pdf

Tesch, D., and Kempton, W. (2004). Who is an environmentalist? The polysemy of environmentalist terms and correlated environmental actions. *JEA* 8, 67–83. doi: 10.5038/2162-4593.8.1.4

Timmons Roberts, J., Pellow, D., and Mohai, P. (2018). "Environmental justice" in *Environment and society: Concepts and challenges Palgrave studies in environmental sociology and policy*. eds. M. Boström and D. J. Davidson (Cham: Springer International Publishing), 233–255.

Turner, J. C., Hogg, M. A., Oakes, P. J., Reicher, S. D., and Wetherell, M. S. (1987). *Rediscovering the social group: a self-categorization theory*. United Kingdom: Basil Blackwell.

United States Environmental Protection Agency, US EPA (2016). EJ 2020 Action Agenda: The U.S EPA\u0027s Environmental Justice Strategic Plan for 2016-2020. Washington DC. Available at: https://www.epa.gov/sites/default/files/2016-05/documents/052216_ej_2020_strategic_plan_final_0.pdf

US Census Bureau. (2019). U.S. Census Bureau QuickFacts: United States. Available at: https://www.census.gov/quickfacts/fact/table/US/PST045219 [Accessed July 12, 2021].

Uzelgun, M. A., Mohammed, D., Lewiński, M., and Castro, P. (2015). Managing disagreement through yes, but … constructions: an argumentative analysis. *Discourse Stud.* 17, 467–484. doi: 10.1177/1461445615578965

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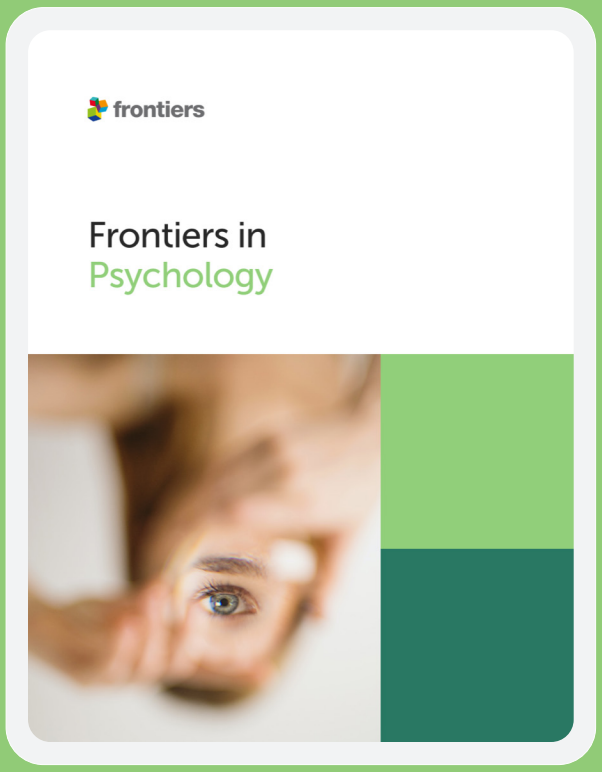

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