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Current trends in environmental psychology, volume II

Edited by
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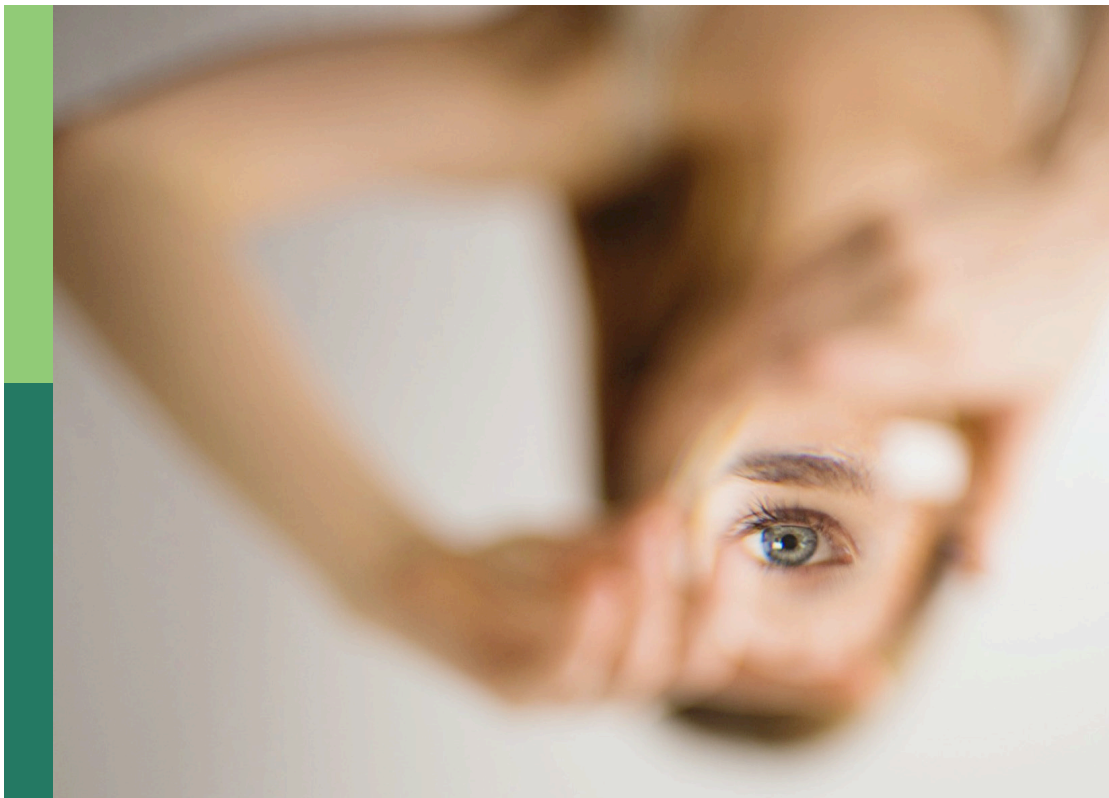

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Current trends in environmental psychology, volume II

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Editorial: Current trends in environmental psychology, volume II

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Editorial on the Research Topic
Current trends in environmental psychology, volume II

This Research Topic, "*Current trends in environmental psychology - volume II*", is associated with the 3rd International Conference of Environmental Psychology (ICEP 2021), which was held in Siracusa, Italy, from the 4th to 9th October 2021 and it is the natural prosecution, and completion, of the volume I of the same Research Topic (see also De Gregorio et al., 2023 for an overview). The opening of the Research Topic was made during a very difficult time: the threat of a global pandemic/syndemic from the COVID-19 viral infection was a dominant international concern and was changing drastically living conditions at a global level. Since its emergence in early 2020, the COVID-19 pandemic has monopolized public opinion: the permanent threat to citizens' health and safety, the sweeping measures that national governments have adopted, and their economic repercussions, have cast some shadow on other relevant and urgent problems outlined by environmental scientists, such as global warming and climate change, and might continue to affect how they are seen and interpreted. The spread of the disease gave rise to a condition characterized by the implementation of physical distancing measures, entailing human disconnection, isolation, and increased reliance on virtual interactions, as well as a greater emphasis on remote work through information and communication technologies (ICT). These transformations might have occurred abruptly, perhaps forcefully, perhaps in a shock and awe way, but surely at the expense of diseases, panic, mental health issues, and in the worst-case scenario loss of life. Nowadays, these emergency measures are overcome. In fact, while we are writing this editorial we are breathing an air of hope for the future, profoundly aware of the deep scars left on our world, serving as a permanent reminder and inspiration for the continuous adjustment of the implementation of complex solutions to complex people-places relationship issues. On May 5th 2023, the World Health Organization officially declared the end of the pandemic. However, while addressing this in a post-pandemic world, negative repercussions are emerging, with a significant portion of the global population residing and working in confined spaces. The COVID-19

challenge was finally overcome thanks to an enourmous global effort of people, governments, scientific institutions and organizations (including OA publishers such as Frontiers). Some mistakes were also made, including a lack of coordination, equity, and solidarity at the global level in some cases. That means that existing tools and technologies were not always used at their best to answer the complex societal issues posited by the pandemic.

The aim of this Research Topic was the promotion of the scientific dialogue over the most recent empirical findings and theoretical advances in environmental psychological science, and to build evidence-based knowledge and innovative approaches to understanding the relationship between humans and their socio-physical environments.

The influence of COVID 19 in environmental issues was highlighted, for example, by the study of Bertolotti et al. showing that people's attitudes toward the environmental crisis can be influenced also by counterfactuals arguments related to the expenses incurred during the COVID-19 pandemic, suggesting a potential conflict between economic and health issues. This suggests a connection between public perception of the pandemic and climate change, even though they appeared initially unrelated. The echo deriving from the pandemic period is likely to impact communication efforts related to climate change actually and in the future as well. The authors showed that communication strategies are crucial in motivating individuals to responsibly engage in the environmental domain.

There was a variety of built environments investigated, like homes and offices with a different focus: Nartova-Bochaver et al. analyzed the home environment, considering the construct of home attachment, which is especially important for students away from their hometown as one of the most mobile social group. The authors validated cross-culturally the Short Home Attachment Scale (SHAS) in a student sample from five countries (Armenia, India, Indonesia, Russia, and Ukraine), offering a psychometric contribution in line with recent suggestions by Tam and Milfont (2020). The authors, acknowledging that human–environment interactions are culture-bound, outlined the vital importance for environmental psychology research to incorporate the understanding of culture into theoretical analyses and empirical investigations.

Different authors devoted their attention to organizational settings and environmental issues: Chen and Wu in order to investigate employees' green behavior, explored the interaction effect of green Human Resource Management practices and green transformational leadership on employees' green behavior, acknowledging the intermediary role of green mindfulness and the regulatory effect of green self-efficacy. This contribution could help both the academic community to better understand how green-related contextual factors jointly influence environmental behaviors and in providing successful recommendations to corporate managers. Zhu et al., starting from the consideration that current urban lifestyle lead people to spend more and more time in office settings and that prolonged periods in an uncomfortable environment can have negative impacts on employees' wellbeing, analyzed the aesthetic evaluations of different office types of furniture. The authors specifically examined the incorporation of wood in office furniture as a means to create a healthy environment, suggesting that the use of wood in office spaces has been found to effectively alleviate mental fatigue among employees, creating more pleasant, desirable and restorative offices. Ma et al. proposed a moderated mediation model to explain when and how tourism service firms can promote employee retention by considering Green Talent Management strategies. The findings of this study provide meaningful insights for managers and service firms in the tourism industry.

Outdoor environments were also considered with different approaches: Bruzzese et al. investigated civil society's perception and knowledge toward Forest Ecosystem Services (FES) and how these changed in the post-COVID era. The authors presented a very informative case study: they conducted a choice experiment with individuals intercepted in the Argentera Valley, in the Western Italian Alps, highlighting a strong interest in biodiversity and cultural services, such as landscape aesthetic quality and psychophysical health. These findings could be useful to optimize the matching of supply and demand and to provide more robust information for promoting the participatory and shared decision-making process in forest planning and management. The importance of nature was investigated also with a theoretical contribution: Prins et al. conducted a systematic review and meta-ethnography of qualitative research on the value of play in nature-based compared to non-nature-based environments, and its implications for the developmental outcomes of young children (2–8 year). Their study showed that playing in nature-based environments supports young children's healthy global development, i.e. physical, social-emotional, motor, and cognitive. These results could be a further interesting insight to understand the dynamics and processes of humans-nature connectedness.

Other studies have applied socio-environmental theories and models to a wide range of issues and topics: Haji and Hayati aimed to provide a comprehensive theoretical framework in the field of analyzing conflict behavior among rangeland exploiters in Iran. Specific environmental psychological theories, such as the Norm Activation Theory, the Value Beliefs Norms Theory, or the Theory of Planned Behavior, were found a suitable framework to explain conflict behavior in rangeland exploitation contexts. Likewise, using the Social Identity Model of Collective Action, Valizadeh et al. investigated Iranian farmers' intentions to participate in Aquifer Storage and Recovery, an innovative and alternative method for the sustainable management of water resources. The authors highlighted the need to consider the formation of social identity and the consideration of "we" thinking systems as the best strategy for aquifer storage and recovery. The role of personality factors in shaping pro-environmental behaviors was also investigated by other studies: Haefner et al. investigated the mediating role of animal-related ethical values in the association between Big Five Personality traits, animal-related ethical values, and different types of meat consumption (i.e., beef, poultry, and fish), providing useful information for susrtainable dietary change.

Finally, digital environment studies could not miss the call in this RT: Suseno and Hastjarjo investigated the role of simulated natural environments in virtual reality and 2D video in reducing stress.

Researchers from Europe (in particular, Italy, Germany, and the Netherlands), Russia, China, Iran, and, Indonesia have contributed

to the co-construction of a collective scientific endeavor that at this moment has collected about 25,000 views across 11 different papers.

The richness and diversification of the published articles were the natural answers to complex questions like the ones presented in the call for papers of our Research Topic. A commitment to trans-disciplinarity was emerging and it could be seen as a form of cooperative research among the different parts of society, professionals, and academia (Pohl and Hadorn, 2008), enabling the blurring, and then the transcending, of the boundaries between different disciplines. Trans-disciplinarity, in its hybrid and non-linear nature, enables it to transcend and indeed incorporate any academic disciplinary structure. We like to believe that also our RT could offer a small but significant contribution toward this direction.

Author contributions

OM: Conceptualization, Writing—original draft, Writing—review and editing. FF: Conceptualization, Supervision, Writing—review and editing, Writing—original draft. SM: Conceptualization, Supervision, Writing—review and editing, Writing—original draft. YP: Conceptualization, Writing—review and editing, Writing—original draft. MSa: Conceptualization, Supervision, Writing—review and editing, Writing—original draft. MSc: Conceptualization, Supervision, Writing—review and editing, Writing—original draft. GC: Conceptualization, Funding acquisition, Project administration, Supervision, Writing—review and editing, Writing—original draft.

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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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BRIEF RESEARCH REPORT
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Measurement Invariance of the Short Home Attachment Scale: A Cross-Cultural Study

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The home environment is a particularly significant part of life that is supposed to satisfy inhabitants' needs, form their identity, and contribute to psychological wellbeing. The construct of home attachment is especially relevant for students as a most mobile social group. This study is devoted to the validation of *the Short Home Attachment Scale (SHAS)* in a student sample from five countries (Armenia, India, Indonesia, Russia, and Ukraine). A total of 1,349 (17–26 years; M_{age} = 19.82, SD_{age} = 2.14; 78% females) university students participated in the study and filled in the 14 items of *HAS*. In order to avoid redundant items with high error covariances damaging the model, a new scale—the *SHAS* was developed by eliminating seven items. The shortened scale has satisfactory structure validity in terms of model fit in all countries except Indonesia; internal reliability values were acceptable in all countries. Measurement invariance across countries was tested with Multi-Group Confirmatory Factor Analysis (MG CFA) and Alignment Analysis. MG CFA confirmed both configurational and metric invariance. The invariance of item factor loadings, as well as item intercepts, was also confirmed by the Alignment Analysis. The mean scores varied across cultures, with the highest in India and the lowest in Russia. The final version of *SHAS* is a valid, reliable tool that may be recommended for use in cross-cultural research. However, the *SHAS* factor structure robustness in the Indonesian population should be investigated thoroughly.

Keywords: place attachment, home attachment, questionnaire, validation, reliability, cross-cultural research

INTRODUCTION

East or West home is the best
An English saying

The current paper's aim is to develop a short cross-culturally invariant standardized tool–the *Short Home Attachment Scale (SHAS)* validated in the student sample from five cultures: Armenia, India, Indonesia, Russia, and Ukraine. Home attachment is important to study due to several long-term and ongoing changes in the lifestyles of humankind, in the first line, for intellectual youth,

and students (Di Masso et al., 2019; Robinson, 2020; Rathakrishnan et al., 2021). They leave home for university and have to solve the problem of overcoming attachment to their parents' home, establishing a new one in temporary housing–a dormitory or a rented apartment (Heidmets and Liik, 2021; Lacerda et al., 2022). Home attachment is an important factor predicting mental wellbeing, whereas homesickness is often experienced as a "mini-grief" (Stroebe et al., 2016). On the other hand, the unusual circumstances of home confinement caused by the COVID-19 pandemic have made the home a particularly important habitat for everyone, increasing the need for its arrangement as a school and a workplace. Being in lockdown was easier for those who loved their homes (Meagher and Cheadle, 2020; Ramkissoon, 2020, 2021; Counted et al., 2021). However, the latest emerging adulthood studies show that young people are returning to their parents' homes mostly due to economic crisis (in the United States, every third young person does this) (Arnett and Schwab, 2013; Fingerman and Yahirun, 2016). So an empty nest turns into a crowded nest (Seiffge-Krenke, 2016). These features of modern life require the development of a reliable, stable tool for measuring the home attachment level.

Home attachment is a positive attitude to home manifesting in the preference for this environment over others, the desire to return there, take care of it, and keep it in the memories (Manzo and Devine-Wright, 2020; Maricchiolo et al., 2021). Since home attachment is a kind of place attachment we want to refer to the theory that describes its structure and content. There is no complete consensus on this topic. Scannell and Gifford (2010) suggested a tripartite model of place attachment including person, place, and the interaction between them. In line with this model, Hidalgo (2014) also emphasized three dimensions: person, place (social and physical levels), and psychological (affective, cognitive, and behavioral) processes. Some authors focused on place identity as a core component of place attachment (Giuliani, 2003; Williams and Vaske, 2003; Hernández et al., 2007), whereas other researchers think it may rather be a place dependence (Stokols and Shumaker, 1981; Backlund and Williams, 2003; Hernández et al., 2014). Raymond et al. (2010) and Ramkissoon et al. (2013) identified four components of place attachment: place identity, place dependence, nature bonding, and social bonding. Again, the concept of attachment links together place, nature, and people living in this place (Kyle et al., 2005; Morgan, 2010; Ramkissoon, 2021), and can be considered as a unity of emotions and activities that modulate a distance between a person and the object of attachment (Bretherton, 2013).

Home attachment is expected to differ from attachment to other objects, like a park, a city, or a tourist attraction. Being a multifunctional environment, home is responsible for inhabitants' recreation, kinship, storage, stimulation, intimacy, and productivity (Billig, 2006; Graham et al., 2015), as well for stabilization/stimulation, support/prevention, and enhancing/ennobling (spiritualization) functions (Nartova-Bochaver et al., 2018). Home is a unity of physical, social, and existential properties of a specific place satisfying inhabitants' needs; it means (and demonstrates) happiness, a sense of belonging, and identity. "There is an almost unanimous opinion that the prototypical place is home"; people are "domicentric" (Lewicka, 2011, p. 211). Home is a symbol of anti-chaos, stability, privacy, comfort, romance, togetherness, and security (Dmitrieva, 2014; Khachaturova and Nartova-Bochaver, 2017; Nartova-Bochaver et al., 2018; Nartova-Bochaver and Kusnetsova, 2018; Tobiasz-Lis and Wójcik, 2021), and is uniquely associated with positive feelings (McIntyre et al., 2006). Despite the agreement among scientists that the home is a most important living environment, the near-total absence of the instruments for studying home is evident. To date, there are very few standardized tools that measure the quality of the home environment or home attachment. Most of the instruments are modifications of questionnaires based on place attachment in a broad sense of this word, attenuated to a specific place, like a park or neighborhood (Williams and Vaske, 2003; Bonaiuto et al., 2006; Inglis, 2008; Boley et al., 2021) or a sense of place (Jorgensen and Stedman, 2001; Walpole et al., 2020).

The first tools to evaluate the physical features of the house were developed by Espe and Schulz (1983), Caldwell and Bradley (2003), Jansen et al. (2011), and Graham et al. (2015). However, these instruments are not standardized, long and difficult to analyze, or focused on the child environments only, and do not reflect the inhabitants' attachment to home.

The first questionnaire measuring the level of attachment specifically to the home (the, *HAS*) was developed by Reznichenko et al. (2016). *HAS* measured a person's emotional and functional attachment to home as an integral construct; it was a uni-dimensional scale and consisted of 14 items describing the subjective meaning of the home for its inhabitants, rated on a five-point Likert scale ranging from 1 (Strongly disagree) to 5 (Strongly agree). From that moment on, it began to be widely used in Russian-language studies.

Home attachment is a culturally sensitive phenomenon (McIntyre et al., 2006; Kavalir, 2015). Flanders (2014) distinguishes "domestic" (mainly northwestern Europe–England, Germany, and Netherlands) and "non-domestic" European cultures (mainly southern Europe–Spain, Italy, and France). Gauvain and Altman (1982) noted at least two dimensions of the home differentiating between cultures, namely identity/communality and openness/closedness. We can expect that attachment to home widely varies in conditions of the increasing diversification of family types (Georgas et al., 2006), depending on the salience of "familism" or autonomy in each culture. Therefore, for cross-cultural studies, it is important to develop a culturally invariant instrument for measuring the level of home attachment, which would reflect the stable core of this phenomenon. To our knowledge, there are no valid cross-cultural versions of home environment measures so far, except for Jones et al. (2017).

The current study presents the first five countries' cross-cultural validation of *HAS*, in a shortened modification (*SHAS*). We expect to receive the uni-factorial structure of *SHAS* because emotions regarding a place and dependence on it are tightly interconnected (Reznichenko, 2016; Junot et al., 2018), this was proved by most previous scales, that were uni-factorial as well.

To examine *SHAS* psychometric indicators, we arranged a cross-correlational research design.

MATERIALS AND METHODS

Participants

A total of 1,349 university students (17–26 years; Me_{age} = 19, M_{age} = 19.82, SD_{age} = 2.14; 78% females) from Armenia, India, Indonesia, Russia, and Ukraine took part in the study. After removing outliers from each subsample, the aggregate sample size was 1307: Armenia–322 participants, India–270, Indonesia–177, Russia–278, and Ukraine–260) (for the detailed information, see **Supplementary Appendix 1**). All students studied on university campuses away from home ($M_{distance}$ = 439 kilometers from home) and lived mostly in dormitories or with relatives; a few (∼15%) lived in apartments rented for the duration of their studies. Participants were included in the sample if they were 17–26 years old and in an undergraduate or graduate program at the university. The exclusion criteria were respondents' non-indigeneity or permanent rather than temporary respondents' housing (dormitory, relative's house, rented house) while at university.

Data were collected in 2019–2020 (see **Supplementary Appendix 1**). Participation was voluntary; the respondents provided some demographic information (age, sex, birthplace, and place of residence during university studies).

Measurement Instruments

The original *HAS* items were translated into the teaching languages of the universities participated: Armenian and Indonesian, by the authors according to ISPOR requirements (Wild et al., 2005). The English version was adopted from the English questionnaire (Williams and Vaske, 2003) and modified for the home environment. As for the Armenian and Indonesian versions, these translations were made by bi-lingual psychologists who have been working for more than ten years (respectively, Armenian-Russian, and Indonesian-English specialists). After this, the back-translation was checked and approved by Dr. Reznichenko–one of the authors of the original *HAS*. All wordings were discussed with professional linguists if needed.

Analytic Strategy

The factor structure of the questionnaire was tested step by step. The search for the optimal number of factors, as well as testing of the primary confirmatory factor analysis (CFA) model, were carried out on the data of the Russian sample (n = 278) since the tool was first developed in this country. The entire sample (n = 1,307) was used to conduct Multi-Group Confirmatory Factor Analysis (MG CFA) and Multi-group Alignment Analysis to calculate internal reliability and descriptive statistics.

We used Exploratory Graph Analysis (EGA), conducted within the glasso estimation method (graphical least absolute shrinkage and selection operator), and the Walktrap algorithm to identify the optimal number of subscales in the questionnaire.

We performed CFA with the robust maximum likelihood (MLR) rescaling-based estimator to analyze the factor structure of *HAS*. The set of commonly used goodness-of-fit indicators was used to interpret the results of both CFA and MG CFA: CFI, TLI, RMSEA, PCLOSE, and SRMR. Both CFI and TLI values exceeding 0.95 indicate a good model fit (Hu and Bentler, 1999). Value of RMSEA not greater than 0.08 and 0.06 suggests an "adequate" and "close" mode fit, respectively (Marsh et al., 2005), while SRMR values smaller than 0.08 indicate an acceptable fit (Hu and Bentler, 1999).

The internal reliability of the tool was estimated with the McDonald's *omega* (ω) and Cronbach's *alpha* (α; to compare the reliability across studies): both ω and α threshold values 0.70 are considered as acceptable for research purpose measurement instruments (Hair et al., 2010). The accelerated bootstrap confidence intervals for both estimates were calculated based on 1,000 bootstrap replications.

Testing of measurement invariance of the scale across countries was carried out *via* MG CFA, using the full information maximum likelihood (FIML) method. MG CFA contained three assessments of equivalence with increasing constraints: configural (no constraints), metric (constrained factor loadings), and scalar (constrained factor loadings and intercepts). Evaluation of the invariance was conducted by the assessment of changes in the fit index: ΔCFI and ΔTLI less than 0.01, ΔRMSEA less than 0.015, and ΔSRMR less than 0.03 (Chen, 2007).

It is known that scalar invariance in real research is not easy to satisfy; thus, the comparison of the factor means is often limited. In such cases, another method to test metric and scalar invariance, namely the multi-group factor analysis alignment, is more practical. The measurement alignment does not require equality restrictions on factor loadings and intercepts across groups (Asparouhov and Muthén, 2014; Fischer and Karl, 2019). Therefore, we decided that if full metric and/or scalar invariance across countries cannot be proved in the traditional MG CFA, we will choose a less demanding method. The alignment procedure was performed using a fixed approach with alignment power values specified for λ (loadings) and ν (intercepts) parameters as 0.25 and 0.25 for λ and ν tolerances set to 0.4 and 0.2, respectively.

The magnitude of the latent mean structure difference was specified using Cohen's *d*, measuring the effect size of differences in means, where *d* greater than 0.2 is considered as a small effect, d = 0.5 is medium, and d = 0.8 or above a significant effect (Cohen, 1988).

In the current study, we used the packages psych 2.1.9 (Revelle, 2021), lavaan 0.6–9 (Rosseel, 2012), semTools 0.5–5 (Jorgensen et al., 2021), MBESS 4.8.1 (Kelley, 2021), EGAnet 1.0.0 (Golino and Epskamp, 2017), sirt 3.11–21 (Robitzsch, 2019), and ccpsyc 0.2.4 (Fischer and Karl, 2019) implemented in the R Software and Programming environment 4.1.1 (R Core Team, 2020). The calculations were performed both in Excel and R.

RESULTS

Testing the Structure of the *Home Attachment Scale* in the Individual Countries

To handle missing data in the dataset (3.11% of the entire sample) the FIML method was used. Based on the calculated probability ($p < 0.001$) of the Mahalanobis distance for each observation, 42 multivariate outliers were identified and then

removed from the sample (see **Supplementary Appendix 1** for details). The final sample included 1,307 cases. Both the Mardia's multivariate kurtosis and skewness tests didn't meet the normality assumption. None of the items had a normal univariate distribution according to the Anderson-Darling test, however, the absolute values of skewness and kurtosis in each sample were between −2 and + 2, which is considered acceptable to prove normal univariate distribution (George and Mallery, 2010). Items 1, 2, 3, 4, 11, 14 showed slightly left-skewed distribution. No floor effect was detected. There was little evidence (percentage frequency of highest possible score were within 16–25%) of a ceiling effect for these items.

Exploratory Graph Analysis conducted on the Russian sample (n = 278) suggested the extraction of 1 cluster in the partial correlation matrix. The strongest relations were found between items 1, 3, 4, 7, 11, and 14. The results of the dimension stability analysis (based on 1,000 replica samples) confirmed that a uni-dimensional model was relatively precise: Me ± SD (CI) number of dimensions = 1 ± 0.63 (1.53); 1 factor was replicated 714 times, while 2, 3, or 4 factors only 134, 112, and 40 times, respectively. The items 8, 9, 10, and 12 had the lowest stability indices and replicated between 75 and 77% of the time in their dimension. With regard to the EGA results and original factor structure of *HAS*, a uni-dimensional solution was chosen for the CFA analysis.

The initial one-factor model performed on the Russian sample (χ^2 = 249.42, df = 77, p < 0.001) showed acceptable SRMR value (0.057), but poor RMSEA (0.090 [95% CI, 0.078–0.101]; PCLOSE < 0.001) and incremental fit indices (CFI = 0.897, TLI = 0.878). The factor model was then successively reduced based on the EGA results (the most unstable items), the modification indices, and the item analysis indices (difficulty, discrimination, and item-total correlations). Items 8, 9, 10, 12, and 13 were removed first because they had (a) the lowest factor loadings (less than 0.50); (b) multiple and high error covariances between themselves and with other items, and (c) the lowest scores of item discrimination (<0.40) and item-total correlation (<0.50). These trends were fully or partially replicated in samples from all other countries. Deletion of these items led to a significant, but insufficient improvement in the model fit (RMSEA = 0.078; SRMR = 0.035; CFI = 0.949, TLI = 0.936).

The modification indices showed that the sources of the residual model misspecification are high and serial error covariances between semantically close items 1–3, 1–7, 1–11, 3–7, 7–11, 3–6, and 4–14 (e.g., 1: "*I feel like my home is a part of me*"; 3:"*My home is a really special place to me*") and that a substantial amount of misspecification can be avoided by deleting items 1 and 11. The final uni-dimensional model included seven items (2, 3, 4, 5, 6, 7, 14; see **Figure 1**) with the range of loadings 0.66–0.82 and fitted the Russian data perfect: χ^2 = 22.25, df = 14, p = 0.074; RMSEA = 0.046 [95% CI, 0.000–0.077]; PCLOSE = 0.543, SRMR = 0.026, CFI = 0.989, TLI = 0.983.

Due to this radical shortening of the scale, it was labeled *SHAS* (see **Supplementary Appendix 2**). Internal consistency was satisfactory for both the CFA (Russian) sample (ω = 0.90, α = 0.90) and for other subpopulations in different countries (ω range 0.82–0.89, α range 0.82–0.89). Descriptive statistics of *SHAS* in the countries studied are shown in **Table 1**.

We have successfully replicated this solution both in India and Ukraine, where fit indices were excellent (RMSEA = 0.031/0.020; SRMR = 0.028/0.034; CFI = 0.993/0.996, TLI = 0.989/0.993, respectively) (see **Table 2**). In Armenia, we got moderate fit indices in terms of RMSEA = 0.081 and TLI = 0.942 but good fit in terms of SRMR = 0.036 and CFI = 0.961. The model could be improved by adding covariances between the errors of items 3–4 and 3–6, but these modifications led to a deterioration in the model fit of other countries, particularly Russia. Therefore, we decided not to modify the model obtained on the Russian sample and to include the Armenian data in further MG CFA because of its relatively adequate model fit. In Indonesia, the model was poor-fitted to the data (RMSEA = 0.115; SRMR = 0.044; CFI = 0.938, TLI = 0.907) and required drawing multiple, theoretically inexplicable correlations between error terms of the items 2–3, 3–6, 5–6, 3–7 2–5, 2–14, 6–7. Since the fit of the model with the data in each country is a necessary requirement for invariance, Indonesia was excluded from further analyses.

Measurement Invariance Testing Across Countries

Multi-Group Confirmatory Factor Analysis

In order to examine measurement invariance of the SHAS across different cultures (except Indonesia) for further comparison of latent factor means, configural invariance, metric invariance, and scalar invariance were sequentially tested. As shown in **Table 2**, the configural invariance was confirmed which assumed that the overall factor structure is identical across countries. The model comparison test (configural vs. metric) suggested full metric invariance (ΔRMSEA = 0.004, ΔCFI = −0.01, ΔTLI = −0.004, ΔSRMR = 0.029), indicating that factor loadings are the same in all countries. However, scalar invariance wasn't achieved, because all compared indicators significantly exceeded its thresholds: ΔRMSEA = 0.046, ΔCFI = −0.086, ΔTLI = −0.072, ΔSRMR = 0.037.

The effect sizes in item bias (dMACS) were calculated to check which items led to the greatest mismatch of factor models in different countries and estimate their magnitude of the misfit. Items 4 and 5 (average dMACS 0.581 and 0.689, respectively) turned out to be most problematic: it had the greatest impact both on the metric and scalar variance. The dMACS of items 3, 6, and 7, on the contrary, were the lowest (0.375, 0.262, and 0.376, respectively). The maximum dMACS values were observed in the pair of India and Armenia, and the minimum in the pair of Russia and Ukraine.

Multi-Group Alignment Analysis

Since we failed to establish scalar invariance of the *SHAS* using MG CFA, we used the multi-group alignment approach (Asparouhov and Muthén, 2014) to compare the latent factor means.

Table 3 displays (non)invariant countries for each item factor loading and item intercept: if a group is enclosed in parentheses, the parameter of this group is denoted as non-invariant. As can be seen, all the item factor loadings remain

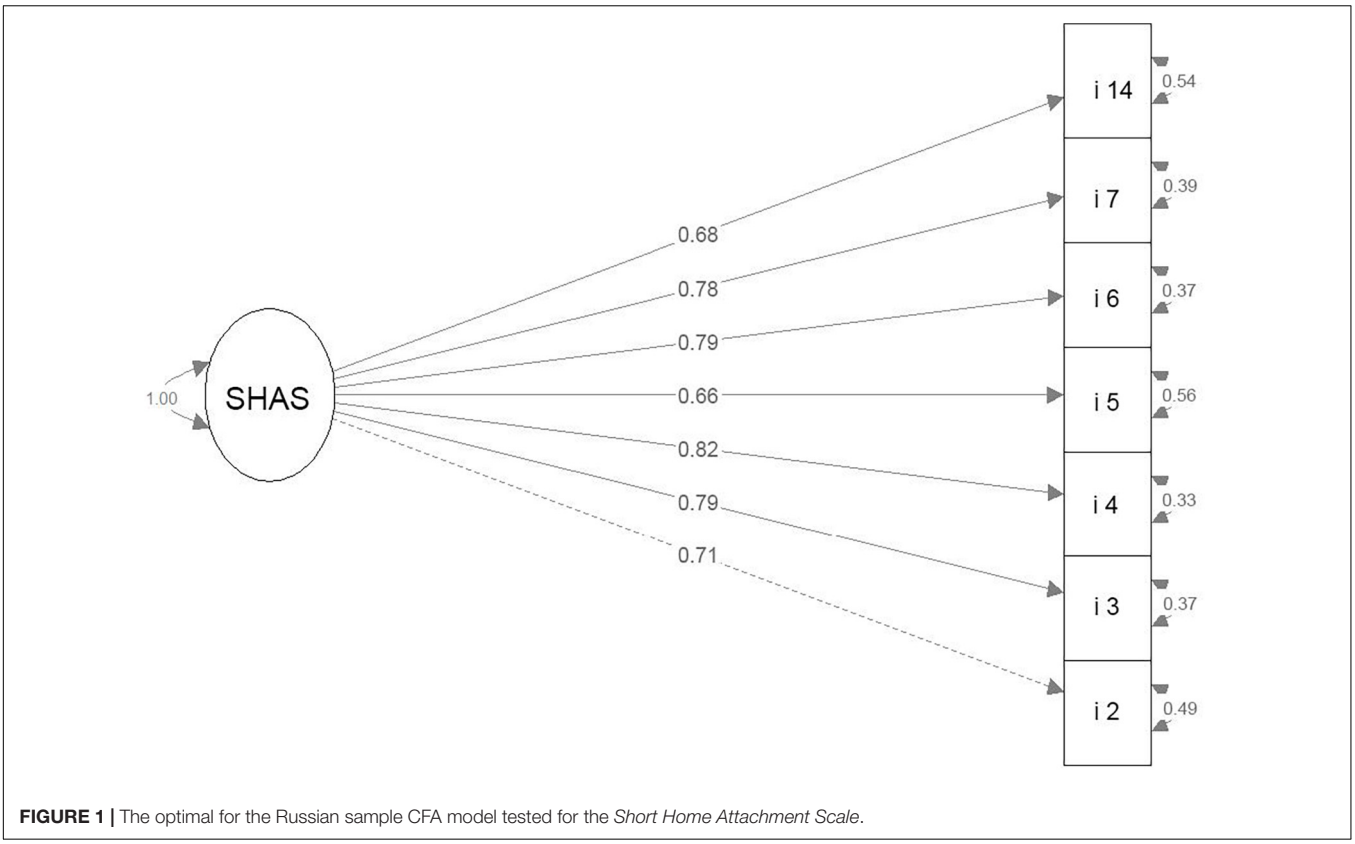

FIGURE 1 | The optimal for the Russian sample CFA model tested for the *Short Home Attachment Scale*.

TABLE 1 | Descriptive statistics of the *Short Home Attachment Scale* across countries.

	N	M (SD)	SE mean	Median [95%CI]	Asymmetry	Kurtosis	McDonald's omega [95% CI]	Cronbach's alpha [95% CI]
Armenia	322	28.12 (5.55)	0.31	29 [29–30]	−0.84	0.47	0.89 [0.87–0.92]	0.89 [0.87–0.91]
India	270	30.46 (4.32)	0.26	31 [30–32]	−1.06	0.70	0.82 [0.77–0.86]	0.82 [0.78–0.86]
Indonesia	177	27.21 (4.95)	0.37	28 [27–29]	−0.39	−0.38	0.89 [0.86–0.92]	0.89 [0.86–0.91]
Russia	278	24.29 (6.57)	0.35	25 [24–25]	−0.52	−0.02	0.90 [0.88–0.92]	0.90 [0.88–0.92]
Ukraine	260	25.76 (5.86)	0.36	26 [25–26]	−0.57	−0.27	0.84 [0.81–0.87]	0.84 [0.80–0.87]

The median's, McDonald's omega's, and Cronbach's alpha's confidence intervals have been estimated for each group through bootstrapping with 1,000 replicates.

TABLE 2 | Separate and multigroup confirmatory factor analyses of the *Short Home Attachment Scale* across countries.

Model	χ2 (df)	RMSEA [95% CI]	SRMR	CFI	TLI	Factor loadings
Separate CFA models						
1. Armenia	48.40 (14)***	0.081 [0.061–0.110]	0.036	0.961	0.942	0.60–0.85
2. India	15.46 (14)	0.020 [0.000–0.056]	0.034	0.996	0.993	0.52–0.72
3. Indonesia	46.88 (14)***	0.115 [0.081–0.151]	0.044	0.938	0.907	0.58–0.82
4. Russia	22.25 (14)	0.046 [0.000–0.077]	0.026	0.989	0.983	0.66–0.82
5. Ukraine	17.41 (14)	0.031 [0.000–0.069]	0.028	0.993	0.989	0.51–0.77
Multigroup CFA models across countries						
1. Configural invariance	102.66 (56)***	0.054 [0.039–0.069]	0.028	0.981	0.971	–
2. Metric invariance	145.52 (74)***	0.058 [0.046–0.071]	0.057	0.971	0.967	–
Δ 2-1	42.86 (18)***	0.004	0.029	−0.01	−0.004	–
3. Scalar invariance	370.73 (92)***	0.104 [0.094–0.114]	0.094	0.885	0.895	–
Δ 3-2	225.21 (18)	0.046	0.037	−0.086	−0.072	–

*Data from Indonesia were excluded from the multigroup CFA. ***A chi-square difference is significant at $p \leq 0.001$.*

TABLE 3 | Approximate measurement invariance (non-invariance) for groups and comparison of aligned factor means of the *Short Home Attachment Scale* across countries.

Items	Invariance (non-invariance) for countries		Latent mean comparisons across groups*	
	Loadings	Intercepts	Country	Factor mean (SD)
2	AR IN RU UK	AR IN RU UK	AR	0.681 (0.767)
3	AR IN RU UK	AR IN RU UK	IN	1.096 (0.611)
4	AR IN RU UK	(AR) IN RU UK	RU	0.000 (1.000)
5	AR IN RU UK	AR IN RU UK	UK	0.286 (0.899)
6	AR IN RU UK	(AR) IN (RU) UK		
7	AR IN RU UK	AR (IN) RU UK		
14	AR IN RU UK	AR IN RU UK		
Percentage of non-invariance item parameters	0%	14,3%		
Degree of invariance (R^2)	0.990	0.998		

AR, Armenia; IN, India; RU, Russia; UK, Ukraine.
When a group is parenthesized, the parameter of that group is indicated non-invariant.
**differences between the latent means of the SHAS for all pairwise comparisons are significant at $p \leq 0.001$ (Bonferroni-adjusted significance level for pairwise comparisons is $\alpha = 0.008$).*

invariant. The intercepts of the items were more non-invariant than the loadings of the items. Armenia showed non-invariance in the intercepts of items 4 and 6, Indiaitem 7, and Russia–item 6. The percentage of non-invariance of the intercepts was 14.3% which is less than a cut-off of 25% non-invariance suggested by Asparouhov and Muthén (2014). R^2 for loadings and intercepts were 0.99 and 1, respectively. These results indicate that essentially all non-invariance is caused by group-varying factor means and variances.

Latent Mean Comparisons

Based on the multi-group alignment analysis, the latent factor means of the *SHAS* were compared. After inspecting the results, we found that the Russian sample had a smaller factor mean, so we fixed its latent mean at zero and standard deviation at one whereas the latent means and standard deviations of other groups were freely estimated (**Table 3**). The latent means compared by *t*-test with Bonferroni correction significantly differed across countries. Russian students had the smallest factor mean, and Indian students had the highest one [differences in means: 1.10; t(546) = 15.43; $p > 0.001$; Cohen's $d = 1.32$]. Ukrainian students were stronger attached to their homes than Russian students [differences in means: 0.29; t(536) = 3.48; $p = 0.001$; Cohen's $d = 0.30$], but less than Armenian, and Indian ones [differences in means: −0.40, −0.81; t(580) = −5.72 and t(528) = −12,18; all at $p > 0.001$; $d = 0.48$, 1.06, respectively]. Students from Armenia had lower SHAS scores than Indian students [differences in means: −0.42; t(590) = −7.19 at $p > 0.001$; $d = 0.59$].

DISCUSSION

The study aimed to examine the structural validity, measurement invariance, and reliability of *HAS* in the youth from five countries with predominantly collectivist cultures.

Consistent with the results of a previous validation of *HAS* conducted on the Russian population, the current study retained the single-factor structure of the scale. Nevertheless, the CFA results conducted on the Russian sample showed that some semantically close items of the questionnaire had high error covariances and/or low factor loadings. This led to a significant decrease in the model fit. We identified seven items that had the highest factor loadings, unique variance, and discriminative parameters and formed the most sustainable and parsimonious factor solution in the Russian sample; they were included in the final shortened version of the scale (*SHAS*). These items constitute a uni-dimensional construct of home attachment and reflect the three most frequently identified manifestations of a strong attachment to home: affect (emotions), cognition (identity), and behavior (action) (Ruiz and Hernández, 2014). This model was successfully replicated in India and Ukraine, and with relative success in Armenia where fit indices were acceptable but not perfect. In Indonesia, the model showed a poor fit to the data and required adding serial, theoretically questionable correlations between error covariances of the items' set. Thus, *SHAS* can be used without structural modifications in Russia, Ukraine, India, and Armenia, but requires a more thorough study of the factor structure on data from the Indonesian population.

In the current study, there was evidence for both configural and metric invariance as tested by MG CFA. The invariance of item factor loadings, as well as item intercepts, was also confirmed by the alignment analysis: all the items factor loadings were the same across cultures, while the intercepts of only four items out of seven were fully invariant. However, the percentage of non-invariance (14.3%) is quite low and indicates that the structure of the questionnaire and item parameters have sufficient cross-cultural stability to compare the latent means of *SHAS* in respondents from different countries.

We could assume that home attachment is related to culture: in countries with a pronounced collectivistic orientation and a high value of family, such as India and Armenia, the highest indicators were obtained, and in countries with a moderately collectivistic orientation, such as Russia and Ukraine, lower (Hofstede Insights, 2022). This trend is consistent with several other studies showing that collectivistically orientated international students who place greater emphasis on cooperation, obligation, and respect for family values have higher levels of homesickness compared to students who endorse individualistic values because it is harder for them to tolerate reduced family presence (Hack-Polay, 2020; Poyrazli and Devonish, 2020).

CONCLUSION

This paper reports the results of the structural validation of a new standardized instrument–*SHAS*, which was examined in five

countries (Armenia, India, Indonesia, Russia, and Ukraine). The results show that the aim of our research has been achieved, and now, researchers have a new concise and convenient method of studying the personal attitudes to home environment.

Nevertheless, the current study is not free of some limitations; the most important of them might be overcome through examining the content, discriminant, and convergent validity; a more detailed study of the factor structure and modification indices of the questionnaire on Indonesian data; further exploration of the age dynamics in home attachment, widening the number of participants from individualistic cultures; extending the sample by recruiting different social groups, for instance, work migrants, refugees, homeless people; and implementing the research results in the abroad social context and practice. This is on the agenda for future studies.

Despite these limitations of the current study, the new method can be recommended for cross-cultural research, especially for homelessness, homesickness, adaptation to a new (temporary or permanent) place of residence, and also used in applied research, such as motivation for mobility and tourism.

DATA AVAILABILITY STATEMENT

The datasets analyzed in this study are available online in the OSF repository (doi: 10.17605/OSF.IO/9GM4W).

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Commission for the Ethical Evaluation of Empirical Research Projects of the Department of Psychology at HSE University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SN-B developed the main idea of the manuscript, collected data, organized the database, wrote the first draft of the manuscript, contributed to the manuscript revision, read and approved the submitted version. SR contributed to the study's conception and design, performed the statistical analysis, contributed to the manuscript revision, read and approved the submitted version. VB, MK, VY, NK, IK, SK, and ZZ collected data, organized the database, provided feedback, read and approved the submitted version. All authors approved the submitted version of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.834421/full#supplementary-material

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How to facilitate employees' green behavior? The joint role of green human resource management practice and green transformational leadership

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Given the severity of today's environmental issues, companies are increasingly making green concepts a key component of their operational strategies. As an essential complement to corporate environmental strategy, employees' green behavior has received attention from all sectors of society. Based on resource conservation theory, this study explores the formation mechanism of employees' green behaviors in enterprises starting from two green management tools: green human resource management (HRM) practices and green transformational leadership. Through two-stage questionnaire research, 296 sample data points were obtained, and the research hypotheses were tested by using linear regression analysis. The results showed that green HRM practices in enterprises enhance employees' green mindfulness and thus stimulate their green behaviors and that green transformational leadership and green self-efficacy play a positive moderating role in the above relationship. These results support the applicability of resource conservation theory in green management and suggest that green HRM practices and green transformational leadership can be used together in the process of green management.

KEYWORDS

green human resource management, green transformational leadership, green behavior, green mindfulness, green self-efficacy

Introduction

Employees' green behavior can be generally understood as employee activities that aim to conserve natural resources and the ecological environment and that work to reduce environmental degradation and improve environmental quality (Norton et al., 2015). Given the critical value of employees' green behavior, scholars have begun to explore what management measures organizations can use to motivate employees to pursue green practices. Current scholarly research on corporate employees' green behaviors has focused on individual traits (Tariq et al., 2020), leadership traits (Wang et al., 2018), and

organizational climate (Zientara and Zamojska, 2018). In particular, green transformational leadership (Tian and Jiang, 2021) and green human resource management (HRM) practice (Renwick et al., 2016; Shen et al., 2018; Hazarika and Zhang, 2019; Fawehinmi et al., 2020; Farooq et al., 2021) have attracted much attention as two sharp tools of green management.

As a soft means of green management, green transformational leadership aims to convey the "subjective" norms of protecting the environment to organization members to stimulate green behavior among subordinates (Robertson and Barling, 2013). As a hard means of green management, green human resource management practice regulates employees' green behavior at the system and policy levels (Dumont et al., 2017). However, previous studies have discussed the effects of green transformational leadership and green human resource management practices in a fragmented way, ignoring the joint mechanism of the two on employees' green behavior (Robertson and Barling, 2013; Dumont et al., 2017; Tian and Robertson, 2019; Yusliza et al., 2020). Theoretically, unilateral factors have difficulty explaining most of the variations in green behavior and are not conducive to a comprehensive and systematic understanding of the inducing influences on employees' green behavior. As Leroy et al. (2018) pointed out, leadership behavior and human resource management practice have a common goal of managing people more effectively in the organization. Based on this commonality, they can coexist in the organization and shape employees' workplace behavior together. Therefore, considering the interaction between the two can not only improve the research's explanatory power but also help reveal how multiple situational factors shape employees' green behavior. Following this logic, this study aims to explore the interaction between green transformational leadership and green human resource management practice on employees' green behavior and its internal mechanisms, covering the gap in corporate environmental responsibility fulfillment research at the micro-level.

According to resource conservation theory (Hobfoll, 1989), when individuals have more resources, they are more willing to engage in resource investment behavior. Green human resource management practices, such as green training and green empowerment, are typical work resources that improve employees' green mindfulness to a certain extent (Chen et al., 2015; Ren et al., 2018), which helps employees show more green behaviors. At the same time, the effectiveness of HRM practices depends on organizational leadership to a certain extent. The leadership characteristics of green transformational leadership can effectively coordinate the relationship between organizational strategy and human resource management, enhance employees' green mindfulness, and then influence green behavior. Revealing the intermediary role of green mindfulness can provide a more specific explanation for the interactive effect of the two green management tools. In addition, the difference in individual self-efficacy may lead to different degrees of green behavior among employees under the same human resource management. Therefore, if enterprises want to motivate employees to show attitudes and behaviors that conform to the development of organizational strategy and realize the maxim, "love what the company loves and do what the company does," on environmental issues, they must jointly apply green transformational leadership and green HRM practice and then shape employees' green mindfulness and influence employees' green behavior.

In summary, this study will integrate green transformational leadership (soft means) and green HRM practice (hard system) and explore how they affect employees' green behavior together. The main purposes of this study are as follows: first, to explore the interaction effect of green HRM practice and green transformational leadership on employees' green behavior; second, to test the intermediary role of green mindfulness; and finally, to test the regulatory effect of green self-efficacy.

Theoretical background and hypothesis development

Hard measures to stimulate employees' green behavior: Green human resource management

Existing research suggests that HRM practices positively influence employees' attitudes, motivations, and behaviors and that employees' perceptions of HRM are significant predictors of their work attitudes and behaviors (Tian and Jiang, 2021). Green HRM practices are mandatory systems to support green management that aim to integrate "environmental issues" into HRM functional modules (Renwick et al., 2013; Yong et al., 2020) and regulate employees' green behaviors at the institutional level. According to Renwick et al. (2013), green HRM practices are mainly manifested in introducing green issues into recruitment, training, performance evaluation, compensation and benefits management activities. Employees are more likely to demonstrate green behaviors through these green-oriented management activities. The specific reasons are as follows. First, by recruiting green-oriented staff and doing green practices an employer brand, companies can attract and bring in environmentally conscious employees, and these employees will naturally show green behavior after entering the company. Second, by organizing environmental skills training, companies can enrich employees' environmental knowledge and train them to solve environmental problems so that employees are more capable of implementing green behavior. Third, by introducing green issues to employees, companies can make employees more likely to show green behavior. Fourth, by incorporating employees' green behavior into the performance evaluation and compensation system, employees can clarify their responsibilities and realize that they can earn rewards for being more active in environmentally protective behavior (Dumont et al., 2017). In conclusion, when employees experience green HRM practices, they will show more green behaviors.

> *H1*: There is a positive correlation between employees' perceived green HRM practices and green behavior.

Soft measures to stimulate green behavior: Green transformational leadership

Green transformational leadership refers to leaders motivating employees to achieve green goals and encouraging employees to demonstrate green behaviors beyond the expected level (Chen and Chang, 2013; Peng et al., 2019a), including through influence, motivation, intellectual stimulation and personalized care (Robertson, 2018). Green influence refers to leaders acting as environmental role models and influencing the green behavior of subordinates through their charisma. Green motivation means that leaders encourage employees to go beyond their short-term self-interest and work hard to achieve green goals. Green intellectual stimulation refers to leaders inspiring employees to challenge old ideas and use new methods to solve environmental problems. Green personalized care refers to leaders who value their employees' green contributions and help them develop environmental skills (Robertson, 2018). Through the green influence and green motivation, green transformational leaders help employees understand the importance and feasibility of green behaviors to realize that green behaviors are encouraged and expected by organizations and that they should demonstrate green behaviors (Robertson and Barling, 2013). At the same time, through green intellectual stimulation and green personalized care, green transformational leaders can develop employees' ability to think about environmental issues, enrich their environmental knowledge, and help them develop environmental skills so that they have the will and ability to demonstrate green behaviors (Kura, 2016). In summary, when employees perceive that leaders show green transformational leadership behavior, they will show more green behavior.

> *H2*: There is a positive correlation between employees' perception of green transformational leadership and green behavior.

The interaction of green human resource management practice and green transformational leadership on employee green behavior

The effectiveness of green HRM practices also depends to some extent on the organization's leadership, and motivating employees to engage in green behaviors through leaders is essential for companies to establish a green image. In this study, green transformational leadership and green human resource management practices are two important reference sources before employees take green actions. When employees perceive a high level of green human resource management practice, and the more leaders show a high level of green transformational leadership behavior, the more likely employees are to perceive that both sides are consistent, which can accelerate the recognition and adoption of green ideas, green expectations and green behavior. Specifically, when the organization insists on green orientation in human resource management activities, employees will realize the importance and value of green management. In this case, as long as the leader continues to show a high level of green transformational leadership behavior (Robertson and Barling, 2013), employees can obtain more consistent clues from their work environment, more firmly believe in the importance of green behavior, and believe that green human resource management practices can be implemented within the department. This is conducive to strengthening employees' determination to engage in green behavior.

However, when employees feel that there is a difference between green transformational leadership and the green human resource management level, employees will receive two inconsistent messages. Because the two messages have a certain weight in the organization, employees will be uncertain and initiate a cognitive processing process dominated by negative prejudice (Roeck and Farooq, 2018), that is, pay more attention to the clues that will bring them losses or negative impacts. For example, under the practice of low-level green human resource management, the higher the degree of green transformational leadership perceived by employees, the more likely they are to believe that engaging in green behavior only satisfies the personal wishes of leaders and benefits them personally but will not be recognized and rewarded by the formal system of the organization. In this case, employees will regard "engaging in green behavior" as a loss of time or energy that cannot obtain benefits from the organization, which will consequently fail to increase the probability of green behavior. In summary, this study proposes the following hypothesis.

> *H3*: Employees' perceived green transformational leadership and green human resource management practice positively interact with employees' green behavior. Under a high degree of green human resource management practice, green transformational leadership strongly impacts employees' green behavior.

The mediating role of the green mindfulness of corporate employees

Mindfulness refers to a state of conscious awareness, living in the present moment, and nonjudgment (Barbaro and Pickett, 2016). Scholars in the field of organizational management define mindfulness as "a receptive attention and awareness of current events and experiences" (Peng et al., 2019b). Research has found that mindfulness in the workplace positively impacts employees' work well-being, pro-environmental behavior, and learning

(Liu and Li, 2020). Chen et al. (2015) define green mindfulness as a type of awareness in which individuals focus their attention on the various contexts and contents of environmental well-being in the present. Green mindfulness includes four characteristics: sensitivity to the environment, openness to new information, multiperspective cognition, and awareness and attention to different backgrounds (Dharmesti et al., 2020). Many researchers have recognized that HRM practices usually do not directly influence employees' work attitudes and behaviors; rather, this influence is transmitted through specific social and psychological processes (Tian and Jiang, 2021). According to resource conservation theory (Hobfoll, 1989), multiple resources in green HRM systems (e.g., green training, green job design) contribute to increasing employees' psychological resources, such as green mindfulness, green sensitivity, and green attention (Guerci et al., 2016; Liu and Li, 2020). Among them, green mindfulness, as a positive psychological resource, is an essential driver for employees to engage in green behaviors. Employees with green mindfulness are concerned about the environmental consequences of their actions and are more likely to participate in implementing and accepting managers' strategic decisions regarding corporate environmental responsibility (Liu and Li, 2020), which in turn directly affects employees' green behaviors in the workplace.

Green Transformational Leadership (Chen and Chang, 2013) and Green Human Resource Management Practice (Dumont et al., 2017) are two important information sources for employees to understand and understand environmental protection goals, which can interactively influence employees' green beliefs. This interaction is shown as follows: Green transformational leadership can strengthen the influence of green human resource management practice on employees' green beliefs. Specifically, under green transformational leadership, employees will have goals and beliefs about environmental practices communicated to them (Robertson, 2018). At this time, if employees experience high-intensity green human resource management practices, they can perceive that the organization attaches great importance to environmental protection issues and their environmental protection responsibilities (Tian and Jiang, 2021) from a series of systems, such as green-oriented training, performance management and salary and welfare (Dumont et al., 2017), thus resulting in more green behaviors.

> *H4*: The interaction between green human resource management practice and green transformational leadership positively affects employees' green behavior through green mindfulness.

Moderating effect of green self-efficacy

Green self-efficacy is a concept of self-efficacy that incorporates green environmental factors, which refers to individuals' evaluation of their ability to perform different activities to achieve green goals (Chen et al., 2015; Guo et al., 2019). Individuals with high levels of green self-efficacy believe they have the ability and confidence to accomplish specific green tasks. Previous studies have found that green self-efficacy, as a self-perception, positively impacts green behavior (Huang, 2016). According to resource conservation theory (Hobfoll, 2001), employees with high green self-efficacy usually have abundant psychological resources (e.g., positive thoughts, confidence, courage) and believe that they are capable of completing challenging tasks (Liu and Li, 2020). In this case, employees will try to obtain more resources from the green HRM system (e.g., green empowerment) and use green behavioral opportunities to create resource surpluses. Therefore, employees with high green self-efficacy will understand the intention and purpose of green HRM practices that are positively implemented by the organization and then make full use of the available internal and external resources to actively participate in green activities; in this way, the impact of green HRM is enhanced. In contrast, when employees' green self-efficacy is at a low level, even if the organization provides employees with various resources (e.g., green training opportunities, green rewards), employees' sense of obligation to engage in green activities will not be strengthened due to their lack of positive intention to participate in green activities; that is, the influence of green HRM will be weakened. In summary, this paper proposes the following hypothesis.

> *H5*: Employees' green self-efficacy plays a positive moderating role in the relationship between green mindfulness and green behavior.

In summary, the employee green behavior model is constructed in the context of Chinese culture, as shown in Figure 1. To test these hypotheses, we carry out a survey that is presented in the next part of this paper.

Research design

Sample and data collection

In recent years, the Chinese government has introduced many environmental regulations urging companies to shift to an environmentally sustainable development model. This study argues that enterprises' adoption of green HRM practices is conducive to the construction of a differentiated competitive advantage. Green employee behavior complements organizational policies and helps promote corporate green management. The samples of existing empirical studies on green HRM are mainly from ISO14001-certified companies, which usually implement green HRM practices (Shen et al., 2018). Given this, this study selected four ISO14001-certified companies representing the tourism, manufacturing, construction, and pharmaceutical industries. Before the formal survey, the researchers contacted the individuals concerned by phone and email to explain the purpose of the study and how the survey would be conducted. After obtaining their consent, the researchers proceeded to the formal survey process. A

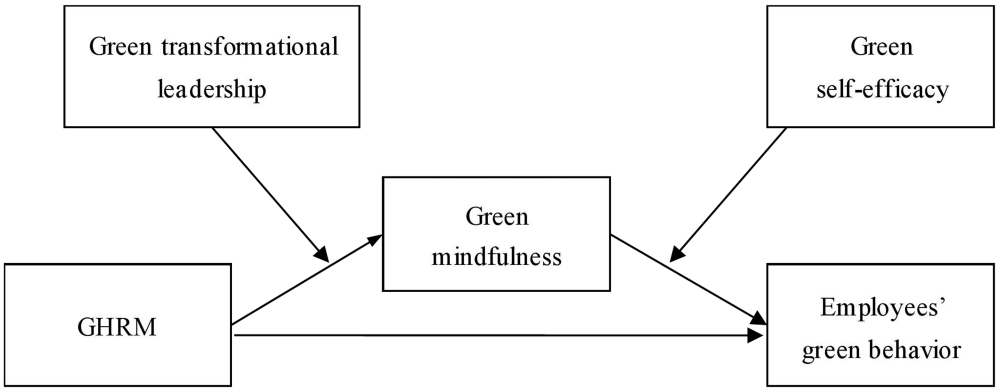

FIGURE 1
The theoretical model of the green behavior of Chinese employees.

TABLE 1 Descriptive statistics of samples.

Demographic information		Respondents ($N = 296$)	Percentage (%)
Gender	Male	167	56.42
	Female	129	43.58
Age	Less than 30 years	125	42.23
	31–40 years	113	38.18
	41–50 years	41	13.85
	51 and over	17	5.74
Education	High school and above	57	19.26
	Associate degree	93	31.42
	Bachelor's degree	114	38.51
	Master's degree or above	32	10.81
Organizational	1–3 years	136	45.95
Tenure	4–6 years	78	26.35
	7–9 years	44	14.86
	10 years and above	38	12.84
Position	Production	114	38.51
	Administrative	67	22.64
	Technical	55	18.58
	R&D	20	6.76
	Other	40	13.51

combination of an on-site survey and commissioned method was used to collect data. To avoid homogeneous variance, this study used two-time points to collect data. Four hundred thirty questionnaires were distributed to employees from July to September 2020. Employees answered questions related to demographic variables, jobs, green HRM, and green mindfulness; 387 questionnaires were returned, and 358 valid questionnaires were obtained after eliminating invalid questionnaires. Three hundred fifty-eight questionnaires addressing green transformational leadership, self-efficacy, and behavior were distributed again in November–December 2020 to 358 employees. Three hundred twenty-five questionnaires were returned, of which 296 questionnaires were valid, with a good return rate of 91.08%. The characteristics of the valid sample are shown in Table 1. The respondents have a wide range of characteristic attributes and coverage that are suitable for further empirical analysis.

Measurement of variables

All the scales in this study were obtained from foreign literature, and a two-way translation procedure was used to translate the main variable scales into Chinese. All items were scored on a five-point Likert scale, with "1" indicating "strongly disagree" and "5" indicating "strongly agree."

Green HRM

Since the improvement of HRM systems on organizational performance is based on employees' perceptions of HRM practices, most studies use employees' perceptions of green HRM practices to measure green HRM (Dumont et al., 2017; Shen et al., 2018). This study uses the Green HRM scale developed by Dumont et al. (2017) with six questions, such as "My company has set green appraisal goals for its employees." In this study, the Cronbach's alpha coefficient of this scale was 0.903, and the CR value was 0.868.

Green mindfulness

The six-question green mindfulness scale developed by Chen et al. (2014) was used, with example questions such as "Employees are free to discuss environmental problems and issues." In this study, the Cronbach's alpha coefficient of the scale was 0.823, and the CR value was 0.821.

Green transformational leadership

Green transformational leadership was measured using the scale developed by Mittal and Dhar (2016). Items that were repetitive, ambiguous, and did not fit the Chinese context were

removed, resulting in questions such as "My leader motivates me to work in an environmentally friendly way," and "My leader states that he is committed to improving the environmental performance of the organization," and "My leader states many times that he values the natural environment." The Cronbach's alpha coefficient for the scale was 0.921, and the CR value was 0.929.

Green self-efficacy

The six-item green self-efficacy scale developed by Chen et al. (2014) was used, with questions such as "I believe I am capable of taking measures to mitigate global warming and stop climate change," "I can think of some environmental ideas," "I feel that I can accomplish most of my environmental goals," and "I feel that I am capable and efficient in handling the tasks assigned by my supervisor to accomplish the environmental goals of my company." The Cronbach's alpha coefficient for this scale in this study was 0.900, and the CR value was 0.893.

Green behaviors

The scale developed by Kim et al. (2016) was used to measure employees' green behaviors. The scale was adjusted appropriately according to the content of this study without changing the meaning of the scale. The final results included "I turn off the lights when I leave an unoccupied room," "I sort the garbage and recycle garbage at work," and "I am very concerned about water waste." The Cronbach's alpha coefficient for the scale was 0.890, and the CR value was 0.888.

Control variables

According to previous studies (Dumont et al., 2017), age, gender, education, years of experience, and position were used as control variables in this study.

Results

Exploratory factor analysis

As reported above, the range of Cronbach's α coefficients was 0.823 ~ 0.921; therefore, the reliability of each scale in this study was good, and all had high internal consistency. By using principal component analysis for pivoting and extracting common factors with eigenvalues greater than 1, the results showed that five common elements could be removed, and the cumulative explained variance of the extracted common factors reached 68.319%. The above results indicated that the scales of this study could accurately measure the content of the study. To verify whether there was common method bias, this study conducted Harman's one-way test on the collected data by referring to Podsakoff et al. (2003) test for common method bias and performed exploratory factor analysis by putting all the measured items of the variables together. The cumulative sum of squares of the first ranked extracted loadings was 34.148%, which did not exceed 40% of the required range, so the collected questionnaire data did not have homogeneity. To test the suitability of the sample for exploratory factor analysis, the KMO value and Bartlett's spherical test were calculated using SPSS 23.0 software. The results showed that the KMO value of the sample was 0.888, and Bartlett's spherical test was significant ($p = 0.000$), indicating that the sample data were suitable for exploratory factor analysis.

Confirmatory factor analysis

In this study, validated factor analysis was performed on the data using Amos 24.0 software to test the discriminant validity of the variables by observing the fitted values of the models. As seen in Table 2, the one-factor model had the worst fit (RMSEA = 0.112, CFI = 0.789, TLI = 0.761), and the five-factor model had the best fit index relative to the other models (RMSEA = 0.054, CFI = 0.953, TLI = 0.944) and reached an acceptable level, indicating that the five variables in this study had good discriminant validity.

Descriptive statistics and correlation analysis

Table 3 shows the means, standard deviations and correlations between the variables involved in this study.

From Table 3, it can be seen that the correlation coefficients between the five latent variables are significant. According to Fornell and Larcker (1981), the arithmetic square root of the average variance extracted (AVE) of the latent variables can be compared with the correlation coefficients between the latent variables to test the discriminant validity between the latent variables. Table 3 shows that the arithmetic square root of AVE

TABLE 2 Confirmatory factor analysis (N=296).

Model	χ^2	*df*	χ^2/df	*IFI*	*TLI*	*CFI*	*RMSEA*
Five-factor model	730.687	391	1.869	0.954	0.944	0.953	0.054
Four-factor model	953.110	406	2.348	0.925	0.914	0.925	0.068
Three-factor model	1391.300	408	3.410	0.866	0.846	0.865	0.090
Two-factor model	1855.748	410	4.526	0.802	0.774	0.801	0.109
Single-factor model	1943.748	411	4.729	0.790	0.761	0.789	0.112

Five-factor model: GHRM, GM, GTL, GSE, GB; Four-factor model: GHRM + GTL, GM, GSE, GB; Three-factor model: GHRM + GTL, GM + GSE, GB; Two-factor model: GHRM, GM + GTL + GSE + GB; One-factor model: GHRM + GM + GTL + GSE + GB.

TABLE 3 Mean value, standard deviation and correlation coefficient of each variable (*N*=296).

Variable	Mean	SD	1	2	3	4	
GHRM	3.421	0.444	0.735				
GM	3.292	0.345	0.639**	0.674			
GB	3.328	0.396	0.608**	0.677**	0.737		
GTL	3.497	0.495	0.291**	0.379**	0.292**	0.829	
GSE	3.701	0.425	0.219*	0.283**	0.303**	0.136*	0.773

Square root of AVE values for each variable at the diagonal.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

values for GHRM practice, green mindfulness, employees' green behavior, green transformational leadership, and green self-efficacy are 0.735, 0.674, 0.737, 0.829, and 0.773, respectively, which are higher than the threshold of 0.5 set by Fornell and Larcker. The minimum value of the AVE (0.674) square root is greater than the maximum value of the correlation coefficient between the variables (0.639), indicating that the scale has good discriminant validity.

Hypothesis tests

This study used gender, age, education, years of experience, and job type as control variables. Regarding econometric conventions, four new dummy variables were produced for the job control variables (the original variables were in five categories): administrative jobs, technical jobs, R&D jobs, and production jobs. The base category was other jobs. To test the mediating and moderating effects between the variables, the authors performed regression analysis on the collected data, following Baron and Kenny (1986) steps for testing mediating effects. Hierarchical multiple regressions were used to test the mediating role of environmental commitment and the moderating role of green transformational leadership and green self-efficacy, where M1-M6 denote the six sets of regression analyses performed, respectively. The leftmost column represents the independent variables of the regression model, the top column represents the dependent variables of the regression model, and the results are shown in Table 4.

As seen in Table 4, Model 3 shows that corporate green HRM practices significantly affect employees' green behavior ($\beta = 0.548$, $t = 13.166$, $p = 0.000$); Hypothesis H1 is further verified. Model 1 shows that green HRM practices significantly influence green mindfulness ($\beta = 0.500$, $t = 14.287$, $p = 0.000$). Model 4 shows that employees' green mindfulness significantly influences green behavior ($\beta = 0.780$, $t = 15.594$, $p = 0.000$). Model 6 shows that green transformational leadership significantly influences green behavior ($\beta = 0.315$, $t = 7.367$, $p = 0.000$), and Hypothesis H2 is further verified. According to Model 5, when green HRM practices and green mindfulness are regressed together, the regression coefficient of green mindfulness is significant ($\beta = 0.555$, $t = 8.907$, $p = 0.000$). The regression coefficient of green HRM practice decreased ($\beta = 0.270$, $t = 5.572$, $p = 0.000$), which indicates that there is a partial mediating effect of green mindfulness, and hypothesis H4 is valid. In addition, this study used the bootstrap method to examine the mediating effect of green mindfulness between green HRM and employees' green behavior by setting the bootstrap random sample 5,000 times. The indirect effect coefficient of green mindfulness is 0.278 with a 95% confidence interval (0.187, 0.389), which does not contain 0. This indicates that the mediating effect of green mindfulness between green HRM and employees' green behavior is significant. Thus, hypothesis H4 is further supported.

The moderating effects were tested in Models 2 and 6. The coefficient of the interaction term between green HRM practice and green transformational leadership was significant ($\beta = 0.049$, $t = 3.246$, $p = 0.001$), and the coefficient of the interaction term between green mindfulness and green self-efficacy was significant ($\beta = 0.095$, $t = 4.830$, $p = 0.000$). The results showed that the confidence interval of the interaction term between corporate green HRM practice and green transformational leadership was (0.085, 0.357). Using the bootstrap method with 5,000 sample resets to test the two moderated mediating effects, the confidence interval of the interaction term between green mindfulness and green self-efficacy was (0.282, 0.780), demonstrating that the moderating mediating effect of green transformational leadership was 0.123, SE = 0.048, CI = (0.035, 0.226) and the moderating mediating effect of green self-efficacy was 0.271, SE = 0.085, CI = (0.117, 0.451). Both hypotheses H3 and H5 were supported.

Conclusion and discussion

Research conclusion

Given increasingly severe environmental problems, improving employees' green behavior has gradually become a topic of concern to all sectors of society. This study considers that green transformational leadership and green human resource management practice are two situational factors to predict employees' green behavior, integrates these two factors for the first time, and proposes the synergy between them as a factor in predicting and influencing employees' green behavior. The results show that green transformational leadership and green human resource management practice can predict employees' green behavior independently and in positive synergistic interaction.

TABLE 4 Output of the hierarchical linear model.

Variables	GM		GB			
	M1	M2	M3	M4	M5	M6
Control variables						
Gender	−0.024	0.018	−0.015	0.003	−0.005	−0.016
Age	0.018	−0.017	−0.002	−0.015	−0.002	0.004
Education	0.002	0.006	0.012	0.008	−0.012	−0.014
Organizational tenure	0.054	0.007	0.099	0.043	0.01	0.007
Production	−0.045	0.07	0.037	0.066	0.069	0.061
Administrative	0.013	−0.023	0.041	0.025	0.061	0.095
Technical	−0.054	0.031	−0.021	0.011	0.032	0.052
RD	−0.024	−0.028	0.012	0.003	0.007	0.035
GHRM	0.498***	0.431***	0.548***		0.270***	
GM				0.780***	0.555***	0.612***
GTL		0.138***				0.315***
GHRM*GTL		0.049**				
GSE						0.150***
GM*GSE						0.095***

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

Moreover, this paper further reveals the mediating role of green mindfulness and the regulating role of green self-efficacy.

First, this study found that green transformational leadership and green human resource management practice positively interact with employees' green behavior, which supports the view that "leadership behavior and human resource management practice play a synergistic role." As a set of hard rules and regulations in the organization, green HRM practices influence the organization or work output in collaboration with the "soft factors" (green transformational leadership) in the organization. When green HRM practices and transformational leaders give consistent and encouraging signals about environmental goals and expectations, these signals reinforce the importance of environmental behaviors in employees' minds and motivate them to work more environmentally friendly. Second, this study further found that green mindfulness is intermediary in the interaction between green transformational leadership and green human resource management practice. In other words, green leadership and HRM first promote employees' green mindfulness and then promote employees' green behaviors. Finally, this study found that green self-efficacy plays a positive moderating role in the influence of the interaction between leadership and HRM practices on employees' green behavior. When employees have a high level of green self-efficacy, green transformational leadership and green human resource management practice have a more substantial synergistic effect on employees' green behavior.

Theoretical contributions

First, this study reveals the positive interaction effect of green transformational leadership and green HRM practices on employees' green behaviors, which can help the academic community better understand how the two green-related contextual factors jointly influence environmental behaviors. For a long time, scholars have either focused on the impact of green transformational leadership on employees' green behavior (Graves and Sarkis, 2018) or explored the impact of green HRM practices on employees' green behavior (Zhou and Zhang, 2018) but have neglected the joint role of these two important contextual factors. By revealing the synergistic mechanism of green management on employees' green behavior, this study can bridge the gap between the two fields of green leadership and green HRM and contribute to a comprehensive understanding of the mechanisms that induce green behavior in the workplace.

Second, based on resource conservation theory, this study finds that green mindfulness plays an intermediary role in the interaction between green transformational leadership and green human resource management practice, thus revealing how the two jointly affect employees' green behavior. Although existing studies have used organizational recognition (Shen et al., 2018), a green psychological atmosphere (Dumont et al., 2017), work motivation (Longoni et al., 2018; Zhou and Zhang, 2018), environmental knowledge (Saeed et al., 2019; Fawehinmi et al., 2020) and other variables to discuss the impact of green human resource management on employees' green behavior, the existing research has ignored the role of green mindfulness as an important variable in explaining the impact of green management on employees' green output (Luu, 2019; Shafaei et al., 2020). From the perspective of resource conservation theory, this study examines the internal psychological mechanism of how work resources (green human resource management practice) are transformed into employees' green output (green behavior). Consistent with previous research (Dumont et al., 2017; Luu, 2019; Zhang et al., 2019), green human

resource management indirectly affects employees' green behavior through the "bridge" of green mindfulness, which further enriches and develops the application of green mindfulness in the field of green human resource management.

Third, this study found that green self-efficacy has a significant positive moderating effect on the relationship between green human resource management and employees' green behavior. Previous studies have shown that the interaction between green human resource management and individual factors (such as environmental values and environmental knowledge) has a positive impact on employees' green output (Dumont et al., 2017; Saeed et al., 2019; Hameed et al., 2020). This study explores the effect of green self-efficacy on the differentiation of green human resource management on employees' green behavior. It is found that green self-efficacy is an important contextual variable affecting employees' green behavior. When employees have a high level of green self-efficacy, green human resource management has a stronger effect on green behavior. This study enriches the boundary conditions of green human resource management and further clarifies the conditions under which it is more conducive to promoting employees' green behavior, which has important theoretical significance for enterprises to implement green management.

Practical implications

First, companies should be aware of the key role that green HRM practices play in improving individual environmental performance and subsequent organizational effectiveness. At the managerial level, companies should establish relevant rules and regulations based on green HRM practices, create suitable conditions to develop an atmosphere of environmental responsibility, enhance employees' perception of corporate environmental responsibility, and reduce employees' negative emotions in the workplace while making it easier for them to accept the environmental values advocated by the organization, which helps to generate green behaviors. The HR departments of enterprises can assess the green mindfulness and green self-efficacy of job applicants through relevant tests in the interview process to recruit and select employees with environmental values.

Second, the role of leaders is crucial in the process of enhancing employees' green mindfulness and stimulating their green behaviors because leadership attitudes toward environmental protection are an important factor in promoting employees' green ideas and behaviors. Green transformational leaders attach importance to sustainable development, take sustainable development goals as their guide, and have strong environmental consciousness. Continuously promoting and advocating for a company's environmental protection policies is conducive to enhancing the effectiveness of green HRM practices and promoting the green behavior of employees.

Third, because individuals with high green mindfulness tend to choose green behavior (Barbaro and Pickett, 2016), organizations should attach great importance to green mindfulness. For example, managers should incorporate green mindfulness into the evaluation system for recruitment. In the process of making a green training program, a green mindfulness course should be introduced, and a green knowledge and information sharing platform should be constructed to increase employees' concentration and awareness of their current experience. Opportunities for employees to participate in the formulation of green initiatives should be provided along with various forms of green learning research conferences or forums, and encouragement for employees to put forward green suggestions and problem-solving methods to cultivate green mindfulness.

Finally, in the process of stimulating employees' green behavior, enterprises should not only train green transformational leaders or implement green HRM policies but also consider both aspects (hard and soft) as much as possible to more effectively promote employees' green behavior and the sustainable development of the organization. Specifically, companies need to train leaders in green leadership, improve their knowledge and skills, teach them how to set green examples, motivate employees to be green, and support them in green practices. However, there are limitations to relying solely on the subjective norms of leaders to manage. For example, it is not easy to ensure that every employee will be convinced of the values communicated by the leader. For this reason, companies should also develop a standardized system for green management, such as incorporating environmental issues into the major modules of human resource management, cultivating, motivating and evaluating employees' green performance, and providing institutional safeguards for leaders' green management behavior. By combining green transformational leadership and green HRM practices, we can take advantage of each other's strengths and complement each other's weaknesses to promote green employee management.

Limitations and future research

While this study validates the target findings, it also has certain limitations that need to be addressed in future research. First, this theoretical study only examines the synergistic mechanism between employees' perceived green human resource management practice and green transformational leadership as an influence on green behavior at the individual level. Previous studies have tested the relationship between human resource management practice (Wang and Xu, 2017), green mindfulness (Yu and Zellmer-Bruhn, 2018), responsible leadership (Huang and Xu, 2021) and green behavior at the team level. Future studies can explore the influence of green human resource management practice and green transformational leadership on team green behavior and its mechanism from the team level. Second, this study focuses on the mediating role of green mindfulness, which is only one of the synergistic outputs of green HRM and green transformational leadership. Future research can explore the synergistic mechanism of green human

resource management practice and green transformational leadership by using variables such as green job remodeling (Luu, 2019), green psychological atmosphere (Dumont et al., 2017), environmental knowledge (Fawehinmi et al., 2020) and green psychological capital (Saeed et al., 2019). Third, although it is essential to promote employees' green behaviors to improve the environmental performance of enterprises, it is necessary to further explore whether green HRM practices can improve the environmental performance of enterprises while taking into account economic performance. Suppose this reduces the economic efficiency of enterprises. In that case, it is necessary to integrate the theoretical basis and research findings of related disciplines to achieve an effective balance between environmental and financial performance.

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

ZW collected and analyzed the data. TC framed the introduction and discussion. 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.2022.906869/full#supplementary-material

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Analysis of internal processes of conflict behavior among Iranian rangeland exploiters: Application of environmental psychology

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Conflicts over rangeland exploitation have been a serious challenge in Iran, rooted in human behavior. Accordingly, this study aimed to provide a comprehensive theoretical framework in the field of analyzing conflict behavior among rangeland exploiters. This research is a descriptive-correlational and causal-relational study conducted using a cross-sectional survey. The statistical population of the study was rangeland exploiters in one of the northwest provinces of Iran (N = 66,867) of whom 384 people were selected as a sample and stratified random sampling method with proportional assignment. The research instrument was a questionnaire, the validity of which was confirmed by a panel of academic experts and the reliability of its items was verified using Cronbach's alpha coefficient. The results showed that the variables of personal norms (PN) and the perceived behavioral control were able to predict 25.9% of the variance in terms of the conflicting behavior of rangeland exploiters; besides, ascription of responsibility, PN, perceived behavioral control, and awareness of consequences, which have been proposed as activators of PN, were able to explain a significant percentage (63.5%) of the variance in terms of PN. Furthermore, analysis of the effects of environmental and cultural values showed that conflict behaviors of exploiters were mostly affected by their underlying values. Generally, the results of this study would help in the development of more integrated and comprehensive models in the field of exploiters' conflict behavior. Eventually, to change and improve the environmental behavior of exploiters to better management of conflict in rangelands, providing a list of considerations and competencies for agricultural extension and education, this article comes to the end.

KEYWORDS

conflict behavior, rangeland degradation, norm activation theory, conflict management, environmental psychology

Introduction

Rangeland degradation has turned into one of the most serious environmental issues in the world (Roudgarmi, 2013). Considering the special environmental and population status of Iran, this country, with 90 million hectares of rangeland (Iranian Ministry of Agriculture Jihad, 2019), has not been secured from such degradations over time (Azadi et al., 2009). It has been estimated that over the last three decades, more than 20% of its rangeland has been degraded in terms of quality and quantity (FAO, 2013; Haghiyan et al., 2016); this amount, occurred with greater intensity, is compared to the European and American countries (Haghiyan et al., 2016). A combination of factors, most related to human activities, is usually considered as the cause for this degradation (Harris, 2010; Savari and Gharechaee, 2020). According to FAO statistics, about 30% of the degradations were related to natural changes and effects, whereas about 70% were related to management and human activities (FAO, 2013). Among human factors, the competition in rangeland exploitation might be pointed out (Ubwa, 2018). Throughout history, human societies have had often challenges over the right to exploit natural resources (Green, 2002); in the present era, disputes over the exploitation of resources have reached their peak (Al-Muqdadi, 2019). One of the abnormal behaviors is social impacts in the form of conflict between individuals (McCollum et al., 2010). On the one hand, paying attention to the standards and facilities that human needs for his wellbeing and life has caused the acceleration of the exploitation of rangelands (Hill and Mustafa, 2011); on the other hand, the failure of communities to establish appropriate structures (governance) and preventive strategies for the conflict prevention provides a suitable environment for these conflicts (Collins, 2019). So, the combination of these factors has led to a decrease in the quality and quantity of rangelands (Adeoye, 2017).

These problems are more indicative of the fact that rangeland is a common pool resource (CPR) and could be available to all (Hileman et al., 2016; Haji et al., 2021). CPR is resource that first, the exclusion of stakeholders would be costly in any way (physical/institutional), and second, the exploitation of the resources by one exploiter reduces others' access to them (Alipour and Arefipour, 2020). Hardin (1968) mentions this theorem as a tragedy of commons; "individuals who are sharing a common resource attempt to act in their own benefit, believing that they might obtain worse results than when they act collaboratively" (Blanco et al., 2019). This complex situation of common resources, such as rangeland, would be a platform for competition and conflict between exploiters (Ochola et al., 2010; Apipalakul et al., 2015; Adeoye, 2017). Analysis of different definitions has shown that "conflict" is a social situation, where two or more actors try to have more access to one or more resources at the same time (Veisi et al., 2020). Conflict occurs when the parties to the conflict have incompatible interests, goals, and values and try to achieve those goals (Yang et al., 2013). Environmental conflicts are basically intra-group conflicts that arise over tangible resources, such as water or land (Opotow and Brook, 2003), and they are mostly led to inequalities and social tensions (Selemani, 2014). When environmental contradictions get through a destructive trend, individuals in one group might negate other groups and ignore the ethical considerations (Opotow and Brook, 2003).

Looking deeply into natural resource management literature suggests that in these areas, three main trends can be identified that include economic, technological, and behavioral trends (Bijani et al., 2017; Haji et al., 2020). Many scientists and scholars believe that the discussion about individual behavior is more important than other factors (Steg and Vlek, 2009; Urech et al., 2013; Sadeghi et al., 2017). Hence, to prevent the decrease in the rangeland resources, development and reinforcement of appropriate behaviors among exploiters (as the largest users) seem to be necessary (Yazdanpanah et al., 2014; Haji et al., 2020). Therefore, knowing the way of people thinking, how they perceive about rangelands, their tendency toward different measures in the conservation of rangeland resources, and solving problems and crises related to that, it would be necessary (Katuwal, 2012) that the first step in this direction comes about understanding their current behaviors (Yazdanpanah et al., 2014). In this regard, as a suitable tool for understanding individuals' behavior, environmental psychology and theories in this field of science have a special place in research sources (literature) (Wauters et al., 2010; Bamberg, 2013; Onwezen et al., 2013).

Theoretical background

In the field of environmental psychology, there are usually two main approaches to pro-environmental behavior of individuals which are referred to as the "rational approach" and "moral approach" (Valizadeh et al., 2016). Each approach has its own special advocates who seek justifications to validate different approaches and theories. Rational approach assumes that human behavior is a rational choice situation (Steg and Vlek, 2009); on the contrary, the presupposition of the moral approach considers human behaviors as a moral perspective (Stern, 2000). A situation of rational choice is one in which one's actions have consequences for the others' welfare (Valizadeh et al., 2018a); in other words, theories like the theory of planned behavior (TPB) and theory of reasoned action (TRA) that fall within the domain of rational approach theories ignore moral considerations; besides, these theories mostly focus on the egoistic values (EV) and individualistic values (IV) of individual behavior (Kaiser et al., 2005), while in the next generation theories in the field of environmental psychology, other values have been formed, which, in addition to EV, have also taken into consideration altruistic values (AV), biospheric

values (BV), and collectivistic values (CV) (Pradhananga et al., 2017). Nevertheless, the TPB and TRA lack rigid theoretical foundations in the crystallization of these values in individual behavior (Valizadeh et al., 2018b). This is while, researchers, who assume self-interests as the most important motivator for environmental behavior, mostly have used rational choice models (Bamberg and Möser, 2007; Valizadeh et al., 2018a; Savari and Gharechaee, 2020).

On the contrary, theories such as norm activation theory (NAT) and value-belief-norm theory (VBN) that are part of the theories put forward in the ethical approach, other than considering the AV and BV, take into account the IV either (Harland et al., 2007), but one of the major weaknesses in the theories of this approach is that it does not consider the impact of social relationships on behavior (Valizadeh et al., 2016). These interactions are especially evident in social challenges, such as conflict behaviors over CPRs as to rangelands, because there are many contradictions between "individual and collective" and "short-term and long-term" desires in the real world. This conflict (acting for an individual or collective interests) is generally manifested in the form of two cultural values, which are IV and CV (Valizadeh et al., 2021). Although environmentalist values show the different dimensions of human–environmental interactions, they do not consider human–human interactions (Valizadeh et al., 2016). Despite all available interpretations, the theories of this approach are widely applied in the sphere of environmental psychology; inasmuch as, in these theories, the relationships between the independent variables and the dependent variables of behavior are explained more clearly. Generally, ethical theories are more applicable in the context of various environmental behaviors and in the area of individual and collective behaviors (Kaiser et al., 2005; Harland et al., 2007; Nigbur et al., 2010).

As stated in the theoretical background of the research, to overcome the shortcomings of each of the proposed theories and to increase their prediction power, the present research framework (**Figure 1**) is a developed form of three theories of norm activation (Schwartz, 1977), theory of VBN (Stern, 2000), and TPB (Ajzen, 1991). But, due to the fact that the main dependent variable in this study was the conflict behavior of individuals in rangeland exploitation and the nature of such behaviors was more matched with the goals and nature of the NAT, it was attempted to consider this theory as a basis for conceptualizing the research framework, because the issue of conflict in rangeland exploitation cannot be assessed in ecological analysis without considering the relationship between

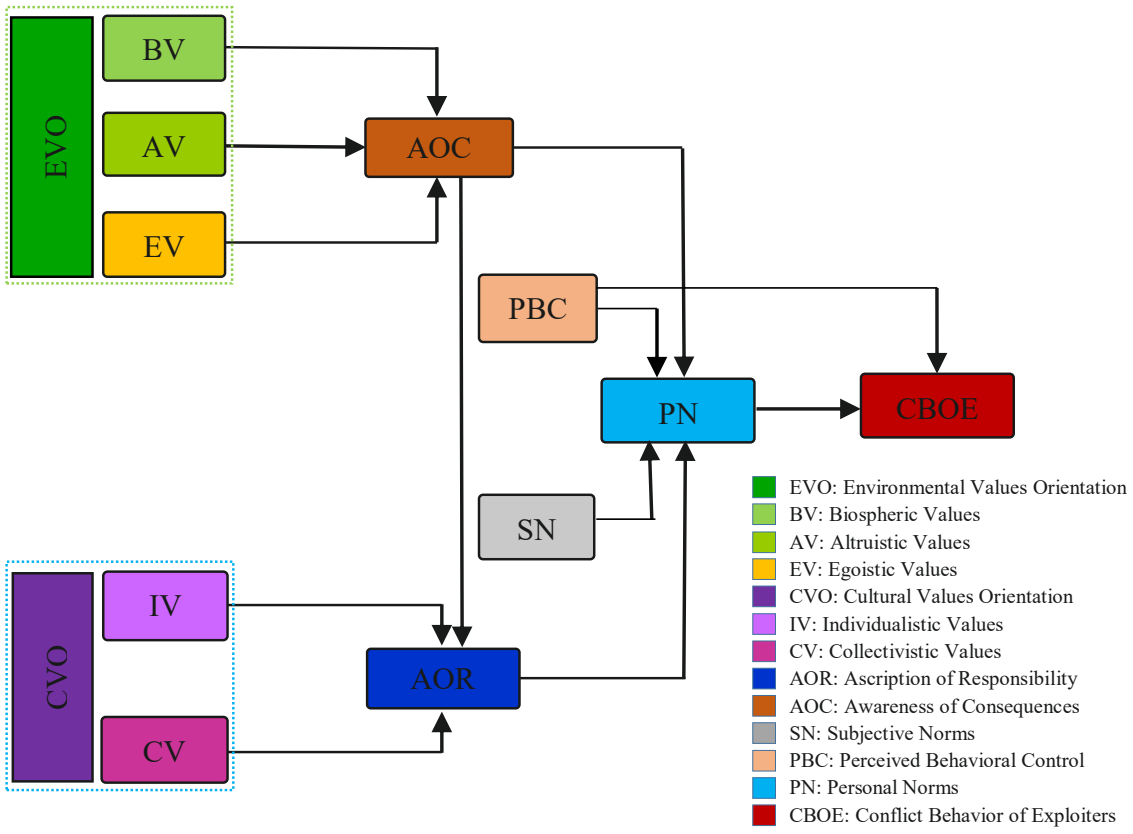

FIGURE 1
Conceptual framework of the study.

human and environment (which is a moral relationship) (Veisi et al., 2020). On the contrary, the moral norm is the core of NAT and the outcome of further conflict behaviors affects the morality of the exploiting community and fellowman (Bijani and Hayati, 2011). In this regard, some of the most important determinants, proposed in various studies as key predictors, were added to the theory of norm activation.

An important presumption of NAT is that personal (moral) norms (PN) are the main predictors of pro-environmental and pro-social (altruistic) behaviors (Klöckner, 2013; Onwezen et al., 2013; Shin et al., 2018). According to the NAT, the variable of PN is considered an immediate variable that affects the conflict behavior of exploiters (CBOE). Schwartz (1977) defines PN as the strong sense of moral commitment that drives individuals to participate in pro-social behaviors (Bamberg and Möser, 2007). According to Schwartz (1977), PN might be activated or deactivated by two belief constructs. These two structures include ascription of responsibility (AOR) and awareness of consequences (AOC) (Abrahamse and Steg, 2013; Lind et al., 2015); in other words, if a person is aware of problems arising from specific behaviors, this awareness would be then followed by his/her own contribution to those problems and the question that whether one can help in solving such problems or not (Abrahamse and Steg, 2013; Lind et al., 2015). In general, if one is aware that his/her behaviors have negative effects on others and also the environment (e.g., AOC), he or she could then feel responsible for those negative effects; so it could be believed that his/her responsible environmental behavior helps the reduction of the environmental problems (e.g., AOR) and consequently activates one's PN (Eriksson et al., 2008; Steg and De Groot, 2010). In other words, an individual's awareness of the problem being the first step toward responsible action, and the degree to which he is aware of solving problems through individuals' behavior, in turn, activates one's personal norm (Davis et al., 2015; Liu et al., 2017). Thus, the above explanations would lead to the following hypotheses:

> **H1:** CBOE will negatively and significantly be affected by PN;

> **H2:** PN will positively and significantly be affected by AOC;

> **H3:** PN will positively and significantly be affected by AOR;

> **H4:** AOR will positively and significantly be affected by AOC.

Other than AOC and AOR, there are other variables that have been considered in various studies as preconditions for PN. In this regard, Bamberg and Möser (2007) have argued that individuals' ability to perform a behavior under their perceived behavioral control (PBC) is effective in the formation of PN. Also, other studies show that PBC can influence CBOE (Pradhananga et al., 2015, 2017; Valizadeh et al., 2021). PBC refers to an individual's ability to successfully perform a behavior (Borges et al., 2014). Based on the NAT, if individuals feel that they have the ability to mitigate the ill effects of a behavior and have access to the resources and potentialities in this regard, then they would show a high level of personal commitment (Schwartz, 1977; Pradhananga et al., 2015). Subjective norms (SN) is defined as a person's understanding of "what others care about?" (White et al., 2009) and "understanding social pressure to the perpetration or not perpetration of a behavior" (Ajzen, 1991). Probably, if individuals understand the importance of the confirmation of that behavior by others, then they would certainly show more commitment to do that (Ajzen, 1991; Wauters et al., 2010). There has been a lot of empirical support in various studies for the predictive effects of PBC and SN variables on the PN variable (Bamberg and Möser, 2007; Klöckner, 2013; Yazdanpanah et al., 2014; Pradhananga et al., 2017). Based on these arguments, the following hypotheses are proposed:

> **H5:** CBOE will negatively and significantly be affected by PBC;

> **H6:** PN will positively and significantly be affected by PBC;

> **H7:** PN will positively and significantly be affected by SN.

There is much evidence for the inclusion of value orientation variables in the NAT. Values act as information filters that enable individuals to selectively accept or follow information (Sarrica et al., 2016; Pradhananga et al., 2017; Valizadeh et al., 2021). According to moral theories, PN are activated by the cognitive structure of individual values and beliefs (Schwartz, 1977). In fact, individuals act in a manner that is correspondent with their values (Klöckner, 2013; Sarrica et al., 2016); besides, it seems that various conflicts and disagreements over resources, such as rangelands, are mainly more related to the conflict of values than to rangeland's resources (Valizadeh et al., 2021). To understand the environmental values of individuals, different frameworks and models have been used by researchers (Schwartz, 1977; Stern, 2000; Corral-Verdugo et al., 2006; Valizadeh et al., 2016), but the commonality of all is the "value diversity" that exists among different individuals in a community for resource valuation, such as rangeland (Valizadeh et al., 2021). These value orientations include environmental values (AV, BV, and EV) and cultural values (IV and CV) (Pradhananga et al., 2017).

Many scholars have confirmed the existence of a relationship between values, AOR, and AOC (Gärling et al., 2003; De Groot and Steg, 2009; Bijani and Hayati, 2013; Ives and Kendal, 2014; Pradhananga et al., 2017; Valizadeh et al., 2018a, 2021). Accordingly, in this study, there has been an attempt to indirectly relate environmental and cultural values to the conflicting behavior of rangeland exploiters through the AOR and AOC variables (**Figure 1**). Based on this, the following hypotheses are proposed:

> **H8:** AOC will positively and significantly be affected by BV;

> **H9:** AOC will positively and significantly be affected by AV;

> **H10:** AOC will negatively and significantly be affected by EV;

> **H11:** AOR will negatively and significantly be affected by IV;

> **H12:** AOR will positively and significantly be affected by CV.

According to the literature, it became clear that although there have been limited studies related to conflict behavior in Iran (Bijani and Hayati, 2013; Mohammadinezhad and Ahmadvand, 2020; Veisi et al., 2020), most of them have been in the field of water resources. Therefore, to the best of our knowledge, no comprehensive research has been conducted on conflict behavior in rangeland exploitation. Also, this study has tried to provide an integrated model of conflict behavior for its better management.

Research methodology

Research design

This study is an applied research in terms of its objective. This is because the results and recommendations of this research might be used by various stakeholders, such as managers of natural resources, watershed managers, managers of agricultural organizations, ranchers, and farmers. In addition, this study is a survey and cross-sectional study in terms of data collection, and time and quantitative research in terms of its nature, which follows the positivism paradigm. It is descriptive and causal-relational in terms of data and information analysis methods. Also, it is a field study in terms of monitoring and controlling variables to examine all variables in natural conditions.

Study area

This research was carried out in West Azerbaijan Province, located in the northwest of Iran (**Figure 2**). Regarding the rural economy in West Azerbaijan Province, it should be noted that the rural economy of this province is mostly based on agriculture and animal husbandry. Rangelands constitute 60% of West Azerbaijan province, which play an important role in the economy and livelihood of rural households and exploiters. However, only 21% of the rangelands in the province are rich and have a high density. Statistics show that due to natural and human factors, 181,000 ha of the province's natural areas have been turned into desert. Natural factors include climate change, reduced rainfall, and droughts, and the human factors include unprincipled exploitation, mining, local conflicts, rangeland plowing, bushes' elimination, livestock increase, and excessive and unprincipled grazing, such as early spring grazing and non-compliance with the capacity and time of livestock arrival (West Azarbaijan Agricultural Jihad Organization [WAAJO], 2019).

Statistical population and sampling method

The statistical population of the study consisted of all rangeland exploiters in West Azerbaijan Province, Iran (N = 115,066). Then, the studied area was divided into three parts, northern, central, and southern, and two counties were selected from each part (N = 66,867). Due to the fact that these counties were different in terms of the number of exploiters, the main sample size was divided between them in proportion to the volume. Using Krejcie and Morgan sampling table (Krejcie and Morgan, 1970) and a stratified random sampling approach, 384 exploiters were selected as the study sample. For sampling, a stratified random sampling method with proportional assignment was used (**Table 1**). The sample included respondents with a wide variety of social and demographic backgrounds. Also, all participants in the process of data collection were volunteers.

Survey instrument

A survey study was used to investigate and analyze the behavior of exploiters' conflict in the use of rangelands. The research instrument was a researcher-made questionnaire (inspired by other researchers), whose validity was confirmed by a panel of experts. Cronbach's alpha coefficients were used to determine the reliability. For this purpose, a pilot study, which included 30 ranchers, was conducted in an area outside the study area. **Table 2** shows the research variables and the values of Cronbach's alpha coefficients for each of them. Based on this coefficient, the reliability of the research instrument

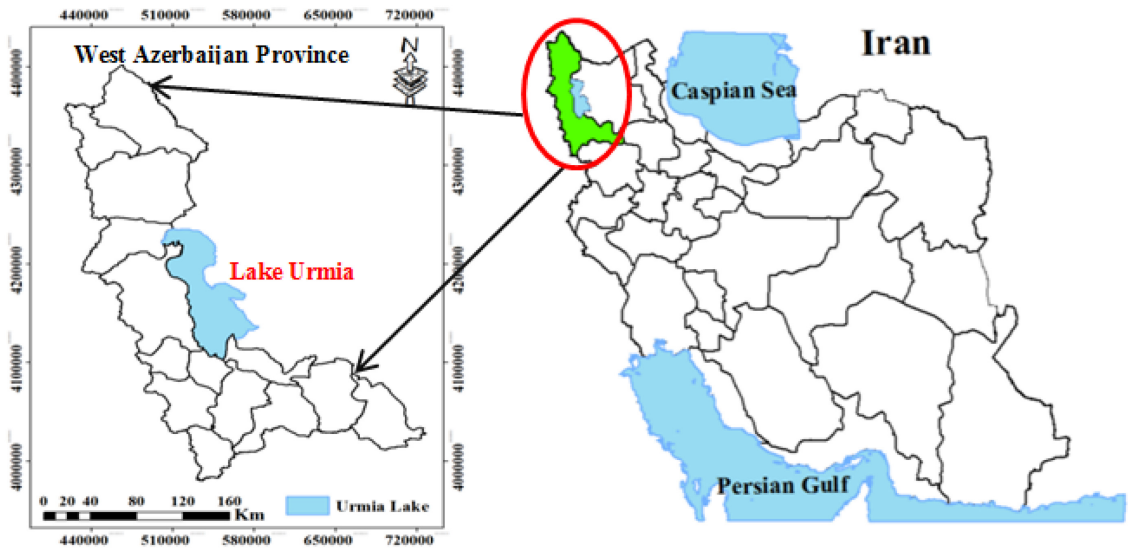

FIGURE 2
Site of the study area.

was between acceptable and good ($0.74 \leq \alpha \leq 0.89$). After the pilot study and making the necessary revisions to the research tool, a questionnaire was prepared for the main survey phase. The questionnaire consisted of three parts, the first part was allocated to introducing the research title and objective, and the second part was related to the demographic characteristics of the respondents. Finally, the third section was related to the main variables in the theoretical framework (Figure 1) and the items for measuring each variable (Table 2). To assess and score the dependent variable (conflict behavior), a five-point Likert scale from 1 (never) to 5 (always) was used. Also, a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree) was used to assess and score the independent variables.

Data collection and analysis

To reflect the views of rangeland exploiters, the data used in this study were collected through a questionnaire in West Azerbaijan province over a period of time (September–October 2020). The face-to-face method was used to collect survey data. Since the studied area and community had people with different cultures, languages, and customs, an interview group was formed before collecting data. This group consisted of five individuals who were fully acquainted with the culture, language, and customs of the local people. Since most interviewees had minimal education, in rare cases, the group of interviewers translated the questions for them during the face-to-face survey. After the briefing session with the interviewers, the research data were collected. At the end of data collection, from a total of 384 distributed questionnaires, 10 were excluded due to inappropriate and inadequate data; eventually, 374 questionnaires were analyzed using $SPSS_{22}$ software. The data analysis was carried out in two parts. In the first part, which included demographic information, descriptive statistics [frequency, percentage, mean, and standard deviation (SD)] were used. In the second part, inferential statistics (Pearson's correlation and multiple regression analysis) were used to analyze the relationships between variables. Also, path analysis was used to analyze the correlation decomposition between the variables and examine the direct and indirect effects of the variables.

TABLE 1 West Azerbaijan rangeland exploiters and selected samples.

Parts	County	Population size	Sample size
North	Maku	8,500	49
	Khoy	14,755	85
Central	Urmia	19,424	111
	Naghadeh	3,905	22
South	Piranshahr	16,318	94
	Bukan	3,965	23
	Total	66,867	384

Statistical Annual of West Azer baijan Province [SAWAP] (2018).

Results and discussion

Descriptive analysis

Analysis of descriptive data showed that respondents were aged 17–71 years, and their mean age was 42 years (SD = 12.32).

TABLE 2 Survey items and Cronbach's alpha coefficients.

Variables	Items	Source
Conflict behavior of exploiters	**CBOE: conflict behavior of exploiters (α = 0.81)**	
	1. I do everything to get my share of the rangeland.	Veisi et al., 2020
	2. I have differences with government officials regarding how to manage the rangeland.	Veisi et al., 2020
	3. If possible, I will not allow other exploiters to access rangelands' resources.	Bijani and Hayati, 2013
	4. If I do not get my share of rangeland exploitation, even if I am fined or imprisoned, I oppose the rangelands' management and conservation.	Veisi et al., 2020
	5. If the natural resources department does not solve my problem, I will solve it personally.	Veisi et al., 2020
	6. I do not cooperate with community members to conserve rangeland resources.	Pradhananga et al., 2017
	7. I follow the laws related to rangeland conservation.	Self-administered
Personal norms	**PN: personal norms (α = 0.86)**	
	1. My personal values encourage me to consider the rights of others when using rangeland.	Shin et al., 2018
	2. I feel morally committed to preserving rangelands, no matter what others do.	He and Zhan, 2018
	3. When I participate in rangelands conservation activities, I feel I am a better (good) person.	Yazdanpanah et al., 2014
	4. I am committed to doing anything that can help reduce the vulnerability of rangelands.	Valizadeh et al., 2016
	5. Due to my own values and principles, I feel obligated to behave in a manner compatible with the environment.	Onwezen et al., 2013
Subjective norms	**SN: subjective norms (α = 0.74)**	
	1. People around me (my surroundings) want me to give up my interests when using the rangeland.	Self-administered
	2. When I participate in rangeland conservation activities, people around me will approve of me.	Yazdanpanah et al., 2014
	3. People around me believe that participation in rangeland conservation is a good job.	Yazdanpanah et al., 2014
	4. Friends and acquaintances want me to do whatever I can do to prevent rangeland degradation.	Self-administered
Perceived behavioral control	**PBC: perceived behavioral control (α = 0.89)**	
	1. I can easily participate in rangeland conservation activities.	Yazdanpanah et al., 2014
	2. I have the resources, time, knowledge, opportunities, and skills for rangeland conservation.	Pradhananga et al., 2017
	3. I am sure, I can put aside my interests when using the rangelands.	Shin et al., 2018
	4. I have the ability to change the way I use rangelands to conserve it.	Pradhananga et al., 2017
Awareness of consequences	**AOC: awareness of consequences (α = 0.84)**	
	1. I know that disputes over the use of rangeland can make the environment worse.	Shin et al., 2018
	2. Lack of optimal use of rangeland resources has caused a large migration of ranchers.	Valizadeh et al., 2016
	3. Lack of conservation of rangeland has been faced serious problems for the exploiters' livelihood.	Valizadeh et al., 2016
	4. The negative consequences of the lack of rangeland resources in the future will be more worrying than we think.	Onwezen et al., 2013
Ascription of responsibility	**AOR: ascription of responsibility (α = 0.86)**	
	1. The local government (i.e., county, town/district) is responsible for maintaining rangeland quality.	Pradhananga et al., 2017
	2. Everyone must take responsibility for the environmental problems caused by the use of rangelands.	Shin et al., 2018
	3. It is the duty of the exploiters to conserve the rangelands, and the government alone is not responsible for it.	Valizadeh et al., 2016
	4. The current problems related to rangeland management are due to the incompetence of managers and have nothing to do with us exploiters.	Valizadeh et al., 2016
Environmental values	**BV: biospheric values (α = 0.85)**	
	1. Rangeland resources do not belong only to ranchers and farmers (humans), but must be consumed by other creatures (animals) that live in the rangelands.	Bijani and Hayati, 2013
	2. Rangeland vegetation should be preserved and people should not use it.	Bijani and Hayati, 2013
	3. Environmental protection and development have priorities over its use.	Bijani and Hayati, 2013
	4. I preserve rangelands for their intrinsic value.	Pradhananga et al., 2017
	AV: altruistic values (α = 0.84)	
	1. We do not have the right to think about rangeland conservation in a situation where rangeland exploiters are in difficult economic conditions.	Bijani and Hayati, 2013

(Continued)

TABLE 2 (Continued)

Variables	Items	Source
	2. Since human beings are the supreme creature, meeting their needs is a priority.	Bijani and Hayati, 2013
	3. To rangelands optimal use, it is better that the exploiters pursue their interests less.	Valizadeh et al., 2016
	4. I preserve rangelands for the welfare of human beings.	Pradhananga et al., 2017
	EV: egoistic values (α = 0.73)	
	1. The rangelands and their exploitation belong only to me and others have no right.	Bijani and Hayati, 2013
	2. In using rangelands, I do not pay attention to the needs of others.	Bijani and Hayati, 2013
	3. The rangeland must first meet my needs and then its benefits reach the rest.	Bijani and Hayati, 2013
	4. It is only to meet my personal needs that I think of protecting rangelands.	Pradhananga et al., 2017
Cultural values	**IV: individualistic values (α = 0.75)**	
	1. In the exploitation of rangelands, I only follow my own personal goals, even if these goals are in conflict with the overall goals of society.	Pradhananga et al., 2017
	2. I would like to use and exploit rangelands in a way different from others.	Pradhananga et al., 2017
	3. The use of rangelands is a personal action and in this regard, I do not need to interact and cooperate with others.	Pradhananga et al., 2017
	CV: collectivistic values (α = 0.86)	
	1. I consider myself a part of the society I live in.	Pradhananga et al., 2017
	2. I have good cooperation and collaboration with people in different fields.	Pradhananga et al., 2017
	3. In trying to solve environmental crises, I try to adapt to the norms accepted by society.	Pradhananga et al., 2017

In terms of gender, 21 respondents (5.6%) were female and 347 respondents (92.8%) were male. The findings of education level in this study showed that 38 (10.2%) of subjects had academic education. In addition, descriptive findings showed that respondents had a minimum and a maximum of 2 and 55 years of experience in animal husbandry and the average livestock experience of subjects was 17.07 years (SD = 9.83). The investigation of individuals' dependence on livestock showed that 73.5% of them had livestock dependence and had no other source of income. Regarding family members, the findings showed that 64% of the respondents were five or more. About 57% of ranchers had light livestock. Approximately 88% of people have experienced some kind of conflict (superficial to deep) in the last three years. Meanwhile, about 14% stated that the quality of the rangelands they use is in a good condition (44% is bad). Approximately 67.5% of them had not attended any rangeland conservation training classes. Also, about 13% believed that the government has more competence to manage, control, monitor, conserve, and exploit rangeland resources. Examining the results of descriptive statistics clearly can pave the way for conflicting behaviors among exploiters.

To obtain a qualitative description of the conflict behavior variable and classify respondents in terms of conflict behavior in rangeland exploitation, the interval standard deviation from mean (ISDM) method was used. This method is one of the popular choices for qualitative description of research variables (Alipour Amir et al., 2021). In ISDM method, the scores obtained are divided into four levels as follows (Table 3). The results showed that the rate of conflict behavior of 19.8% of exploiters was low, 21.4% of them were moderate, 22. 2% was high, and 36.6% was very high. The results of Table 2 state about 60% of people had obvious conflict behavior over rangelands exploitation.

Based on the results of this study, there are significant conflicts among rangeland's exploiters in Iran. One of the main reasons for such a condition could be rooted in the rangeland management. Iranian rangelands came under the ownership and management of the government after the law on nationalization of forests and rangelands in 1963. This led each of the exploiters somehow engage in competition for maximum use of the rangelands, causing their destruction. It is obvious that in these conditions, no one will be held responsible for the current situation. On the contrary, according to a survey, only a limited percentage believed in public management of rangelands. Therefore, it is clear that such conditions will affect individuals' behavior, and the type and extent of rangeland exploitation.

Assessment of the relationships among variables

Pearson's correlation test was used to investigate the relationships between variables (Table 4). According to the NAT, in which PN are the only variable that is directly related to

TABLE 3 Classifying the extent of conflict behavior of exploiters.

A < mean − SD	A < 25.64	Low	19.8%
Mean − SD < B < mean	25.64 < B < 28.17	Moderate	21.4%
Mean < C < mean + SD	28.17 < B < 30.70	High	22.2%
Mean + SD < D	C > 30.70	Very high	36.6%

TABLE 4 Correlation matrix of the theoretical framework variables.

	CBOE	PN	SN	PBC	AOC	AOR	BV	AV	EV	IV	CV
CBOE	1										
PN	−0.488**	1									
SN	−0.416**	0.624**	1								
PBC	−0.395**	0.534**	0.728**	1							
AOC	−0.517**	0.748**	0.616**	0.638**	1						
AOR	−0.578**	0.728**	0.568**	0.558**	0.805**	1					
BV	−0.429**	0.474**	0.694**	0.804**	0.546**	0.557**	1				
AV	−0.426**	0.396**	0.637**	0.818**	0.513**	0.483**	0.821**	1			
EV	0.613**	−0.581**	−0.536**	−0.574**	−0.665**	−0.604**	−0.498**	−0.500**	1		
IV	0.641**	−0.727**	−0.595**	−0.587**	−0.731**	−0.669**	−0.518**	−0.490**	0.804**	1	
CV	−0.439**	0.775**	0.639**	0.672**	0.783**	0.771**	0.577**	0.488**	−0.665**	−0.719**	1

CBOE, conflict behavior of exploiters; PN, personal norms; SN, subjective norms; PBC, perceived behavioral control; AOC, awareness of consequences; AOR, ascription of responsibility; EV, egoistic values; BV, biospheric values; AV, altruistic values; IV, individualistic values; CV, collectivistic values.
**Significant level: 0.01 error.

behavior, this variable was directly related to behavior in this study (Figure 1), and the results showed that this variable has a negative and significant correlation with the CBOE ($r = -0.488$; $p < 0.01$). Based on this finding, it can be concluded that although exploiters are in conflict with each other over the use of rangeland, nevertheless, their moral commitment to the environment and other human beings reduces the conflict behavior. This result is consistent with Schwartz's presumption (Schwartz, 1977) (that PN are the main predictor of altruistic behaviors) and has also been supported by empirical studies (Harland et al., 2007; Pradhananga et al., 2015; Valizadeh et al., 2021). On the contrary, according to the stated theoretical presuppositions, the four variables of the AOR, SN, PBC, and AOC are considered as the main drivers of PN (sense of moral commitment). Analysis of correlation relations in this section showed that all four variables of the AOR ($r = -0.578$; $p < 0.01$), SN ($r = -0.416$; $p < 0.01$), PBC ($r = -0.395$; $p < 0.01$), and AOC ($r = -0.517$; $p < 0.01$) have a negative and significant correlation with the CBOE. Among these, the values of correlation coefficients of the variables of AOC and AOR were higher than the other two variables, respectively. This indicates that these two variables are probably more capable than the other variables of activating PN. This finding shows that awareness of the consequences of conflict among exploiters, as well as their responsibility in relation to society and the environment, can reduce individuals' conflict behavior.

VBN and NAT theories and the results of some empirical studies have emphasized the indirect effect of environmental values (BV, AV, and EV) and cultural values (IV and CV) on an individual's behavior (Stern, 2000; Ives and Kendal, 2014; Pradhananga et al., 2017; Valizadeh et al., 2021). In this study, cultural values and environmental values were indirectly related to conflict behavior in the rangeland exploitation through the AOR and AOC variables. The findings from the correlation of dual cultural values with the AOR showed that variables of IV ($r = -0.669$; $p < 0.01$) and CV ($r = 0.771$; $p < 0.01$) are correlated with the AOR in the field of rangeland exploitation. As expected, BV ($r = 0.546$; $p < 0.01$) and AV ($r = 0.513$; $p < 0.01$) had a positive and significant correlation with the AOC in the field of rangeland exploitation, and the variable EV had a negative and significant relationship with AOC ($r = -0.665$; $p < 0.01$). The contradiction between EV and AOC can be argued from the aspect that economic motivation is more important in the exploitation of rangeland, and this portrays a kind of human selfishness. As a result, this issue has caused exploiters to have distanced themselves from the principles of environmental sustainability and do not pay attention to the consequences of rangeland resource's lack. This result highlights a competitive feature in the face of rangeland resource scarcity.

The analysis of causal relationships among variables

The results of multiple regression analysis showed that the causal model of the study was able to predict 25.9% of the variance in CBOE, 63.5% of the variance in PN, 61.9% of the variance in the AOR, and 50% of the variance in AOC (Table 5 and Figure 3). To facilitate the calculations related to path analysis, the theoretical framework of the research was first divided into four parts (sub-models), and in the next step, multiple regression analysis (ENTER) was used. In the first stage of causal analysis (the first sub-model), the direct effect of the variable of PN (moral commitment) and the PBC on CBOE was examined. The theoretical framework of this research is basically based on the NAT of Schwartz (1977), and in this theory, the PN (personal commitment) of the individual is considered one of the most important determinants of behavior. On the contrary, it is clear that the ability of individuals to control their behavior has a significant

TABLE 5 Calculation of direct effects on CBOE, PN, AOR, and AOC.

	Independent variables	*B*	Beta (β)	*T*	Significant *T*
Direct effects on the CBOE	Constant	35.289	–	53.626	0.001
	PBC	−0.248	−0.189	−3.58	0.001
	PN	−0.573	−0.387	−7.33	0.001
	Significant $F = 0.001$	$F = 66.250$	$R^2_{Adj} = 0.259$	$R^2 = 0.263$	$R = 0.513$
Direct effects on the PN	Constant	1.144	–	3.336	0001
	AOC	0.345	0.381	6.613	0.001
	PBC	−0.072	−0.081	−1.662	0.097
	SN	0.359	0.272	5.659	0.001
	AOR	0.297	0.313	5.858	0.001
	Significant $F = 0.001$	$F = 163.010$	$R^2_{Adj} = 0.635$	$R^2 = 0.639$	$R = 0.799$
Direct effects on the AOR	Constant	1.729	–	5.969	0001
	AOC	0.766	0.805	26.143	0.001
	Significant $F = 0.001$	$F = 683.465$	$R^2_{Adj} = 0.647$	$R^2 = 0.648$	$R = 0.805$
Direct effects on the AOC	Constant	16.425	–	15.377	0.001
	BV	0.353	0.247	3.800	0.001
	AV	0.073	0.052	0.792	0.429
	EV	−0.838	−0.516	−12.014	0.001
	Significant $F = 0.001$	$F = 125.579$	$R^2_{Adj} = 0.500$	$R^2 = 0.505$	$R = 0.710$
Direct effects on the AOR	Constant	8.106	–	6.863	0.001
	IV	−0.380	−0.238	−5.179	0.001
	CV	0.748	0.600	13.052	0.001
	Significant $F = 0.001$	$F = 304.318$	$R^2_{Adj} = 0.619$	$R^2 = 0.621$	$R = 0.788$

CBOE, conflict behavior of exploiters; EV, egoistic values; BV, biospheric values; AV, altruistic values; IV, individualistic values; CV, collectivistic values; AOR, ascription of responsibility; AOC, awareness of consequences; SN, subjective norms; PBC, perceived behavioral control; PN, personal norms.

impact on the occurrence and non-occurrence of a behavior. Perceived ability to reduce risks refers to individuals' beliefs about their ability to act and reduce the adverse effects of a behavior (Yazdanpanah et al., 2014). So that, if people have enough knowledge, skills, and information, they can better take steps to protect rangelands and use them optimally, thus reducing conflicts over the use of rangeland resources. Of course, according to the theoretical framework of the research, the results showed that the CBOE is more influenced by PN, which means that the variable of PN has a significant role in reducing conflict behavior among exploiters. As in the research framework evident, PN (personal commitment) is rooted in the variables of AOR, AOC, SN (directly), and cultural and environmental values (indirectly). The output of the results showed that PN ($\beta = -0.387$; $p < 0.001$) and PBC ($\beta = -0.189$; $p < 0.001$) in the field of rangeland exploitation have a negative and significant effect on the conflicting behavior of exploiters. This indicates that the more the sense of commitment and PBC of individuals in the exploitation of rangelands, the less the conflict behavior will be among them. This is supported by the findings of other researchers (Stern, 2000; Harland et al., 2007; Pradhananga et al., 2015).

In the second stage of path analysis (second sub-model), the effects of PN activators (AOR, SN, PBC, and AOC) on the moral commitment of exploiters were examined. The results of this section showed the three activators of the AOR ($\beta = 0.313$; $p < 0.003$), SN ($\beta = 0.272$; $p < 0.001$), and AOC ($\beta = 0.381$; $p < 0.001$) have positive and significant effects on PN, but PBC ($\beta = -0.081$; $p < 0.097$) had no significant effect on the PN. According to the findings of this stage, AOC had a positive relationship with PN and was one of the most important activators of PN. This indicates that providing information about adverse environmental consequences of rangelands and their impact on the quality of exploiters' life is likely to reinforce pro-environmental norms (personal commitment). As the descriptive statistics show, most of the exploiters have low education and this leads to the impossibility of using the sources of information about the crises that affect rangelands. Also, the research results showed that the AOR has a positive effect on the exploiters' PN. So that if people feel responsible for the rangelands, their moral commitment will increase and they will try to better preserve the rangelands; consequently, they show less conflict. One of the main reasons for the conflict and the destruction of rangelands is individuals' irresponsibility. So in the conservation of rangelands, most exploiters consider the government as the only organization responsible for this. If they do not take responsibility for the existing problems of the rangelands and consider all

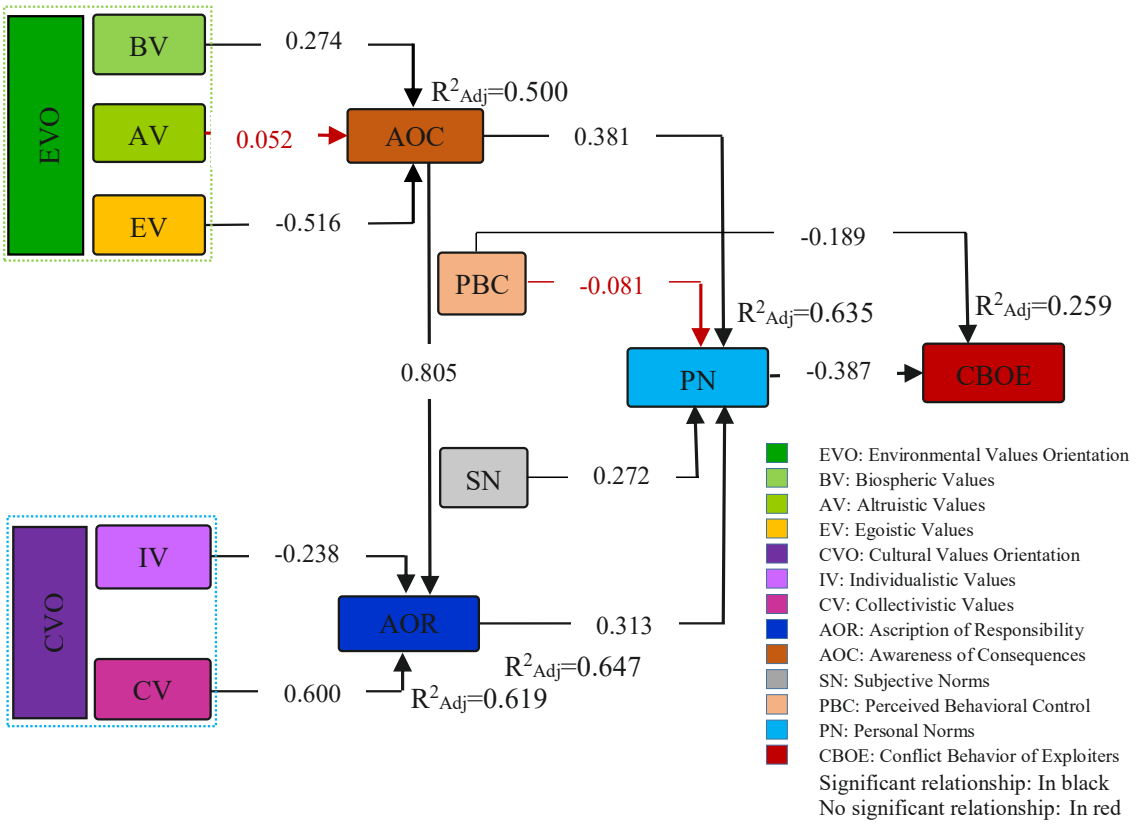

FIGURE 3
The causal research framework.

the problems to be due to mismanagement of officials, the possibility of activating their moral commitment to play a role in reducing the adverse effects of the rangeland crisis will be reduced. Finally, regarding the effect of SN on PN among exploiters, it should be noted that social pressures in the form of SN can activate the moral commitment of individuals and thus reduce their conflicting behavior. The requirement of such SN also depends on the context or social environment of the exploiters and their attitudes and beliefs. The social environment through social pressure can reinforce the sense of moral commitment to preserve rangelands. Pradhananga et al. (2015, 2017), and Valizadeh et al. (2021) report similar results in their research and conclude that the three variables of AOR, SN, and AOC have positive and significant effects on the PN in the field of water conservation behavior. However, their results in terms of the effect of PBC on behavior are not consistent with the results of this study. The unique circumstances of the subjects and the nature of the study regarding the insignificance effect of PBC on PN can be justified. Therefore, this assumption should not be generalized to all communities. Sometimes, people have somehow moral commitment to the environment and communities; however, due to a set of factors (mostly profit motives), they cannot adhere to ethical issues (inability to control behavior).

In the third stage of path analysis, the effects of three environmental values (BV, AV, and EV) on AOC were examined and the findings showed that BV and EV significantly affected the AOC. Meanwhile, BV ($\beta = 0.247$; $p < 0.001$) positively and EV ($\beta = -0.516$; $p < 0.001$) negatively affected the AOC. The results of the previous studies (Pradhananga et al., 2017; Veisi et al., 2020; Valizadeh et al., 2021) support this finding, but the effect of AV on the AOC was not significant.

In the fourth stage, the effects of dual cultural values (IV and CV) on the AOR among exploiters were examined. The results of this stage of the causal analysis indicated that IV ($\beta = -0.238$; $p < 0.001$) had a negative and significant effect and CV ($\beta = 0.600$; $p < 0.001$) positively and significantly affected the AOR. Pradhananga et al. (2017) reported a similar result in their study.

In the third and fourth stages of path analysis, the variables of AOC and AOR were assumed as mediating variables between environmental values and cultural values with PN, respectively. The results of the causal relationship analysis showed that the two environmental values (BV and EV) had a significant contribution to explaining the

AOC (0.50%). Also, cultural values (IV and CV) had a significant contribution to explaining the AOR (61.9%). This is important in these respects that two variables of AOC and AOR are the main determinants of the personal commitment of individuals for engagement in rangelands' resource exploitation activities. It is obvious that individuals have diverse values and act accordingly. For example, individuals with CV, BV, and AV in rangeland conservation programs may focus on environmental and community benefits and emphasize the conservation of rangeland resources as a collective responsibility. In contrast, individuals with egoistic and IV, only if they believe their personal interests are threatened, feel a sense of personal commitment (Stern, 2000). Therefore, these people will better respond to programs that offer special benefits. Finally, the effects of AOC on AOR were examined. The results of this step showed that AOC ($\beta = 0.805$; $p < 0.001$) has a positive and significant effect on AOR.

Correlation decomposition among research variables

To create a suitable context for understanding the relationships and causal mechanisms among the main variables of the research, the correlation values (r) and the standardized impact coefficients (β) were linked using correlation decomposition (Table 6). In this context, it should be noted that the PN variable had no indirect effect since it directly affected on CBOE. While the PBC variable had a direct effect on CBOE and its indirect effect was not significant. Also, environmental values (BV, AV, and EV) and cultural values (IV and CV), AOR, SN, and AOC were indirectly related to CBOE and had no direct effects. Calculation of indirect effects showed that the variables of AOC [$(0.804 \times 0.313) \times (-0.387) + (0.381) \times (-0.387) = -0.244$], AOR [$(0.313) \times (-0.387) = -0.121$], and SN [$(0.272) \times (-0.387) = -0.105$] had the most indirect effects on CBOE. The total (causal) effects also indicated that the variables of PN (−0.387), AOC (−0.224), PBC (−0.158), AOR (−0.121), and SN (−0.105) had the highest causal effects, respectively. It can be concluded that based on the literature and framework provided in this study, although the variables of AOC, AOR, and SN did not directly affect the CBOE, their total effects indicate their key and determining role in the occurrence and explanation of the behavior. Therefore, strengthening these variables among exploiters can minimize the conflict over the use and competition of rangelands among them.

TABLE 6 Analysis of direct, indirect, and total effects of the variables on conflict behavior of exploiters.

No.	Variables	Direct effects	Indirect effects	Total effects
1	PN	−0.387	–	−0.387
2	SN	–	−0.105	−0.105
3	PCB	−0.189	0.031	−0.158
4	AOC	–	−0.244	−0.244
5	AOR	–	−0.121	−0.121
6	BV	–	−0.067	−0.067
7	AV	–	−0.012	−0.012
8	EV	–	0.026	0.026
9	IV	–	0.028	0.028
10	CV	–	−0.072	−0.072

Conclusion and managerial recommendations

As mentioned, various stakeholders are involved in the use and exploitation of rangelands. On the contrary, it should be noted that rangelands are part of CPRs and their use has caused problems and issues for exploiters. Accordingly, this issue has created conflicts among exploiters as the main and most important stakeholders. Therefore, this research sought to determine what factors and processes affect the occurrence of conflict behavior by exploiters. So that identifying the causes and predispositions or backgrounds of conflict behavior can be useful in people's understanding and thus trying to resolve conflict. One of the original contributions of this research was that in the field of conflict behavior in rangeland exploitation, special attention should be paid to behavioral and cognitive-social dimensions other than technical dimensions. For this purpose, in this study, the use of environmental psycho-social models that examine the relationship between humans and the environment can be useful and action guides for managers in this field.

Based on the framework provided in this study, which was based on the NAT and with contributions of VBN and the TPB, the research results showed that the structures of environmental psychology theories create a suitable framework for explaining conflict behavior in rangeland exploitation. In other words, the framework used in this study leads to the development and expansion of understanding in the field of complex interactions that exist between cognitive-behavioral variables of rangeland use. In the NAT, the sense of moral commitment of the individual had been raised as the most important and powerful variable in predicting behavior, which was the same in this study. The results showed that this variable alone could predict a significant share of variance changes in rangeland exploiters' conflict behavior.

In addition, AOR, SN, and AOC variables were considered the main actuators for PN based on the rationale stated in the theoretical literature and they were able to predict the acceptable variance changes in terms of PN. On the

contrary, the results of this study showed that to explain the conflict behavior in the rangelands' exploitation (which is a kind of egoistic and individualistic behavior) and to make appropriate behavioral changes in reducing conflict and conserving rangelands, attention should be first paid to the value foundations (environmental and cultural) of the rural community and then to the exploiters' moral commitment (PN), which is the strongest motivator and driver for their behavior. The results of this study provide practical implications for managers of forests, rangelands and watershed management organizations, environmental conservation managers, natural resources officers, intervention organizations, and even ranchers or exploiters themselves to be able to help achieve sustainability in the field of natural resources, especially rangelands. In addition, these findings can be considered by other countries (especially Iran's neighbors) that have a similar situation to Iran, because the continuation of this situation can also affect the international situation. The importance of psychological and cognitive dimensions in the field of rangeland resource management and exploitation emphasizes the need to pay attention to these variables and determinants. In this regard, a list of considerations and competencies of agricultural extension and education to change and improve the environmental behavior of different stakeholders and thus manage the conflict among them (especially exploiters) is presented:

- Given the special cultural conditions of the community as well as the quality of rangelands in different regions, authorities are suggested to pay sufficient attention to private and participatory rangeland management. In this regard, the use of successful experiences toward local communities' governance in natural resources management can be useful. Iran has different regional cultures. Thus, cultural and value differences affect people's relationships with each other and with the environment. This increases the conflict over rangeland exploitation. On the contrary, rangeland management has been centrally owned by the government since 1963. Therefore, to better manage rangelands and consequently manage the conflict among exploiters, the management structure governing rangelands should be reformed and improved. Therefore, reduction of the transfer of responsibility and management of rangelands to the local level is suggested. For example, the establishment of organizations, such as rangeland cooperatives, can be very useful in the participatory management of local communities. Of course, applying this recommendation to other countries that have similar conditions to Iran can also be considered.
- Policymakers and managers, whose goal is to preserve and rehabilitate rangelands and their sustainability, should focus on those strategies that promote ethics and institutionalize it among the general public, especially the exploiters. Extension agents could be the best actors to achieve such a goal.
- Holding training classes in the form of capacity building, attracting attention to the rights of others, and the needs of the future generations can attract the attention of rangeland conservation authorities. Accordingly, the design of training programs and behavior change interventions should be such that they empower rangeland resource exploiters to overcome their behaviors. In this regard, they should be taught that conflict behavior can lead to the destruction of rangelands as much as possible.
- To strengthen the sense of responsibility among exploiters, steps can be taken to encourage civil liability to preserve rangelands by creating communication campaigns and NGOs. Also, the role of enlightenment agents of change at organizations in charge of rangeland conservation (especially the agricultural extension and natural resources organization in Iran) can be very useful, because they can explain the multiple dimensions (managerial, economic, and technical) to exploiters by implementing enlightenment programs and convince them that part of the current problems in the field of shortage and destruction of rangelands has been caused by humans. Thus, human beings themselves can help solve those problems by accepting responsibility in this field.
- The social environment through social pressure can strengthen the sense of moral commitment to preserve rangelands. Considering the undeniable role of SN and perceptions of those around that are related to the conflicting behavior of rangeland exploiters, local leaders, and community pioneers in different societies could play an effective role to overcome this problem.
- Programs and designs of rangeland resources' conservation can be useful to increase the awareness of exploiters toward the consequences of environmental crises in rangelands and increase their responsibility. At first, they must reconstruct their underlying values. Engaging stakeholders in solving environmental problems (especially rangelands) can be useful to strengthen the values (environmental and cultural). Also, those in charge of rangeland affairs (in Iran, the Forests, Rangelands, and Watershed Management Organization, as well as public participation units) must understand the importance of diversity of values among exploiters and pay attention to the role of these values in their participation to conserve rangelands. This will increase the power of conflict management.

Research limitations

It shall be noted that this study has limitations, and considering them could be useful for future studies. This study

was quantitative research and was conducted based on a survey among the rangeland exploiters of West Azerbaijan Province in Iran. A second limitation was related to the cultural and linguistic differences of the study population. Although this issue increases the generalizability of the results, it should not be forgotten that it may cause problems in data collection. The instrument based on the translation of items constructed in other contexts may have lacked sensitivity in recognizing culturally relevant processes. Furthermore, the questionnaire administered by our research team, and given the particularly sensitive subject matter, may have introduced biases related to the interviewer–interviewees communicative relationship. So, we recommend that future researchers be sensitive to these issues in their studies. Therefore, the use of mixed methods (quantitative and qualitative) may provide more meaningful insights in future research. A third limitation was related to the type of variables. In this study, only the internal factors that affect conflict behavior were discussed from the perspective of psycho-social patterns and variables, not external factors. In this regard, future research should focus on the external causes of conflict in rangeland.

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 DH, Department of Agricultural Extension and Education, School of Agriculture, Shiraz University, Shiraz, Iran. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

Both authors were involved in all stages of the study, including theoretical studies, data collection, analysis and data processing, and the presentation of the report.

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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

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Civil society's perception of forest ecosystem services. A case study in the Western Alps

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Forest Ecosystem Services (FES) are widely recognised by the society nowadays. However, no study in the literature has analysed a ranking of FES after the pandemic. This paper investigated civil society's perception and knowledge toward these services; in addition, the presence of attitudinal or behavioural patterns regarding individual's preference, was assessed. A choice experiment was conducted using the Best-Worst Scaling (BWS) method on a sample of 479 individuals intercepted in the Argentera Valley, in the Western Italian Alps. Results, showed a strong interest in biodiversity, aesthetic landscape quality and psychophysical health and a lower interest in provisioning services. Based on the individual preferences, civil society was clustered into five groups for FES, named "Hedonistic," "Individualist with cultural and health interests," "Sensitive to regulatory and utilitarian functions," "Climate change sensitive" and "Livelihood and hedonistic wellbeing." In general, there was a growing appreciation by civil society for the intangible services offered by the forest, driven by modern lifestyles and an interest in learning more about the provided services. Based on these elements, we believe that similar research should be extended to other mountain contexts to validate the results or to find new insights, and that it is now necessary to study how to involve civil society in decision-making processes of forest planning and management at a local level.

KEYWORDS

forest ecosystem services, Best-Worst Scaling, latent class analysis, civil society, awareness, perception

Introduction

Over the last 50 years or so, ecosystem services (ES) have gained strong recognition from civil society for their importance, not only for the environment, but also for human beings (Lin et al., 2021). Several organisations have attempted to study ES and classify them into specific categories, not least because of the different spatial relationship between their demand and supply (Costanza, 2008). These include the Millennium Ecosystem Assessment (MEA) (2005) project, which first formally defined ES as "the

multiple benefits that ecosystems provide to humans"; the study on The Economics of Ecosystems and Biodiversity (TEEB) (2010), which presented them as "the direct and indirect contributions of ecosystems to human well-being", adding a new category called "habitat services"; and the classification proposed by the Common International Classification of Ecosystem Services (CICES), later revised in 2012, which defined them as "the contributions that ecosystems make to human well-being" (Haines-Young and Potschin-Young, 2012). Thanks to its hierarchical structure, the latter classification allows the identification of different levels of ES detail, thus reducing the translation problems arising from different classification systems that were not always comparable (VanderWilde and Newell, 2021).

The MEA classification, which defines four categories of ES: "supporting," "provisioning," "regulating" and "cultural," was used in this study, also following its wide recognition in the literature (Afonso et al., 2021; Chanza and Musakwa, 2021; Chettri et al., 2021; Kim and Son, 2021). Supporting services have a long-term effect and serve the formation of other services although they are the only ones that do not directly benefit humans; they include soil formation, nutrient cycling, and primary production (Sharafatmandrad and Khosravi Mashizi, 2021). Provisioning services are the material benefits that can be derived from the ecosystem, such as timber, drinking water, and fuel (Yoshimura et al., 2021). Regulating services derive from the management of ecosystem processes and include carbon storage, water regulation, and protection against natural hazards (Kim and Kwon, 2021). Finally, cultural services are the intangible benefits, such as the psychophysical health, the aesthetic beauty of a landscape, and the tourism-recreational activities (Santos Vieira et al., 2021).

Mountain and forest ecosystems play a key role, recognised both at the EU level with the new EU Forest Strategy 2030 (Aggestam and Giurca, 2021) – a flagship initiative of the European Green Deal – and internationally with the UN Sustainable Development Goals (Goal 15) (Marín et al., 2021; Rimal et al., 2021). This recognition can be attributed to the services offered, among which, the provision of drinking water (Piaggio and Siikamäki, 2021), CO2 storage (Blanc et al., 2019), protection against natural hazards (Scheidl et al., 2020), mental and physical wellbeing, and recreational tourism activities (Liu et al., 2021) are growing in importance.

However, these services, to contribute to human well-being, need to be identified, mapped, and assessed from an ecological perspective; furthermore, to make more robust public policy decisions it is crucial to also analyse the social interest of ES to identify lack of awareness, information asymmetry and issues arising from different stakeholders (Castro-Díaz et al., 2022). In this sense, several authors have defined a relational value, i.e., a value capable of including virtues, principles and preferences linked to human-nature interaction and capable of uniting social sciences with natural sciences of conservation, valorisation, and environmental sustainability (Arias-Arévalo et al., 2018; Chan et al., 2018; Himes and Muraca, 2018).

Previous studies attempted to identify the demand for Forest Ecosystem Services (FES) and the willingness of civil society to pay for some of these services (Soto et al., 2018; Jo et al., 2021). Others have tried to estimate their value (Accastello et al., 2019; Rijal et al., 2021) or to provide spatial-based tools capable of quantifying, mapping, and valuing FES (Khalfaoui et al., 2020) or assessing payments for such services (Grilli et al., 2020; Sacchelli et al., 2021). However, few researchers have attempted to ask civil society to identify a ranking of ES. This approach has been adopted: on a specific category, such as cultural services (Kabaya et al., 2019), using simple approaches such as Likert scales (Lin et al., 2021) or, on specific services offered by the forest (Soto et al., 2018; Beckmann-Wübbelt et al., 2021). studies concluded the data collection phase prior to the COVID-19 pandemic (Gouwakinnou et al., 2019; Yang et al., 2019).

Based on these premises and to fill some of these gaps in the literature, our study aims to answer the following questions:

- RQ1) How have civil society's awareness and perception of FES changed in the post-COVID era?
- RQ2) Are there different patterns of civil society attitudes and behaviours regarding preferences for forest ecosystem services?

To do so, we designed a questionnaire, using the Best-Worst Scaling (BWS) method, which can detect individual preferences, following a choice-based approach. We applied this method in a local Italian mountain context in order to (i) identify a ranking of FES by civil society; (ii) define homogeneous groups of subjects according to their preferences toward to the selected different FES.

In recent years, mountain forests have undergone transformation and expansion in terms of occupied area (Malandra et al., 2019; Garbarino et al., 2020) as a result of several factors, including socio-economic changes, such as industrialisation, urbanisation, and the consequent lower intensification of agricultural land use in mountains (Bruzzese et al., 2020), and political-legal factors, such as the introduction of natural constraints and the establishment of parks, protected areas and reserves (Tattoni et al., 2021).

These transformations, in both the civil society lifestyle and in the supply of ecosystem services, may suggest a change in their demand (Schirpke et al., 2020). Indeed, the 20th century has shown a sharp increase in the supply of provisioning services at the expense of regulating and biodiversity ones (Pereira et al., 2020). In 2019, there was a reversal of this trend: regulatory services came first, and a growing interest in cultural services made them equal to provisioning ones (Acharya et al., 2019). Given these changes, we propose the following hypothesis:

> H1) in recent years, partly due to the current pandemic emergency, cultural services provided by the forest have become the most demanded FES by civil society.

The rest of the document is structured as follows: Section "Materials and methods" describes the study area, the theoretical basis of the BWS method, and the questionnaire design adopted. Sections "Results" and "Discussion" report and comment on the results in the light of the classifications and BW scores obtained. The last section concludes with the limitations of this study and its possible developments.

Materials and methods

Case study

The study area was the Argentera Valley, located in the Western Italian Alps in Piedmont, on the border with France (44°54′42.4″N 6°53′49.7″E). The valley has an area surface of about 340 hectares, with a wide altitudinal range from a minimum of 1,540 m a.s.l. to a maximum of 3,303 m a.s.l. and is part of the Site of Community Importance (SCI) of the Natura 2000 network (code IT1110053). The area was chosen because it is a popular destination all year round for tourism and recreational purposes, and because we assumed the visitors are very environmental aware, given that access by car requires the purchase of a €5 ticket.

Survey design and best-worst scaling

A choice experiment was conducted face-to-face in August 2021, using a structured paper questionnaire, developed to define the perceptions and attitudes of a sample of subjects toward ecosystem services (**Supplementary material A**).

Interviews were conducted using the questionnaire administered throughout the day (from 9am to 5pm) considering the whole week (Monday to Sunday) to randomly intercept a sample as heterogeneous as possible. The eligibility criterion of the respondents was for over 17-year-olds. The questionnaire was structured in two sections: the first one dedicated to the socio-demographic characteristics of the individuals, a second part implemented a defined number of BWS questions. The BWS methodology was chosen because it allows defining the degree of preference (through a numerical index) toward a single item describing a product, an environment, a topic, etc., starting from a set of defined attributes/descriptors. This multivariate and quantitative method is based on pairwise comparisons (Shuibul Qarnain et al., 2021), offering several advantages if compared to other methods used for indirect assessment of individual preferences (Finn and Louviere, 1992; Marley and Louviere, 2005; Louviere et al., 2015). During the interviews, respondents were asked to choose the best and worst attributes to describe ecosystem services for each of several subsets (BWS questions) containing the previously selected FES characteristics in different combinations. This procedural approach allows us to overcome the limitations of ranging and ranking that imply a high cognitive effort of the respondent, thus reducing the efficiency of the survey (Marley and Louviere, 2005). The adopted BWS design was developed using the Sawtooth MaxDiff Designer software (SSI-version 8.4.6, Orem, UT, USA[1]) (Orme, 2009), following the standard balanced incomplete block design (BIBD) (Mori and Tsuge, 2017) with the following characteristics: starting from a set of n attributes, r choice sets (best-worst question) are provided, each containing t attributes (constant condition n > t). Therefore, each attribute appears s times in the experimental design and each pair of items appears α times [$\alpha = s \times (t-1) / (n-1)$] (Crouch and Louviere, 2007; Liu et al., 2018). During the interviews, respondents repetitively select the maximum difference couple of attributes (for each best-worst question). In the presented research, $n = 12$ attributes were selected (**Table 1**), organised in the questionnaire into $r = 9$ choice sets, each containing $t = 4$ attributes, and each attribute appeared $s = 3$ times in the experimental design. To further increase the combinations of attribute choices, four different versions of the questionnaire were developed in each of which the order of the attributes within the BWS questions changed.

The analysis of the answers produced an average preference index (ARS) for the individual elements, which it was then used to rank the sample's preferences toward the selected ecosystem services (Umberger et al., 2010). Specifically, the formula applied to calculate the ARS for a single attribute (i) is as follows:

$$ARSi = \frac{COUNTbest - COUNTworst}{s * n}$$

where:

- COUNTbest represents the number of times the individual attribute was chosen as BEST (best);
- COUNTworst represents the number of times the single attribute was chosen as WORST (worst);
- s is the number of times the single attribute appears in the experimental design (s = 3);
- n is the sample size.

These preference scores (which measure the importance of each individual item) can be positive or negative, and their sum is always equal to zero. The standard deviation was used as a crude indicator of variability for defining the preferences of the whole sample.

1 http://www.sawtoothsoftware.com/

Latent class analysis

The relative scores (Rescaled Score – RS) (whose sum, considering all 12 attributes, is equal to 100) were used as dependent variables in Latent Class Analysis (LCA), in order to obtain homogeneous groups of subjects based on the individuals' preferences (Casini et al., 2009; Massaglia et al., 2019). The use of RS in cluster analysis allows for comparing and better interpreting the differences between the obtained groups (Cohen, 2009). The theoretical properties of LCA are explained in Umberger et al. (2010). In general, starting from the characteristic of LCA which, contrary to other segmentation techniques, does not allow to knowing the number and the size of clusters obtained *a priori* and providing several usable solutions, following the suggestions of Dekhili et al. (2011), we selected the lowest values of the Log-Likelihood (LL) and the related Bayesian Information Criterion (BIC) for each model, choosing the best five-cluster model. The HSD ANOVA was conducted in SPSS 28.0 for Windows, using Tukey's test to define significant differences in preferences among the five clusters (Tabacco et al., 2021).

Results

Sociodemographic characteristics

Details of socio-demographic variables of the 479 respondents are reported in **Table 2**. The selected sample is gender-balanced and the average age was 44.3 years. About two-thirds of the visitors were families with children, with a medium to a high level of education. Moreover, about 75% of the respondents visited the site less than 5 times a year and 85% of them came from urban or suburban areas.

TABLE 1 Attributes list and description.

Label	Description
Biodiversity	Plant and animal habitats
Aesthetic quality of the landscape	Beauty of the landscape
Psychophysical health	Reduces stress and strengthens the immune system
Protection against natural hazards	Avalanches, rockfalls and landslides
Recreational tourism	Hiking, mountain biking and camping
Disaster reduction	Flooding
Climate change mitigation	Carbon storage
Drinking water	Drinking water at the home tap
Raw materials	Construction timber, carpentry, and handicrafts
Food	Mushrooms, small fruits, fish, and game
Fuel	Firewood, pellets, and wood chips
Spiritual and religious	Pilgrimage and religious retreats

Best-worst scores

The Raw Average Score (RAS) of each attribute identified the average level of preference for the FES expressed by the respondents (**Figure 1**).

The first three preferred FES resulted from the respondents' answers were biodiversity (with the highest average RAS of 1.81), aesthetic quality of the landscape (RAS = 1.61), and psychophysical health (RAS = 1.26). A general interest in livelihood, cultural, and well-being attributes was therefore expressed.

The least important attribute, on the other hand, was spiritual and religious (RAS = −3.64), in fact the explored case study area has never had a spiritual connotation and therefore visitors confirmed they did not access the area for such reasons. The others two attributes that had the lowest raw scores were: fuel (RAS = −2.00) and food (RAS = −1.61), thus highlighting how the needs of civil society have changed. While in the past these two attributes were essential to the lives of mountain people, they are now not perceived by users, who highlighted interests and needs related to contemporary life and linked to intangible services.

TABLE 2 Sample characteristics.

Category	Item	Frequency	Percent
		[n.]	[%]
Gender	Female	234	48.9%
	Male	245	51.1%
Age groups	18–30	108	22.5%
	31–40	87	18.2%
	41–50	100	20.9%
	51–60	93	19.4%
	>60	91	19.0%
Family composition	1 (single)	28	5.8%
	2 (couple)	126	26.3%
	3	107	22.3%
	4	172	35.9%
	>4	42	8.8%
	n/a	4	0.8%
Educational level	Primary school	1	0.2%
	Lower secondary school	58	12.1%
	Upper secondary school	211	44.1%
	Master's degree	209	43.6%
Site frequency (no. of visits/year)	1	206	43.0%
	2–5	151	31.5%
	6–10	43	9.0%
	11–20	21	4.4%
	>20	56	11.7%
	n/a	2	0.4%
Residence area	Urban area (City)	238	49.7%
	Small towns or suburbs	168	35.1%
	Rural area	59	12.3%
	n/a	14	2.9%

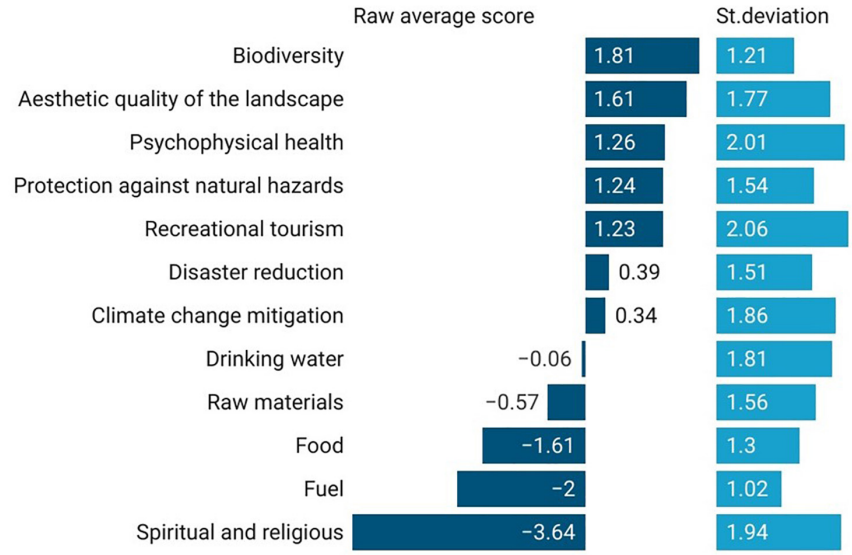

FIGURE 1
Raw average score for each FES attribute.

Clustering results

The Latent Class analysis was performed considering the entire sample of respondents (n = 479) allowing the identification of 5 different groups of individuals (**Table 3**).

The first cluster, called "Hedonistic," identified respondents who used natural resources mainly for recreational tourism purposes, enjoying the aesthetic quality of the landscape, the beauty linked to biodiversity, and with the aim of improving their mental and physical health. Compared it to the next group, which is similar in terms of its positive assessment of the aesthetic quality of the landscape and recreational tourism, this group also stood out for rationally assessable aspects such as biodiversity and protection against natural hazards.

The second cluster, "Individualist with cultural and health interests," identified respondents who used forests and mountains in their free time with tourist activities (walking, mountain-biking, hiking), for personal purposes linked to emphasising the pleasure of enjoying the beauty of the landscape to achieve psychophysical well-being, reducing stress, and strengthening the immune system.

The group "Sensitive to regulatory and utilitarian functions" was represented by respondents attentive to the regulatory aspects provided by ecosystems, both on a local scale (avalanches, rock falls, landslides) and, therefore, with reference to the active use of the territory, and on a basin and regional scale, considering the mitigation effect that the forest can guarantee with respect to calamitous events, also highlighting interest in aspects related to biodiversity.

The "Climate change sensitive" cluster identified users who were attentive to ongoing climate change and express a general interest in the capacity of natural ecosystems to actively contribute to mitigating the effects of global change, as well as guaranteeing protection from natural hazards and maintaining biodiversity.

Finally, the "Livelihood and hedonistic wellbeing" cluster identified respondents who placed the forest as an ecosystem at the service of humans, with the function of supplying drinking water and raw materials (such as timber for construction, carpentry, or objects), for its aesthetic qualities linked to the landscape and for the possibility of recreational activities.

In general, two attributes were common to at least three clusters in terms of the level of importance: Biodiversity and Aesthetic quality of the landscape. Aspects that together identified the strategic centrality of the examined area for tourism activities.

On the other hand, the five clusters agreed on defining Food, Fuel, Spiritual and Religious as not particularly important. This revealed the evolution of the concept of the resource itself and the abandonment of the traditional functions of supplying materials and food, and the absence of spiritual links with the natural resource examined.

Discussion

Several authors highlighted the importance of the role attributed to FES for the environment, society, and economy (Acharya et al., 2019; Bussola et al., 2021; Kramer et al., 2022). In a review conducted by Nummelin et al. (2021) on the topics and trends of international forestry scientific research in the period 2000–2019, an increasing interest in such services emerged.

The recognition of FES by civil society led, on the one hand, for forest owners and managers to deal with an increase in their demand, as reported by Müller et al. (2020); on the other hand, as highlighted by Bonsu et al. (2017) in the creation of bottom-up initiatives that gave space for the population to participate in decision-making processes of forest planning and management.

In this context, it is therefore important to identify civil society's perception of and interest in the FES to optimise the matching of supply and demand and to provide more robust information for decision-making. Based on these considerations, two key results emerge from our analyses:

1. Today, society's awareness and perception of the FES has changed, accelerated by the current pandemic emergency. Our study reported biodiversity, aesthetic quality of the landscape, and psychophysical health as the most preferred services by civil society, while food, fuel, and spiritual and religious activities as the least. These results partially confirmed our hypothesis and what Acharya et al. (2019) stated in their study on the perception and prioritisation of ecosystem services by users and local stakeholders in a mountain context. Indeed, except for regulating services, which were of primary importance in both studies, cultural services received more recognition than provisioning services in our case. This could be attributable to the socio-demographic characteristics of our sample or, to the effects induced by the pandemic, which promoted greater frequentation of forests and natural environments, especially for recreational purposes or psychophysical well-being, as confirmed by several authors (Bamwesigye et al., 2021; Hansen et al., 2022; Jarský et al., 2022; Vos et al., 2022).

Conversely, the fact that food has been perceived as less important among ecosystem services, may be due to the respondents' lack of knowledge about edible forest products (such as blueberries, mushrooms, and game), hence the need for awareness-raising campaigns, as reported by Gouwakinnou et al. (2019). The low interest in fuel is to be found in the socio-demographics of the sample, as most respondents come from urban backgrounds and probably do not use woody biomass for energy purposes. Finally, the little attention paid to religious and spiritual activities can probably be attributed to the specificity and distinctiveness of the service.

Before the pandemic emergency, one of few studies conducted in Italy on social perception was the one by Pastorella et al. (2016), but it is related to forest functions and not to ecosystem services, which are rather different concepts (Brun, 2002). Therefore, these studies referred to the capacity of the forest to provide goods and services (De Groot, 1992), rather than to the benefit produced by them for humans (Farber et al., 2002). In any case, the results seemed consistent with those obtained from our analyses, since the primary importance of biodiversity emerged, followed by that of the aesthetic quality of the landscape. This may indicate, on the one hand, that perceived importance is influenced by ecological knowledge and by the socio-economic and cultural context of a place, and on the other, that there was a matching between what stakeholders consider important from the forest and what civil society wants.

TABLE 3 Latent class analysis results showing the rescaled scores (relative preference index) for each FES attribute, resulting in the obtained 5 clusters.

	Average raw score				
Cluster name	**Hedonistic**	**Individualist with cultural and health interests**	**Sensitive to regulatory and utilitarian functions**	**Climate change sensitive**	**Livelihood and hedonistic wellbeing**
Cluster size	**25.8%**	**22.4%**	**19.8%**	**18.0%**	**14.1%**
Attribute					
Food	1.636 a	2.055 a, b	2.773 b	4.323 c	7.092 d
Drinking water	1.564 a	9.169 b	7.680 b	9.907 b, c	12.831 d
Raw materials	4.645 b	8.071 d	1.146 a	5.780 b, c	9.628 c
Fuel	1.179 a	1.656 b	2.923 c	2.396 c	4.435 d
Climate change mitigation	6.663 b	2.914 a	11.900 c	16.758 d	5.576 b
Disaster reduction	7.982 b	2.266 a	14.880 d	10.836 c	10.231 b
Protection against natural hazards	11.693 b	4.760 a	18.824 d	13.482 c	11.203b
Biodiversity	15.158 c	11.560 b	16.126 c	15.599 c	9.437 a
Aesthetic quality of the landscape	17.684 c	18.315 c	6.387 a	6.896 a	12.547 b
Recreational tourism	16.148 c	17.938 c	10.091 b	1.697 a	12.322 b
Spiritual and religious	0.530 a	1.761 b	0.768 a	0.744 a	1.996 b
Psychophysical health	15.117 d	19.535 e	6.501 b	11.583 c	2.703 a

a–d: preference averages (rescaled scores) within a row with different superscripts differ ($P < 0.05$) for Tukey *post-hoc* test.

Conversely, at the international level, provisioning services continue to be of key importance. Lhoest et al. (2019) investigated the perception of forest ecosystem services by local communities in Cameroon. In a sample of 225 respondents, the primary interest was shown in provisioning services (93.3% of respondents), followed by cultural services (68%), and regulating services (16%). Zhang et al. (2019), conducted a study in China on a sample of 386 respondents, which showed a keen interest in provisioning and regulating services. Tauro et al. (2018), conducted a study in Mexico on a small sample of 27 livestock farmers, which showed that the most important ecosystem services include provisioning services (50%) and that the rest are given by a combination of supporting, regulating and cultural services. Finally, Haida et al. (2016) conducted a study on a sample of 53 decision-makers in mountain areas of Austria and Italy, which showed that most of them ranked provisioning services as the most important, followed by regulating and supporting services.

It seems logical to assume that these different perceptions are attributed to the different socio-cultural contexts, as stated by Caballero-Serrano et al. (2017). Indeed, local customs, dietary habits, proximity to the forest, dependence on the forest for work and income are all factors that contribute to influencing respondents' preferences and should be kept in mind when interpreting the results of the study.

2. Civil society was classified into five groups in terms of FES preference. The "Hedonistic" group, which found pleasure in the sight of a beautiful landscape and in conducting recreational activities in the forest that also influence psychophysical health. The fact that this group emerged as the main one from our analyses may underline the statement already made by Koprowicz et al. (2022) in their study to determine the attitudes of Poles toward the forest during the COVID-19 pandemic. What emerged from a sample of 1025 participants was a visible societal need for forestry activities, which accrued particularly during the pandemic.

The second group, defined as "Individualists with cultural and health interests," highlighted a marked interest in the wellbeing of the individual resulting from conducting activities in the forest. Several authors in the literature, in fact, highlighted the multiple physical and psychological benefits derived from forest recreation, such as stress reduction, immune system strengthening, and pressure reduction (Bielinis et al., 2019; Kotera et al., 2022; Muro et al., 2022; Roviello and Roviello, 2022).

The "Sensitive to regulatory and utilitarian functions" group placed the main emphasis on the safety and liveability of a place, therefore, presenting a greater interest in the protective role that the forest has against gravitational natural hazards and disasters, and in biodiversity as a principal element for the stability of an ecosystem. In a study conducted on the protective role of a forest stand against rockfalls, Lingua et al. (2020) pointed out that the protection offered by the forest in the mountains has always been considered prominent. Scheidl et al. (2020) also stressed the importance of mountain forests in reducing the risk of rockfalls over large areas and long periods of time.

The "Climate change sensitive" group was more concerned with an interest of global importance, which is the mitigation of the climate crisis. This group expressed an altruistic and legacy function, which can be partly traced back to the views commonly referred to as the "Greta generation" (Magnenat, 2021; Prakoso et al., 2021; Sabherwal et al., 2021).

The last group, defined as "Livelihood and hedonistic wellbeing," emphasised cultural services, but also recognised the role of the forest in the provision of products as well as services and specifically drinking water. The fact that provisioning services were considered less interesting can be attributed to two causes. The first cause is due to the socio-demographic characteristics of the sample, as most of the subjects were users and not mountain dwellers and were probably not aware of the role of supply provided by a forest. The second cause may be attributable to the current trend regarding the FES, which as reported by Acharya et al. (2019), is more focused on regulating and cultural services than on provisioning and supporting services.

Conclusion

This study sought to understand civil society's perception and relative preference for forest ecosystem services in the post-COVID period. To our knowledge, this is the only post-pandemic study to have identified a ranking of FES belonging to the various categories defined by the MEA, using a choice-based approach. Our results highlight a strong interest of civil society in the component of biodiversity and cultural services, such as landscape aesthetic quality and psychophysical health, and based on individual preferences, identify different homogeneous groups of attitudes and behaviours toward FES. This is a small but significant step toward a better understanding of the forest-society relationships that underpin good policy and good governance on the part of decision-makers.

Limitations and future research

There are two potential limitations to this study. The first concerns the characteristics of the sample, the results we have obtained probably reflect the preferences of a civil society that frequents the mountains as tourists and does not live there permanently. This may be one of the main reasons why provisioning and regulating services related to the safety and liveability of a place were not considered so important. Further research must be conducted in this respect, analysing

several samples at a time, and assessing the differences between them. The second limitation concerns the choice of ecosystem services to be assessed in the questionnaire, which is based on only some of those proposed by the MEA classification. The reason for this choice is twofold: on the one hand, those most recognisable to civil society were selected; on the other hand, as the methodology is based on a process of choosing between several alternatives, there was a risk of spending too much time filling in the questionnaire.

In conclusion, our study can contribute to improving the participatory and shared decision-making process in forest planning and management, which considers the multiple interests deriving from the different components of society (authorities, stakeholders, and citizens) and are indispensable in resource decisions. Further research is required, however, to understand how and in what way to better involve civil society during the decision-making process.

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

SBr and SBl: conceptualization. SBr, SBl, and VM: methodology. SBr and VM: formal analysis. SBr, SBl, VM, SM, and FB: writing – original draft preparation and writing – review and editing. SM: supervision. All authors contributed to the manuscript revision, read, and approved the submitted version.

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.2022.1000043/full#supplementary-material

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Application of social identity models of collective action to facilitate participation in groundwater aquifer storage and recovery management

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Aquifer storage and recovery (ASR) is considered as an innovative method and an alternative one for sustainable management of water resources that has, in recent years, attracted the attention of experts and thinkers. Implementation of this method would entail the participation and collective action of various stakeholders. In this process, farmers are considered as the most important stakeholders; and limited studies have been conducted on their intentions to participate in collective actions of ASR management. In this regard, the investigation of farmers' intention to participate in ASR and its determinants, using social identity models of collective action, was selected as the main purpose of the present study. For this purpose, using a cross-sectional survey, 330 Iranian farmers were interviewed. In this study, the ability of the dual-pathway model of collective action (DPMCA) and the encapsulation model of social identity in collective action (EMSICA) was evaluated and compared to explain farmers' intentions towards participation in ASR management. The results revealed that the both models had good predictive powers. However, DPMCA was a stronger framework than EMSICA for facilitating farmers' collective behaviors in the field of participation in ASR management. This is one of the most important results of the present research that might be used by various users including decision makers, managers, and practitioners of water resources management in Iran and generally the world. Finally, the creation of a "*we thinking system*" or social identity in the field of ASR management was highlighted as one of the most important take-home messages.

KEYWORDS

aquifer storage and recovery, water management, farmers' participation, social identity, Fashafuyeh plain, environmental psychology

Highlights

- Aquifer storage and recovery is an innovative method for water management.
- Collective action models are useful for implementation of aquifer storage and recovery.
- Formation of social identity is a crucial for collective aquifer storage and recovery.
- The study introduces *we thinking system* as the best strategy for aquifer storage and recovery.

Introduction

Iran has always been regarded as a dry country where only one-fourth of its surface has been suitable for agricultural practices; the remaining three quarters are covered by deserts and mountains (Madani, 2014). In Iran, the average annual rainfall has been about 250 mm in the recent three decades (Fallahati et al., 2020), which does not have a proper and fair distribution in terms of time and space (Khozeymehnezhad and Tahroudi, 2019). It is apparent that in water sector and resources management, Iran is facing many problems. Brisk population growth, migration and de-peasantization, water distribution issues, low quality of water, inefficient agriculture sector, dream of food self-reliance, increased demand for water, low price of energy and water, dams, deep wells, droughts, floods, climate change, thirst for development, sanctions and economic instability, inadequate water governance structure, and lack of environmental awareness are of the most significant reasons of this issue (Madani et al., 2016; Valizadeh et al., 2020).

Increasing population and increasing water demand; as well as shortage of water resources, have a great impact on various agricultural, industrial, and service sectors (Tizro et al., 2011); thus, overexploitation of groundwater resources has caused extreme groundwater level decline, increased pollution, and increased public concern in most plains (Arabameri et al., 2019; Ghobadi et al., 2020). Every year, owing to the migration of people to urban areas, a huge volume of wastewater is continuously produced by metropolitan areas; This water source is usually used around urban areas directly for agricultural purposes (Deh-Haghi et al., 2020) and that is prevented from being overrun into the aquifers (Khanpae et al., 2020); though, the direct consumption of this wastewater has many environmental, social, and economic consequences. In other words, by directing them into aquifers in ASR management process,such impacts might be avoided (Maliva et al., 2020; Zekri et al., 2021). ASR means directing water into the aquifer at times when water is available and also re-harvesting that when it is needed (Forghani and Peralta, 2018). With regard to the characteristics of the aquifers, this method might be used as a suitable way for water storage in arid and semi-arid areas. It can be particularly effective in areas with low water resources, severe groundwater levels, and high salinity of aquifers.

ASR, as an approach to water storage (Smith et al., 2017), is an inexpensive solution to increase water storage, to remove pollution (Stuyfzand and Osma, 2019), to reduce aquifer salinity (Ghaffour et al., 2013; Gibson et al., 2018; Sathish and Mohamed, 2018), and to improve aquifer quality (Smith et al., 2017; Ghose et al., 2018). This method has advantages such as evaporation decrease, no need for large land areas for implementation, low cost of implementation (Bouwer, 2002; Khan et al., 2008; National Research Council, 2008; Maliva and Missimer, 2010; Forghani and Peralta, 2018; Wasif and Hasan, 2020), potentiality for being used in different aquifers and climates (Maliva et al., 2011; Jeong et al., 2018), and prevention of the progression of the salinity (Pyne, 2005; Zuurbier and Stuyfzand, 2017).

Throughout the year, Municipal sewage production is referred to an accessible water source for the agricultural and industrial sectors on the outskirts of metropolitan areas. This alternative water source might be used for artificial aquifer feeding and prevention of environmental pollution; that is, to achieve sustainable management of water resources and to reduce the economic, social, and environmental problems of metropolitan areas, waste water is one of the best subjects (Sathish and Mohamed, 2018). The use of waste water for feeding aquifers removes or reduces metals (Page et al., 2017; Vanderzalm et al., 2020), improves the microbial, physical, and chemical quality of waste water (NASEM, 2016; Sharma and Kennedy, 2017), reduces the risk of diseases and health human problems, values less than wastewater treatment, and evaporates less than surface water (Nema et al., 2001; Crites et al., 2014; Sharma and Kennedy, 2017).

ASR management has the potentiality to be used in various regions such as Iran that are struggling with many problems as to excessive abstractions of groundwater and decline of groundwater levels (Bagheri et al., 2020). Fashafuyeh plain in Iran due to its unique economic, social, and geographical characteristics, has been recently considered as one of the target areas for ASR management. With drying of *Qanats* and significant decrease in the surface water of Karaj River which is caused by the construction of a dam upstream of it, the water inflow of this river to Fashafoyeh area has sharply decreased in the last few decades. This has led to the seasonality of rivers/surface currents entering the plain; besides, the agricultural sector of this region, owing to the interruption of Karaj River, relies on dam overflows, and therefore groundwater resources are not responsible for compensation of this shortage. In addition to the agricultural sector, residential sectors, airports, and large industrial hubs are applicants for having water in Fashafuyeh plain. However, the increase in water abstraction over the past few decades has severely affected the aquifer in terms of quantity and quality. Thus, most areas have EC values greater than 2000 thousand μs/cm. This has made villages down the plains face salinity problem in drinking water supply; besides, drilling wells for agricultural and industrial purposes has caused the aquifer to experience an extreme groundwater level decline.

Due to the existence of these issues in Fashafuyeh plain, it seems that ASR management might be one of the best ways for achieving sustainability in water resource management in this area; where the agricultural sector is the main consumer of water in that. Therefore, farmers are certainly considered as one of the most significant stakeholders in ASR, the behavioral intention of whom towards participation would be of great importance (Bagheri et al., 2020). In other words, farmers' participation is one of the main prerequisites of any sustainable water resource management program (Rahimi-Feyzabad et al., 2020; Valizadeh et al., 2021a,b,c); ASR management in Fashafoyeh plain is no exception to this rule and in its implementation, the need for farmers' participation is undeniable; However, it should be mentioned that the crisis of water resources management in Fashafuyeh plain is a regional level (not individual level) crisis and requires collective actions of stakeholders, i.e., farmers (Bagheri et al., 2020). In other words, the intention towards participation in collective actions in large-scale crises such as sustainable management of water resources in Fashafuyeh plain is much more effective than individual actions of farmers. Preliminary studies conducted around the world and Iran show that no study has been conducted to determine the intention of farmers towards participation in collective ASR management. Conducting such research might provide innovative and useful solutions, insights, and policies for managers, planners, decision-makers, and other stakeholders of sustainable water resources management. In this regard, investigating farmers' intentions towards participation in ASR, using social identity models of collective action, was determined as the main purpose of the present study.

Theoretical framework

Many sustainability-related issues, such as sustainable management of water resources require collective action of farmers and must be done in coordination with all farmers. For example, ASR management, integrated pest management, watershed management, and wetland management require long-term and large-scale measures. In other words, they need collective action (Meinzen-Dick and Di Gregorio, 2004). Collective action is an action taken by a group of individuals to pursue perceived common interests (Scott and Marshall, 2009; Judge et al., 2022; Sia and Wilson, 2022; Valizadeh et al., 2022; Wibisono et al., 2022). Among community members, collective action and networking is of many advantages. For instance, it facilitates access to information and allows farmers as members of the community, to participate in the development of related technologies (Valizadeh et al., 2021a,c; Odağ et al., 2022). It also makes it easier for them to access financial credit, and also share potential risks among members of the community (Meinzen-Dick and Di Gregorio, 2004; Khumalo et al., 2022). The social psychological mechanisms underlying collective actions are configured in the form of some collective identity models. The dual-pathway model of collective action (DPMCA) and the encapsulation model of social identity in collective action (EMSICA) are among these frameworks that consider the determinants influencing participation in collective action by basing social identity as a crucial determinant in this field (Shi et al., 2015).

The dual-pathway model of collective action

DPMCA was first developed by Stürmer and Simon (Stürmer and Simon, 2004, 2009; Figure 1). This model is based on two distinguished interpretations or pathways for motivating participation and collective action. The first interpretation is based on the cost–benefit assessments of individuals. In other words, people who look through the lens of cost–benefit worldview to participation in collective actions such as ASR expect external rewards. Of course, it should be mentioned that in this interpretation, the meaning of external reward refers to the outcome expectancy for collective action. In the second interpretation, social identity is considered as a concept and motivation of social movement participation behavior (Tajfel and Turner, 1986). Through participation in ASR collective actions, Identification acts as a driver in this pathway. The cost–benefit pathway was proposed by Olson (1965) and is also known as Olson's social dilemma. According to this paradox, individuals pursue their individual and personal goals in collective and participative actions (Bamberg et al., 2015). This conflict of individual interests of group members with collective interests could in some cases lead to the failure to form genuine collective action. In the second pathway or theory of social identity, collective and group goals are considered as the ultimate goal of individual participation. For instance, if farmers participate in ASR management that is due to this fact that they feel it is beneficial to the farmer group/community and their participation strengthens the group's position (Liao et al., 2020). It is worth mentioning that striving for collective and group goals can lead to the formation of individuals' identities and strengthens their self-confidence in individual actions' effectiveness, which is also crucial in determining the intentions and behavior (Scheepers and Ellemers, 2019). Furthermore, the second interpretation (social identity theory) introduces normative motives as another root of individuals' collective behavior. This motive refers to the effect of the type of thinking of group members or social environment on individuals' intentions and behaviors (Klandermans, 1984; Bingley et al., 2022; Valizadeh et al., 2022a). According to Bamberg et al. (2015), these three motives are combined with the Reasoned Action Theory of Ajzen and Fishbein et al. (1980) and pave the way for construction of a more comprehensive theory entitled DPMCA, in which collective identity, attitude, subjective norms of behavior, and perceived control on the behavior are the main predictors of intentions towards participation in collective pro-environmental actions (Figure 1). These four variables are in fact manifestations of three normative, reward, and collective motives.

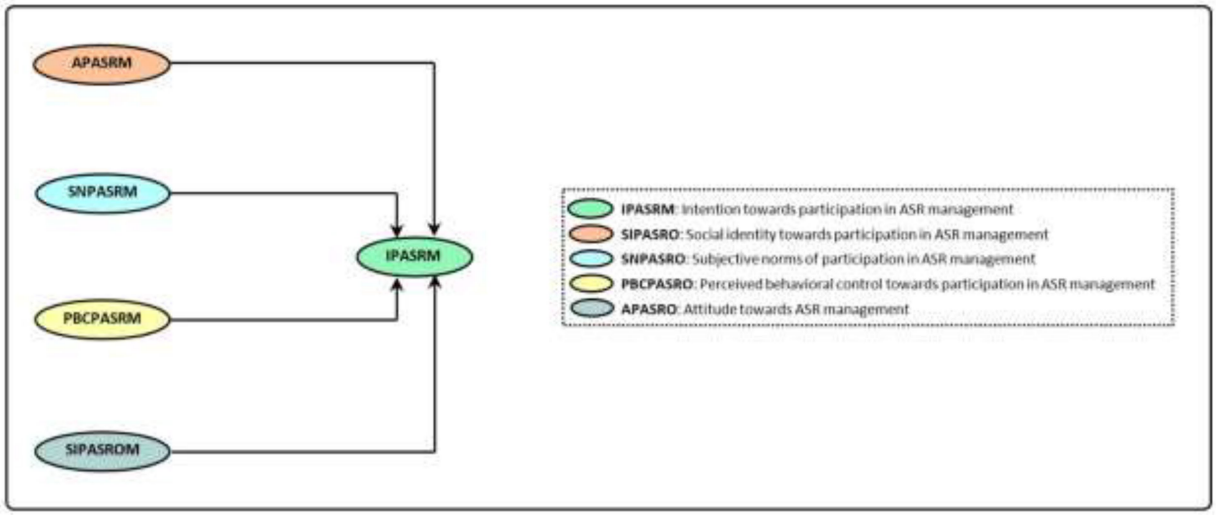

FIGURE 1
The dual-pathway model of collective action (Bamberg et al., 2015).

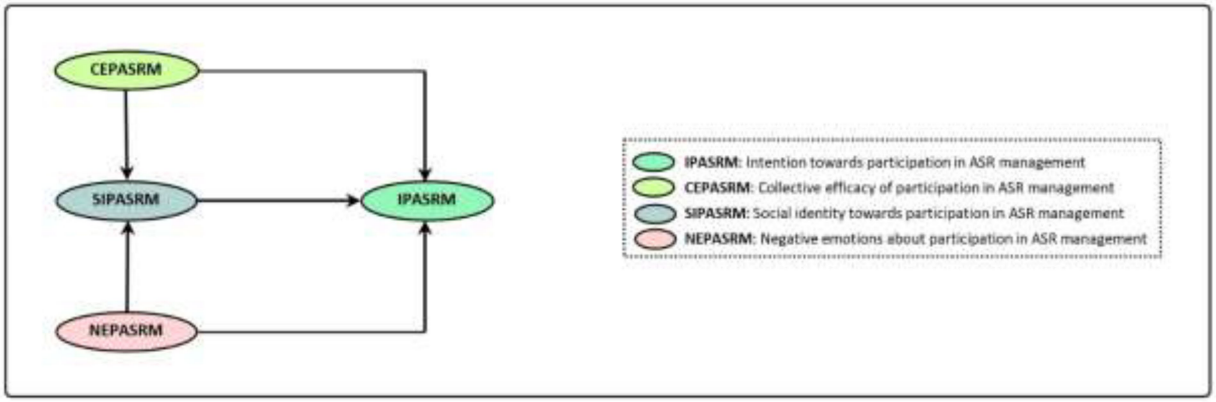

FIGURE 2
The relationships of variables in EMSICA (Thomas et al., 2009, 2012).

The encapsulation model of social identity in collective action

EMSICA was developed by Thomas et al. (2009, 2012) and Van Zomeren et al. (2008; Figure 2).

Like DPMCA, social identity or we thinking system is one of the key variables in team building and collective actions to address different challenges such as ASR. However, in this model social identity is more important and it is believed that it can influence the effects of participative efficiency and negative emotions on collective behaviors (Bamberg et al., 2015). Negative emotions refer to very strong reactions of people (e.g., anger, sadness, etc.), and situations such as injustice and inequality (Kessler and Hollbach, 2005; Thomas et al., 2009). Collective efficiency also refers to the feeling of individuals towards usefulness and efficiency of collective and group actions in solving a problem or crisis (Van Zomeren et al., 2010). In addition to indirect effects, the variables of collective efficiency and negative emotions, through the mediating role of social identity, have indirect effects on intentions towards collective action (Thomas and McGarty, 2009; Bamberg et al., 2015; Figure 2).

Research methodology

Study area

The present study was conducted in Fashafuyeh plain. With an area of about 330 square kilometers, this plain, being located in the south of the capital of Iran (Tehran), is positioned on the bed of the Karaj River. The average annual precipitation and

evapotranspiration are 155 and 1,061 mm, respectively. This plain covers the city of Robat Karim, Imam Khomeini International Airport and 20 more villages. Geologically, the maximum aquifer thickness exceeds 150 meters.

Population and sampling

The statistical population consisted of farmers in Fashafuyeh plain in Tehran province (N = 2,400). According to Krejcie and Morgan (1970) sampling table, 331 farmers were selected as the minimum sample. The sample were selected using a five-step and stratified sampling method. In the first stage of sampling, the study area, based on the National Division Guide, was divided into 20 villages. In the second stage, the names and characteristics of the villages of Fashafuyeh plain were determined. In the third stage, the number of farmers in each village was extracted from the statistical handouts of the agricultural Jihad Administration of Robat Karim. In the fourth stage, the total sample size was proportionally distributed among the studied villages. Finally, the sample was randomly selected according to farmer population of each of the villages.

Research instrument

The research instrument used was a closed-ended questionnaire that used the opinions of a group of academic experts in the technical and social fields of water resource management and also the opinions of practitioners of sustainable water resource management interventions; thus, the face validity and content validities of which were confirmed. After some modifications, the questionnaire was evaluated using a pilot test. The reliability of the tool was examined using criteria including Cronbach's alpha coefficients, items' composite reliability, corrected item-total correlation coefficients, and loading factors of measurement models for the variables. Cronbach's alpha coefficients were calculated after a pilot study and interviews with 30 farmers. The pilot study resulted in some insightful lessons; besides, it implied that all alpha coefficients were greater than the acceptable value of 0.7. The main survey was performed following the pilot study; after the survey, the composite reliability (CR) and the corrected item-total correlation (CITC) coefficients were examined. The values obtained for CR and CITC coefficients were higher than the valid values of 0.7 and 0.3, respectively. Calculation of the loading factors for the measurement models of each composite constructs demonstrated that all their values were greater than the logical value of 0.4.

To appraise the validity of the cross-sectional survey's questionnaire, convergent or average variance (CV), or Average Variance Extracted (AVE) and divergent validity indices were employed. To evaluate the divergent validity of the research tool in SEM, we first used the average shared squared variance (ASV) index; then, the maximum shared squared variance (MSV) was applied as a supporting criterion.

Study variables

Generally, there were seven variables in the two frameworks of collective action that were applied to analyze farmers' participation in ASR management. The method of measuring and operationalizing these variables has been thoroughly presented in Table 1; nevertheless, their conceptual definitions are presented below. All of these variables were measured using a five-level Likert scale (strongly agree to strongly disagree).

Intention towards participation in ASR management (IPASRM): Indicates the farmers' willingness to participate in collective actions of ASR management.

Social identity towards participation in ASR management (SIPASRM): Refers to farmers' identity-oriented beliefs about their participation in collective actions of ASR management.

Subjective norms of participation in ASR management (SNPASRM): Refers to the farmers' perceptions of the way those surrounding them think about their participations or non-participations in collective ASR management.

Perceived behavioral control towards participation in ASR management (PBCPASRM): Represent the farmers' perception of their ability to participate in collective ASR management.

Attitude towards participation in ASR management (APASRM): Stands for the positive or negative orientation of the farmers towards participation in ASR management.

Collective efficacy of participation in ASR management (CEPASRM): Indicates the degree of individual belief in the effectiveness of collective action in ASR management.

Negative emotions about participation in ASR management (NEPASRM): Refers to the strong reactions of farmers (anger, resentment, and etc.) to the lack of participation of other farmers and stakeholders in ASR management.

Data collection and cross-sectional survey

To gather the needed data, face-to-face interview with farmers in Fashafuyeh plain was conducted. In general, 331 questionnaires were distributed, out of which 330 questionnaires were collected. A single questionnaire, owing to many deficiencies in the respondent's answers, was discarded. Eventually, 330 questionnaires were analyzed; for this purpose, $SPSS_{26}$ and $AMOS_{25}$ were employed.

Data analysis techniques

Mardia's coefficients of skewness and kurtosis were employed to test the normality of the data. The estimates of measurement and structural models were used to analyze the data using SEM.

TABLE 1 Survey items and variables.

Var.	No	Items	Source
CEPASRM	Collective efficacy of participation in ASR management (CEPASRM)		
	1	Collective action can play a significant role in storing and rehabilitating groundwater resources and reducing water quantity and quality problems.	Self-developed
	2	Group-based activities increase the efficiency of the ASR operations.	
	3	Collective action and community participation are of the main drivers of succeeding ASR plan in the region.	
SNPASRM	Subjective norms of participation in ASR management (SNPASRM)		
	1	People around me and my acquaintances think that I should be involved in ASR operations.	Self-developed
	2	My commitment to participate in ASR management leads to my endorsement by those around me.	
	3	My friends and acquaintances expect me to participate in ASR management in the Fashafuyeh plain.	
NEPASRM	Negative emotions about participation in ASR management (NEPASRM)		
	1	I do not think other stakeholders (farmers, government, and the private sector) will be involved in ASR management.	Self-developed
	2	I am upset if some of the stakeholders do not participate in the various stages of the project or have no commitment to it.	
	3	Violation of any of the stakeholders in the rules and regulations set for the process of the aquifer storage, causes me to violate the rules.	
IPASRM	Intention towards participation in ASR management (IPASRM)		
	1	I want to participate in ASR management in this region.	Self-developed
	2	I would like to pay for ASR management in the area.	
	3	I intent to encourage other farmers to participate in ASR management in Fashafuyeh plain	
	4	If necessary, I would like to learn the skills needed to participate in ASR management.	
	5	I intent to work with experts and specialists of ASR management.	
SIPASRM	Social identity towards participation in ASR management (SIPASRM)		
	1	I would be happy to participate as a member of a group in ASR management.	Self-developed
	2	Participating and playing a role in ASR management is an important part of my self-image.	
	3	I feel I have strong connections with the people involved in ASR management.	
APASRM	Attitude towards participation in ASR management (APASRM)		
	1	In my opinion, participation in ASR management has favorable results for all residents of the plain.	Self-developed
	2	Participating in ASR management is a public duty or wise task to improve current situation.	
	3	Participation in ASR management has so many economic, social, and environmental benefits.	
	4	Farmers' participation in ASR management in the current water shortage crisis of the plain is a must.	
	5	ASR management in the Fashafuyeh plain is a suitable solution to deal with the crisis, and we farmers and ranchers must be actively involved in this process.	
PBCPASRM	Perceived behavioral control towards participation in ASR management (PBCPASRM)		
	1	I think it is easy to participate in ASR management.	Self-developed
	2	I have enough time and skills to participate in ASR management.	
	3	I have the economic capacity to participate in ASR management.	
	4	I have the sufficient knowledge to participate in ASR management.	
	5	The people of this region have enough ability and capability to participate in ASR management.	

Results and discussion

Correlations among the variables

According to the theoretical frameworks, the results of correlation relationships between the variables showed that in DPMCA, four variables of APASRM ($r = 0.781$; $p < 0.01$), SNPASRM ($r = 0.418$; $p < 0.01$), PBCPASRM ($r = 0.700$; $p < 0.01$), and SIPASRM ($r = 0.486$; $p < 0.01$) have positive and significant correlations with IPASRM (Table 2). These results demonstrate that by increasing or amplifying these four variables, IPASRM increases either. Comparison of the correlation values indicates that despite the significance of them, compared to the other two variables (SIPASRM and SNPASRM), APASRM and PBCPASRM have a remarkably stronger correlation with IPASRM. Researchers such as Bamberg et al. (2015) and Fritsche et al. (2018) have supported these findings with their results. In order to elaborate the comparison of the results of present study with the results of previous researchers, its should be mentioned that Bamberg and his colleagues' results revealed that attitude towards collective climate actions, perceived behavioral control, subjective norms of collective climate actions, and social identity of collective climate actions have significant positive effects on the cooperatives members'

TABLE 2 Correlation matrix of the study variables.

	IPASRM	SIPASRM	SNPASRM	PBCPASRM	APASRM	CEPASRM	NEPASRM
IPASRM	1						
SIPASRM	**0.486****	1					
SNPASRM	**0.418****	0.300**	1				
PBCPASM	**0.700****	0.417**	0.374**	1			
APASRM	**0.781****	0.485**	0.434**	0.711**	1		
CEPASRM	**0.555****	**0.465****	0.406**	0.507**	0.591**	1	
NEPASRM	**−0.413****	**−0.341****	−0.377**	−0.432**	−0.513**	−0.469**	1

IPASRM, Intention towards participation in ASR management; SIPASRM, Social identity towards participation in ASR management; SNPASRM, Subjective norms of participation in ASR management; PBCPASRM, Perceived behavioral control towards participation in ASR management; APASRM, Attitude towards participation in ASR management; CEPASRM, Collective efficacy of participation in ASR management; NEPASRM, Negative emotions about participation in ASR management. **Sig. level: 0.01 error. The bold values represent the correlations of the theoretical frameworks' variables.

intention towards participation in collective climate actions. Fritsche et al. (2018) also concluded that variables social identity, perceived behavioral control about the collective actions, and attitude towards collective actions are positively and significantly correlated with the variable intention. Based on the results, CEPASRM ($r = 0.555$; $r < 0.01$) and SIPASRM ($r = 0.486$; $r < 0.01$) in EMSICA had positive and significant correlations with IPASRM. The results of the research done by Van Zomeren et al. (2008) confirm these findings. Van Zomeren et al. (2008) employed EMSICA to conceptualize the intention towards collective actions. Their results revealed that the constructs collective efficacy and social identity are of great and positive effect on intention of the individuals to participate in a specific behavior. In contrast, NEPASRM ($r = 0.413$; $p < 0.01$) significantly correlated with IPASRM. This result reflects this insight that with the increase of NEPASRM, IPASRM decreases and vice versa. Similar results can be found among the findings of Thomas et al. (2012) and Faghani et al. (2022). More specifically, Thomas et al. (2012) in their study concluded that negative emotions have significant and negative effects on the intention of the individuals towards taking a specific action. Furthermore, Faghani and his colleagues studied the pro-environmental behaviors of environmental cooperatives in Iran and concluded that negative emotions towards participation in collective pro-environmental behaviors are significantly and negatively correlated with the intention of the cooperative members towards participation in collective pro-environmental behaviors. In addition, the correlation between CEPASRM ($r = 0.465$; $p < 0.01$) and NEPASRM ($r = -0.341$; $p < 0.01$) with SIPASRM was significant. However, since the direction of correlation between them is opposite, the direction of their effects would be different.

The results of measurement models in SEM

The results of examining the measurement models of the variables in the two frameworks indicated that for all items, the numerical values of loading factors were greater than or equal to 0.4; Therefore, loading factors had acceptable values (Table 3). The values obtained for CR and AVE were greater than or equal to 0.7 and 0.5, respectively (Valizadeh et al., 2021b). These results also show that the different parts of the tools developed and applied in the present study fulfilled the composite reliability and convergent validity criteria; besides, Comparison of divergent validity indices (ASV and MSV) with AVE index revealed that the values of these indices were less than AVE values. Therefore, it can be concluded that the study tool had divergent validity. The last two columns in Table 3 stand for the values of Mardia's coefficients of multivariate skewness and kurtosis. Given that their values were less than ±1.96, it can be concluded that the research data had normal distribution (Table 3).

Results of structural models and comparison of their estimates

Running and estimation of DPMCA structural model showed that APASRM ($\beta = 0.520$; $p < 0.01$), PBCPASRM ($\beta = 0.267$; $p < 0.01$), and SIPASRM ($\beta = 0.101$; $p < 0.01$) had positive and significant effects on IPASRM (Table 4; Figure 3). This result indicates the high power of these variables in explaining and directing IPASRM. Of these three variables, APASRM and PBCPASRM had stronger standardized effects than SIPASRM. Nevertheless, the role of SIPASRM in explaining IPASRM cannot be ignored. It should be mentioned that in estimating the DPMCA structural model, the effect of SNPASRM on IPASRM was not significant. Therefore, the SNPASRM→IPASRM path or hypothesis was not supported ($\beta = -0.048$; n.s.). Taken together, the independent variables were able to predict 65.4% of the variance changes of IPASRM in DPMCA (Table 4; Figure 3).

Estimation of EMSICA structural model revealed that all predicted paths were significant. In other words, all the hypotheses predicted in EMSICA were confirmed (Table 4; Figure 4). Based on the results, the standardized effects of CEPASRM ($\beta = 0.336$; $p < 0.01$) and SIPASRM ($\beta = 0.235$; $p < 0.01$) on IPASRM were positive and significant; that is, with increasing and reinforcing these variables, IPASRM is strengthened. However, NEPASRM ($\beta = -0.176$; $p < 0.01$) affected IPASRM negatively. This variable had a significant negative effect on SIPASRM ($\beta = -0.200$; $p < 0.01$). CEPASRM ($\beta = 0.463$; $p < 0.01$) was the second variable

TABLE 3 Th results of estimating measurement model and reliability and validity assessment.

Items/index	IPASRM	SIPASRM	SNPASRM	PBCPASRM	APASRM	CEPASRM	NEPASRM	Skew	Kurtosis
IPASRM1	0.86*							0.298	0.725
IPASRM2	0.54							1.525	0.856
IPASRM3	0.84							0.396	0.991
IPASRM4	0.50							−0.722	0.687
IPASRM5	0.59							1.235	1.365
SIPASRM1		0.75*						−0.459	0.775
SIPASRM2		0.80						1.991	0.288
SIPASRM3		0.40						0.753	−0.163
SNPASRM1			0.79*					0.168	0.240
SNPASRM2			0.78					−1.750	1.927
SNPASRM3			0.75					0.456	−0.746
PBCPASRM1				0.80*				0.258	0.510
PBCPASRM2				0.76				0.368	0.752
PBCPASRM3				0.45				1.815	−1.249
PBCPASRM4				0.60				−0.753	0.306
PBCPASRM5				0.56				1.685	0.466
APASRM1					0.58*			1.202	0.726
APASRM2					0.66			0.287	−0.377
APASRM3					0.68			−0.695	1.758
APASRM4					0.78			0.367	0.805
APASRM5					0.75			0.741	−0.230
CEPASRM1						0.80*		0.984	−0.462
CEPASRM2						0.78		0.583	1.711
CEPASRM3						0.57		−1.235	0.631
NEPASRM1							0.92*	0.369	−1.025
NEPASRM2							0.70	−0.613	0.522
NEPASRM3							0.89	1.586	0.699
CR	0.89	0.83	0.83	0.90	0.90	0.83	0.79		–
AVE	0.63	0.64	0.62	0.67	0.66	0.63	0.59	–	–
MSV	0.60	0.23	0.18	0.50	0.60	0.35	0.26	–	–
ASV	0.33	0.18	0.14	0.29	0.36	0.25	0.18	–	–

*Fixed item in confirmatory factor analysis.

TABLE 4 The results of structural models and comparison of the results of two models.

Model	Hypothesized relationship	Unstandardized estimates	S.E.	Standardized estimates	Sig.	Hypothesis test
DPMCA	APASRM → IPASRM	0.507	0.050	0.520	0.001	Supported
	SNPASRM → IPASRM	0.081	0.063	0.048	0.200	Unsupported
	PBCPASRM → IPASRM	0.301	0.054	0.267	0.001	Supported
	SIPASRM → IPASRM	0.185	0.071	0.101	0.009	Supported
EMSICA	CEPASRM → IPASRM	0.527	0.091	0.336	0.001	Supported
	SIPASRM → IPASRM	0.432	0.100	0.235	0.001	Supported
	NEPASRM → IPASRM	−0.236	0.068	−0.176	0.001	Supported
	CEPASRM → SIPASRM	0.725	0.080	0.463	0.001	Supported
	NEPASRM → SIPASRM	−0.269	0.069	−0.200	0.001	Supported

IPASRM, Intention towards participation in ASR management; SIPASRM, Social identity towards participation in ASR management; SNPASRM, Subjective norms of participation in ASR management; PBCPASRM, Perceived behavioral control towards participation in ASR management; APASRM, Attitude towards participation in ASR management; CEPASRM, Collective efficacy of participation in ASR management; NEPASRM, Negative emotions about participation in ASR management.

that was predicted to have a positive and significant effect on SIPASRM in EMSICA. And the results of structural model estimates confirmed this hypothesis. In general, the results indicated that the independent variables in EMSICA could account for about 36.5 and 33.5% of the changes in IPASRM and SIPASRM, respectively (Table 4; Figure 4).

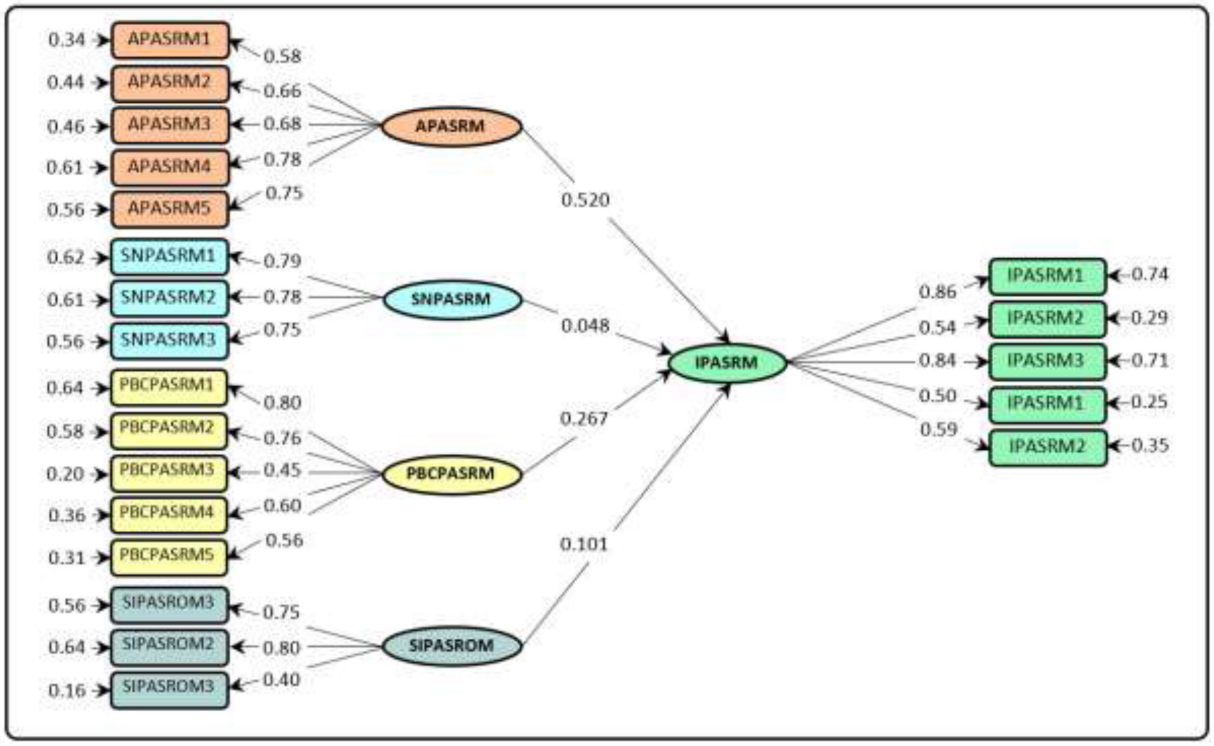

FIGURE 3
Structural model of DPMCA.

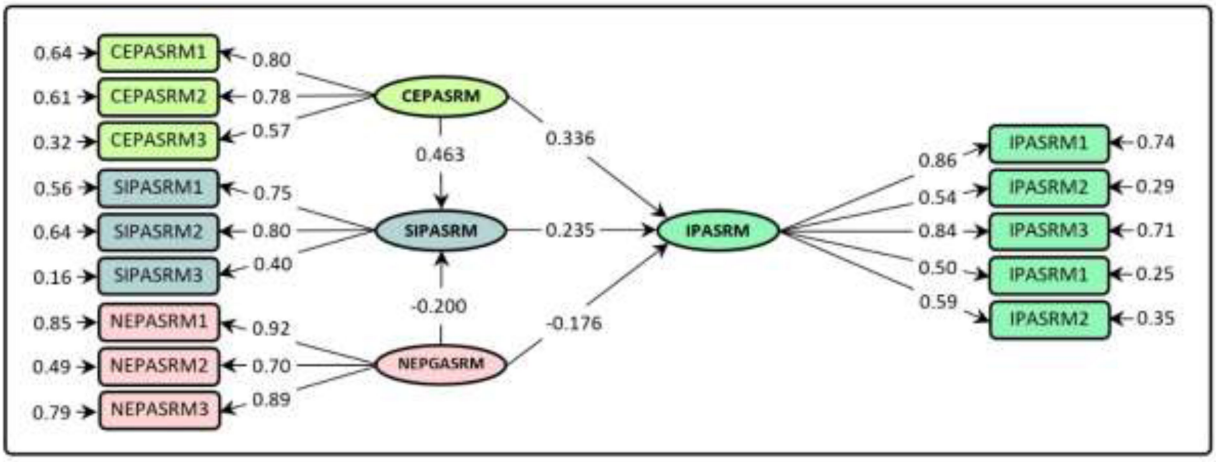

FIGURE 4
Structural model of EMSICA.

Estimation of indirect effects and total independent variables on the dependent variable in EMSICA

Due to the lack of a mediating variable in the DPMCA, a direct/total structural model was employed to run that; therefore, there were no indirect effects for the independent variables. Though, in EMSICA, the SIPASRM acts as a mediating variable, and therefore a mediation/indirect structural model was applied in its running process. The results of employing the mediation/indirect structural model helped to estimate the indirect and total (causal) effects of independent variables on IPASRM (Table 5). The results obtained from this section showed that CEPASRM has

TABLE 5 The results of indirect and total effects on IPASRM in the EMSICA.

Model	Variables	Direct estimate (DE)	Indirect estimates	Total effects
EMSICA	CEPASRM	0.336	0.108	0.444
	SIPASRM	0.235	----	0.235
	NEPASRM	−0.176	−0.047	−0.223

IPASRM, Intention towards participation in ASR management; SIPASRM, Social identity towards participation in ASR management; CEPASRM, Collective efficacy of participation in ASR management; NEPASRM, Negative emotions about participation in ASR management.

TABLE 6 Results from estimation of fitness indices for the structural models.

Fitness index	Cut-offs	Results for present study	
		DPMCA	EMSICA
CFI	≥0.90	0.938	0.913
GFI	≥0.90	0.922	0.906
AGFI	≥0.90	0.935	0.919
NFI	≥0.90	0.940	0.925
IFI	≥0.90	0.926	0.937
RMSEA	≤0.10	0.063	0.058
chi-square normalized by degrees of freedom	≤5	2.863	3.759

the greatest indirect effects; however, the indirect effect of NEPASRM on IPASRM is not significant. In addition, the variables CEPASRM, SIPASRM, and NEPASRM had the largest total/causal effects on IPASRM, respectively.

Results from estimation of fitness and validation indices for the structural models

In order to evaluate the fitness of structural models, seven evaluation criteria including Comparative fit index (CFI), Goodness of fit index (GFI), Adjusted Goodness of Fit Index (AGFI), Normed fit index (NFI), Incremental Fit Index (IFI), Root Mean Square Error of Approximation (RMSEA), and chi-square normalized by degrees of freedom (CMIN/DF) were applied. Acceptable obtained values for the two structural models tested in this study have been presented in Table 6. The Comparison of the fitness criteria obtained for DPMCA with acceptable values shows that the model is of suitable validity; Besides, the fitness criteria confirmed the validity of EMSICA (Table 6).

Conclusion and policy implications

The main purpose of the present study was to analyze the intentions towards participation in ASR management, using two EMSICA and DPMCA frameworks. The results demonstrated that in DPMCA, APASRM is the strongest determinant of IPASRM. According to DPMCA, farmers' positive attitudes toward participation in collective ASR management measures, highly depend on the understanding of the positive consequences of their participation. In other words, farmers should recognize that by participating and taking collective actions for ASR management, they (as the agricultural community) and the whole region would have tangible benefits in terms of water, agriculture, and economy. Therefore, it is recommended that some local training workshops and courses get arranged for farmers in this area. It is worth mentioning that in these training course,s the outcomes and benefits of farmers' participation in collective measures of ASR management shall be addressed and emphasized. The main outcomes and benefits are including solving agricultural water shortage problems, preventing migration, raising groundwater level, reducing water pollution, and producing healthy agriculture crops. In fact, it should be kept in mind that each of the aforementioned points should be supported with valid reference to the scientific contents. (which have become understandable messages for farmers). The results of running DPMCA also revealed that PBCPASRM positively and significantly affected IPASRM. This result indicated that according to the DPMCA social identity model, farmers believed that participation in the collective actions related to ASR management was not beyond their capability and control; that is, they have reached a desirable level of self-confidence in their ability to participate in the collective actions of ASR management, and this self-confidence has a positive effect on their IPASRM. Such a result might be recognized as a turning point for sustainable water resources management programs, interventionists and managers/policy-makers of ASR management. Because, in such circumstances, there is no need to spend much time and financial or human resources for strengthening the self-efficacy and self-confidence of farmers, so that they can participate in collective actions of ASR. The insignificance of the effect of SNPASRM on IPASRM supports such a conclusion either. This result shows that farmers in their decisions to participate in collective ASR management activities, are not influenced by possible beliefs dictated by others.

CEPASRM was the strongest direct determinant of IPASRM in EMSICA, which affected that positively. From this result, it can be inferred that farmers' beliefs about the effectiveness of their collective and participatory actions might play an important role in increasing their intentions and motivations to participate in ASR management. In other words, if farmers conclude that collective actions of ASR management can have significant and positive consequences for improving water-related crises in the region, then they would be more willing to participate in that action. They may even spontaneously initiate such collective actions and

encourage other organizations and stakeholders to play more active roles. One of the best strategies to raise awareness and enlightenment on the effectiveness of collective actions in ASR management is the application of successful national and international experiences of collective/social environmental crisis management actions. In this regard, it is suggested that the institutions responsible for the implementation of sustainable water management programs use such strategies to form this belief that relying on *collective will* and the effectiveness of participatory measures in projects such as ASR management can overcome many problems.

NEPASRM negatively and significantly affected IPASRM. It can be concluded that beliefs, feelings, and reactions such as anger, pessimism, etc. towards collective actions in the field of ASR management can reduce farmers' willingness towards participation. Considering that the formation of such negative feelings about participation is generally related to farmers' previous and personal experience of disputes with various stakeholders (especially governmental stakeholders), lack of mutual trust, and stakeholders' effort to maximize their share of the collective interest, it is recommended that the share of participation, decision-making power, authority, job descriptions, etc. be specified accurately in the implementation of ASR management. Furthermore, it is recommended that each stakeholder involved in the collective ASR management, provide an executive guarantee/commitment to perform his/her duties. This would build trust in the agricultural community. Building trust also reduces negative emotions and strengthens IPASRM. Based on the results of running DPMCA and EMSICA frameworks, SIPASRM affected IPASRM positively and significantly. This suggests that both social identity models of collective action see SIPASRM as an undeniable requirement for farmers' willingness to participate in collective ASR management. In other words, in order to strengthening IPASRM, they need to find an identity and feel that the group members and their *personal selves* have no meaning without each other. In such a situation, the individual interests of each farmer would be in line with the collective interests of the group involved in ASR management. Such convergence in the individual and group interest of farmers might have a synergetic and constructive effect on IPASRM and effectiveness of ASR management. In this regard, it is recommended that policy-makers, planners, managers, and practitioners of sustainable water resources management programs (like ASR management projects) use the participation and consensus of farmers in various stages of the projects such as diagnosis and contextualization of the problems, plannings, implementations, and evaluations. This would lead to the formation of a social identity and then they would consider ASR management project as their own; therefore, achieving collective goals would be equivalent to achieving individual goals. Such a collective and *we thinking system* would ultimately strengthen IPASRM and the effectiveness of policies and programs.

The main take-home massage of the present research is that for the first time in the world, social identity models of collective actions have been used in conceptualizing IPASRM. The results of this study showed that social identity models of collective action have a good capability in predicting IPASRM; though, DPMCA has more explanatory power than EMSICA. This study introduces the formation of a *collective and we thinking system,* as a significant basis of any policy, program, and intervention in the field of sustainable ASR and water resource management, in agricultural communities.

This research had three limitations that should be mentioned and suggestions for future researchers should be made based on them. First, in this study, the self-reporting system was used to collect the required data, and the results were interpreted based on the self-reports of the respondents in Fashafuyeh plain. Future researchers can use non-self-reporting methods such as case studies, focus groups, etc. to collect similar information. This can help increase the plausibility of research results. Second, in this study, in order to strengthen the feasibility of the research process, simplified versions of social identity models of collective action were used. Future researchers can develop these models by adding other social and cultural variables. Thirdly, this study was conducted only in Fashafuyeh plain and its results can be used in other geographical areas that have common characteristics with this plain. However, in other geographical areas that have different characteristics, separate researches should be conducted. Conducting such researches can help to cross-validate the results of the current research and increase their generalizability. In this regard, it is suggested that future researchers use social identity models of collective action to manage groundwater water resources in other plains.

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. Written informed consent from the patients/participants or patients/participants legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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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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"If it weren't for COVID-19...": Counterfactual arguments influence support for climate change policies *via* cross-domain moral licensing or moral consistency effects

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In two studies, we investigated whether counterfactual messages (i.e., "If... then...") on the economic costs of past public policies influence support for future climate change policies. In Study 1, we tested whether the effect of upward counterfactual messages depended on their referring (or not) to the COVID-19 pandemic. Results showed lower support for a future climate change policy when the past expenses evoked by the upward counterfactual messages were attributed to COVID-19. In Study 2, we combined upward counterfactuals with downward counterfactuals presenting past economic efforts to deal with the COVID-19 pandemic as a moral credit. Results showed that exposure to downward counterfactuals decreased support for climate change policies among participants with low endorsement of anti-COVID-19 measures, whereas it increased support among participants with high endorsement. Discussion focuses on the conditions under which counterfactual communication may activate cross-dimensional moral licensing or moral consistency effects, influencing support for climate change policies.

KEYWORDS

COVID-19, climate change, counterfactual communication, moral licensing, moral credits, moral consistency

Introduction

Since its emergence in early 2020, the COVID-19 pandemic has understandably monopolized public opinion and collective economic efforts to tackle it. This threat to citizens' health and safety, the sweeping measures that national governments have adopted to address it, and their economic repercussions, have cast some shadow on other relevant and urgent problems, such as global warming and climate change, and might continue to affect the way the public sees them. A YouGov poll conducted in 11 European countries

showed that where the economy was most hardly hit by the pandemic, or where economic conditions were already precarious, such as in Spain, Portugal, Greece, and Italy, a large proportion of citizens (from 58 to 66%) ranked economic recovery from the COVID-19 pandemic as a higher priority than environmental sustainability (YouGov, 2020). Consistently, past research (Ecker et al., 2020) found that framing climate change as a secondary issue during the pandemic emergency reduces citizens' environmental concern and support for mitigation policies. As the consequences of the COVID-19 continue to affect the economic conditions of many countries, some politicians and actors in the public discourse might argue against the adoption of pro-environmental policies stating that climate change policies could have been adopted, if it were not for COVID-19 and its repercussions on the economy. Some citizens might find these arguments convincing and use past economic turmoil as an excuse not to support future collective commitment to tackle climate change.

In this paper we investigated whether communication on COVID-19 influences support for climate change policies. Specifically, in two studies we analyzed for the first time whether an upward counterfactual (i.e., "If only…") statement on past public expenses to curb the spread of the pandemic can be used as an excuse for withdrawing support for a future climate change policy, and whether downward counterfactual statements on public health outcomes can strengthen or hinder the persuasiveness of such excuse.

Theoretical background

The effects of communication on the economic costs of climate change policies

Past research has shown that citizens' support for climate change policies is affected by communication on their expected costs (DeGolia et al., 2019) and benefits (Bain et al., 2012; Bertolotti and Catellani, 2014; Stecula and Merkley, 2019). Politicians and interest groups opposing climate change policies sometimes exploit the persuasiveness of economic arguments, framing the adoption of environmental policies as a trade-off between future environmental benefits and future economic costs or losses (Ecker et al., 2020). Economic arguments have been shown to be effective not only with those who are already against the climate change policy (Whitmarsh and Capstick, 2018; Leiserowitz et al., 2020), but also with those who agree with the policy in principle (Bertolotti et al., 2021).

Economic arguments against the adoption of climate change policies are often formulated in *prefactual* terms focusing on the anticipated negative outcomes of these policies (e.g., "If we regulate carbon emissions, we will impose excessive burdens on companies in the energy and manufacturing sectors"). Prefactuals are conditional propositions (if… then…, Byrne and Egan, 2004; Epstude et al., 2016) simulating how present or future actions and decisions can lead to a certain outcome in the future. Past research has shown the persuasive force of a prefactual communication of this type (Bertolotti and Catellani, 2014, 2015; Bertolotti et al., 2021). But economic arguments against climate change policies may be also formulated in *counterfactual* terms, focusing on how past events could have made their adoption more feasible in the present (e.g., "If the economy had been in better conditions, we would have been able to make investments in renewable energy sources"). Counterfactuals (Roese, 1997; Catellani and Covelli, 2013) are conditional propositions simulating how things could have been different if some element of the past had been altered. Individuals can mentally simulate either *better* or *worse* alternatives to reality, thus formulating *upward* or *downward* counterfactuals, respectively (Sanna, 1998; Eisma et al., 2021).

Past research indicates that counterfactuals partially obfuscate the persuasive intent of the speakers and allow them to make statements without fully committing to the hypothetical scenarios they propose (Fiedler and Mata, 2013), thus preventing possible backlash for negative or controversial statements (Catellani and Bertolotti, 2014; Bertolotti and Catellani, 2018). By establishing a link between a policy under discussion and an unmodifiable past event, a counterfactual statement is likely to reduce the need for the speakers to justify their position against the adoption of the policy, blaming said past event for it.

The persuasiveness of an economic argument against the adoption of climate change policies might be therefore enhanced by claiming that the policy could have been adopted "if only…" the economic conditions were different, rather than by directly rejecting the policy itself. No empirical studies have tested this hypothesis, so far. In the present research we explored whether the COVID-19 pandemic and its related exceptional public expenses provide an adequate basis for counterfactual arguments against the adoption of climate change policies.

Upward counterfactuals focused on COVID-19 as an excuse to not support climate change policies

Counterfactual thinking is often triggered by events that are perceived as a deviation from the routine (Kahneman and Miller, 1986) or social norms (Catellani and Milesi, 2001; Catellani et al., 2004; Catellani and Milesi, 2005; Halpern and Hitchcock, 2015). When individuals detect a deviation from normality, they mentally simulate how things would have gone if a supposedly disruptive element was removed. In doing so, they focus on a specific element or actor in the event (Medvec et al., 1995; Gerstenberg et al., 2012; Alicke et al., 2015), attributing it a prominent causal role (McClure et al., 2007), and a certain degree of responsibility for the final outcome (Zultan et al., 2012; Catellani et al., 2021). Another factor that often triggers counterfactual thinking is the negative valence of events and outcomes, as individuals are motivated to figure out how things

could have been better if only things had gone differently in the past. Past research has shown that when people experience negative outcomes, or reflect on them, they tend to spontaneously generate more *upward* counterfactuals, i.e., hypothetical comparisons with how things would have gone *better* otherwise, than *downward* counterfactuals, i.e., hypothetical comparisons with how things would have gone *worse* (Kahneman and Miller, 1986; Mandel, 2003).

Since exceptional and negative events tend to trigger upward counterfactuals, an event such as the COVID-19 pandemic has likely made such counterfactual thoughts highly available to individuals' minds across a range of situations, including when public policies are discussed. As several countries were in the process of discussing their plans for climate mitigation right when the pandemic struck, the heightened availability of counterfactual thoughts might be exploited to explain decisions taken (or not taken) regarding climate change policies. In this vein, Ecker et al. (2020) presented participants with a fictional newspaper article arguing that given the sudden and extreme negative consequences of the pandemic on the economic situation, climate change policies should take a "back seat" for a while. Such argument implicitly hints at a counterfactual scenario (i.e., "If the pandemic had not occurred, we could have focused on climate change") and the results of this study showed that exposure to this argument indeed resulted in decreased concern for climate change and lower support for mitigation policies. A temporary disengagement from the climate change issue was therefore apparently excused by the global health emergency.

Past research indicates that upward counterfactual statements can be effectively employed as excuses (Wong, 2010; Catellani and Bertolotti, 2014). For example, they can effectively influence recipients' evaluations of politicians' past behavior, resulting in more lenient attributions of responsibility for their inappropriate or insufficient action. Politicians can effectively defend their poor results by saying that things would have gone better, if the conditions had been different or if the opposition had not countered their efforts (Catellani and Covelli, 2013; Catellani and Bertolotti, 2014). Further research showed that individuals use counterfactual thinking to excuse their past failures and maintain a positive self-esteem (McCrea, 2008). Crucially, counterfactual excuse has also the effect of reducing one's commitment to a task or goal and the intention to achieve better results in the future (Mercier et al., 2017; Smallman and Summerville, 2018). Upward counterfactual arguments focusing on an exceptional event, such as the COVID-19 pandemic, may therefore have a similar effect on citizens' support for future collective efforts, as well.

Downward counterfactuals focused on COVID-19 as triggers of moral licensing versus moral consistency

Upward counterfactual excuses of the type described above may be accompanied by downward counterfactuals stating that the consequences of the COVID-19 would have been even *worse* if the public expenses to curb the spread of the virus had not been made. Exposure to downward counterfactuals of this type might moderate the effect of the upward counterfactual excuses, *via* the activation of a moral credit (Nisan, 1991). Focusing on the collective efforts undertaken in the recent past and the negative outcome they prevented (in this case greater spread of the virus, more hospitalizations, and eventually more deaths), downward counterfactuals might provide a moral credit which individuals may be induced to "spend" by retaining their support for climate change policies. This possibility is consistent with the results of past research on *moral licensing* (Monin and Miller, 2001), namely, the tendency to use past (moral) actions to excuse present and future inaction (or immoral action).

According to the theory of moral licensing, moral choices made in the past may license individuals to engage in immoral or unethical behaviors in the future. This is due to the human propensity to reduce uncertainty by anchoring morality judgments (and self-judgments in particular) to past virtuous behaviors (Merritt et al., 2010; Merritt et al., 2012). Using the metaphor of a moral bank account, individuals gain moral credits (Nisan, 1991) by performing good deeds and spend them by committing bad deeds (Hollander, 1958). By acquiring and maintaining a positive moral balance, individuals feel licensed to engage in questionable or immoral acts. To do so, they often engage in a process of selective and strategic recall, remembering past virtuous actions to be indulgent with themselves, and feel more justified when they engage in subsequent immoral behaviors (Effron et al., 2009; Mazar and Zhong, 2010; Jordan et al., 2011; Conway and Peetz, 2012).

Counterfactual thinking can be used as a subtle strategy to acquire moral credits (Effron, 2014), claiming them not from actual moral actions, but from the immoral actions that one could have pursued in the past. In other words, individuals can evoke an "*immoral road not taken*" by mentally simulating an immoral choice they avoided in the past, to acquire a moral credit in the present or the future (Effron et al., 2012, 2013). So far, research has investigated counterfactual thinking as an intra-personal process that may be related to moral licensing (Blanken et al., 2015; Simbrunner and Schlegelmilch, 2017 for meta-analytical reviews). In the present research, for the first time we explored the possibility that exposure to counterfactual communication can also trigger moral licensing. We tested whether reading a downward counterfactual message, describing how the COVID-19 pandemic would have had worse consequences if adequate public expenses had not been undertaken, may influence recipients' support for public expenses in another domain, that is, the mitigation of climate change.

Past environmental research has already detected *intra-domain* moral licensing (Tiefenbeck et al., 2013; Truelove et al., 2014; Gholamzadehmir et al., 2019), while only few studies have investigated *inter-domain* moral licensing (e.g., Mazar and Zhong, 2010; Miller and Effron, 2010), that is, tested whether a person's moral behavior in one domain is used to justify less moral behavior in another domain. However, it should be noted that this stream of research has gained momentum in the recent literature,

as evidenced by recent works on intra- vs. inter-domain effects (Reimers et al., 2022). So, in the present research for the first time we tested whether decisions in the environmental domain may be influenced by counterfactual reference to past decisions in another domain, namely, the public health domain. Moral licensing, however, is just one possible outcome of evoking past moral behavior. When individuals are strongly identified with a moral cause, recalling past related behavior may make commitment salient, and consequently motivate them to act in a consistent way to uphold their moral identity (Shao et al., 2008). Therefore, in the case of people who are highly committed to a moral cause, recalling a past collective moral behavior may induce a *moral consistency* effect, that is, an increased (rather than decreased) likelihood of engaging in further moral behaviors (Conway and Peetz, 2012; Mullen and Monin, 2016). It should be noted that past literature has highlighted some limitations in the application of the moral licensing theory. For instance, Blanken et al. (2015) highlighted that the effect size and the conditions under which the moral licensing effects take place are still uncertain. Moreover, according to Lasarov and Hoffmann (2020), most of the existing literature on moral licensing has overlooked the role of social influences.

In the present paper, we aimed to extend the literature on this topic by investigating the cross-domain moral licensing and moral consistency effects that may be evoked by reference to recent collective efforts to contain the COVID-19 pandemic. These efforts, and the measures and restrictions they entailed, were extensively debated in Italy (as in other nations, e.g., Druckman et al., 2021), polarizing citizens between those who saw them as necessary and useful in dealing with the emergency (Conway et al., 2020; Beria and Lunkar, 2021), and those who saw them as a collective nuisance or even as a threat to their freedom and identity (Conway et al., 2020; Beria and Lunkar, 2021). We expected that a counterfactual message evoking past efforts to contain the COVID-19 pandemic as a moral credit (i.e., presenting them as an action without which an immoral negative outcome would have occurred) would trigger an inter-domain moral licensing effect in the latter group, as these citizens would be less inclined to support other future policies, particularly when associated with the prospect of further economic costs and hardships. Conversely, we expected that the same counterfactual would trigger an inter-domain moral consistency effect in people who agreed with and endorsed the measures undertaken to contain the pandemic (e.g., mask mandates, restrictions, vaccination policies). Being exposed to a counterfactual of this type would bolster their moral identity and, in turn, lead them to be more willing to engage in further collective economic efforts aimed at the common good, such as climate mitigation.

Overview

Starting from the above, in our research we presented participants with upward counterfactuals stating that, were it not for past public policies expenses due to the COVID-19 pandemic, further economic efforts to implement climate change policies could have been adopted. We expected exposure to such counterfactuals to reduce support for the adoption of a climate change mitigation policy. This would be the case because a negative, unexpected, and uncontrollable event such as the COVID-19 pandemic provides a very accessible and convenient excuse to participants considering the opportunity to adopt the climate change policy.

In two studies, we investigated to what extent, and under what conditions, counterfactual communication on COVID-19 and related public expenses would affect support for the future adoption of climate change policies. We presented participants with a simulated political debate scenario, where two opposing parties discussed a climate change policy.

In Study 1, we measured the effectiveness of upward counterfactual messages stating that the economic costs of a climate change policy would be affordable, were it not for past public expenses. The scenario was manipulated to include (or not include) the COVID-19 pandemic as the primary motivation for those past expenses. We expected that the counterfactual messages would be more effective, leading to lower support for the climate change policy, when the COVID-19 pandemic was mentioned. Since COVID-19 is a break from "normal" affairs, counterfactual messages focused on it would provide a convincing counterfactual excuse for the unwillingness to support climate action. Such an expectation, which will be formalized in the following section, has theoretical basis in the cross-domain moral licensing effects that have been extensively investigated in the existing literature (e.g., Mazar and Zhong, 2010; Tiefenbeck et al., 2013; see also Theoretical Framework above).

In Study 2, we tested whether the persuasiveness of the upward counterfactual employed in Study 1 would be increased or decreased by the addition of a downward counterfactual hinting at the adoption of the costly anti-COVID measures as a moral credit or, more precisely, as an "immoral road not taken" (i.e., "If we had not imposed restrictions, the number of sick and dead citizens would have been greater"). Put differently, we investigated whether the effect of the upward counterfactual would be boosted or, conversely, hindered, by combining such counterfactual excuse with a downward counterfactual presenting past efforts to deal with the COVID-19 pandemic as a moral credit, that is, as something that prevented an immoral outcome, such as a worse public health situation. We expected that exposure to downward counterfactuals of this type would trigger two opposite outcomes, depending on the participants' endorsement of the anti-COVID-19 measures the message referred to. Participants with a lower endorsement of the anti-COVID-19 measures would show a form of inter-domain moral licensing (Mazar and Zhong, 2010; Miller and Effron, 2010), "exploiting" the economic sacrifices endured to deal with the pandemic as an excuse to drop their support for further economic sacrifices to implement the climate change policy. On the contrary, participants with a lower endorsement of the

anti-COVID-19 measures would show a form of inter-domain moral consistency (Conway and Peetz, 2012), seeing the future engagement in collective economic efforts to address climate change as a continuation of past collective efforts to curb the spread of the pandemic.

Study 1

In Study 1, participants read a simulated political debate on the adoption of a climate change policy, consisting of two political statements from two different parties, one advocating for the adoption of the policy and the other responding with a counterfactual message arguing that the policy could have been adopted, if only other expensive collective efforts had not been already undertaken in the past. Before reading the scenario, participants were randomly attributed to two different conditions providing different scenarios as the backdrop of the debate. One scenario referred to past public expenses made within the context of the COVID-19 pandemic in a fictional country. The other scenario also referred to past public expenses in a fictional country, but without referring to the COVID-19 pandemic. We formulated the following hypothesis:

> *Hypothesis 1*: Participants who read an upward counterfactual message in a scenario in which the COVID-19 pandemic is present support a climate change policy less than participants who read the same message in a scenario in which reference to the COVID-19 pandemic is absent.

This would indicate that the pandemic (and the collective response to it) can be successfully used as the focus of a counterfactual excuse not to engage in further collective endeavors, such as climate change mitigation.

Methods

Participants and procedure

One hundred forty-nine individuals (47.3% males and 52.7% females, age $M = 40.3$, $SD = 17.1$) took part voluntarily in the study. The participants were recruited using a snowball sampling technique. Prospective participants were contacted by students through personal contacts and social media in December 2021. Participation took place online through the Qualtrics platform, and required approximately 15 min. After reading some introductory information, participants were presented with two alternative versions of a scenario about past public expenses in a fictional country, and only in one of them past public expenses were referred to the COVID-19 pandemic. The two versions of the scenario were around 70 words long (for the full text see Table 1, upper pane). Afterwards, participants were presented with a message from the spokesperson of Party A, advocating the reduction of greenhouse emissions through a national plan for renewable energies, and a message from the spokesperson of Party B, arguing against such plan with upward counterfactual sentences. The gist of all counterfactual sentences was that that the climate change plan could have been adopted, if only the country had not already had to face such large public expenditure (for the full text see Table 1, lower pane). After reading the debate

TABLE 1 Full text of the alternative versions of the scenario and the following debate between Party A and Party B (Study 1).

Past public expenses

Focus on COVID-19	Absence of focus on COVID-19
Imagine you live in a country where political elections are going to take place soon. The fictional country has been experiencing economic welfare. In the last few years, the economy has grown, even during the COVID-19 pandemic, and a few months before the elections the trend is still positive, despite the costs incurred to tackle the health emergency. The state finances are close to balance and the predictions about the national debt are positive.	Imagine you live in a country where political elections are going to take place soon. The fictional country has been experiencing economic welfare. In the last few years, the economy has grown and a few months before the elections the trend is positive. The state finances are balanced and the predictions about the national debt are positive.

Future public expenses

Below are two statements describing the respective positions of Party A and Party B on the issue of climate change policies. The messages are excerpts of declarations by the two parties' spokespeople.

Party A's message

Our position is that the fight against global warming must be addressed as soon as possible, making an important effort to reduce greenhouse gas emissions. We are therefore proposing a major national plan to fully convert electricity production from traditional fossil sources to renewable sources. This will be done by phasing out the current coal, oil and gas plants and replacing them with wind farms, hydroelectric plans, and solar panels. If we adopt this plan, we will obtain benefits for the environment and make our country's energy production completely sustainable.

Party B's message

Our position is that we could have adopted the national plan proposed by our opponents, if only we had not already incurred huge costs. If the country had not already spent a lot of money to support the economy, we could have adopted this plan. We could have closed old power plants and converted the energy sector if only we had not already lost many jobs because of the economic crisis.

extract, all participants were asked to respond to a series of questions.

Measures

Support for the climate change policy

The support for the proposed policy was measured using the following three items (Bertolotti et al., 2021): "To what extent do you agree with Party A's plan on renewable energy?," rated on a 7-point scale ranging from 1 ("fully disagree") to 7 ("fully agree"); "Which priority would you attribute to this energy plan in the current political agenda?," rated on a similar 7-point scale ranging from 1 ("low priority") to 7 ("high priority"); "How much national funds would you invest in this energy plan in percentage?," rated on a 7-point scale ranging from 1 ("less than 1%") to 7 ("More than 20%"). The three item scores (Cronbach's $\alpha = 0.797$) were averaged into a single policy support index.

Climate change belief

Participants' belief in climate change was measured with two items, adapted from previous research on climate change beliefs and attitudes (ESS, 2016): "To what extent do you think that the world's climate is changing?," rated on a 7-point scale ranging from 1 ("Not at all") to 7 ("Very much"); "Do you attribute climate change to natural or human factors?," rated on a 7-point scale ranging from 1 ("Natural factors") to 7 ("Human factors"), plus an additional option ("The world's climate is not changing," coded as 0). The two item scores, $r(269) = 0.456$, $p < 0.001$, were averaged into a single climate change belief index.

Biospheric values

As a measure of endorsement of biospheric values (De Groot and Steg, 2008), participants were asked to rate, on a 5-point scale, the importance given to "Protecting the environment" and "Respecting the Earth," from 1 ("Against my principles") to 5 ("Very important"). The two items, $r(149) = 0.753$, $p < 0.001$, were then averaged into a single biospheric values index.

Socio-demographic variables

These variables included age, gender, education, and profession.

Results

Preliminary analyses

Participants were on average moderately supportive of the climate change policy, $M = 4.68$, $SD = 1.23$. Support for climate change policies ($M = 4.68$, $SD = 1.23$) was positively correlated with belief in climate change ($M = 5.85$, $SD = 1.29$), $r(147) = 0.423$, $p < 0.001$, and the endorsement of biospheric values ($M = 4.45$, $SD = 0.67$), $r(147) = 0.340$, $p < 0.001$.

Predictors and potential moderators of support for the climate change policy

To test our hypothesis, we ran a regression model using PROCESS (Hayes, 2022, Model 1), with participants' support as the dependent variable and the presence/absence of focus on COVID-19 as a predictor (contrast-coded −1 for the absence of COVID-19 emergency and +1 for the presence of it). Additionally, we explored the possibility that participants' environmental commitment, measured as either belief in climate change or the endorsement of biospheric values, would moderate this effect (e.g., van den Broek et al., 2017). Two separate regression models were run, to account for the different psychometric properties of the two measures, in particular the substantial skewness of the climate change belief measure. Finally, we included participants' political orientation as a covariate.

The scenario manipulation showed a trend toward statistical significance, $B = -0.17$, $SE = 0.09$; $t = -1.93$, $p = 0.055$, 95% CI [−0.35; 0.01]. Participants' support was significantly lower in the COVID-19 condition ($M = 4.49$, $SD = 1.21$) than in the control condition, where reference to COVID-19 was absent ($M = 4.89$, $SD = 1.23$), $t(147) = 2.00$, $p = 0.048$. This result supported our *H1*. Belief in climate change also had a strong significant main effect on the support for the climate change policy, $B = 0.4$, $SE = 0.07$; $t = 5.58$, $p < 0.001$, 95% *CI* [0.26; 0.54], with higher belief in climate change leading to higher support for the climate change policy. The interaction between belief in climate change and the scenario manipulation was however not significant, $B = -0.04$, $SE = 0.07$; $t = -0.63$, $p = 0.532$, 95% *CI* [−0.19; 0.1], showing that the main effect of the scenario manipulation was not moderated by belief in climate change. Finally, the effect of the political orientation covariate was also statistically significant, $B = -0.05$, $SE = 0.03$; $t = 2.04$, $p = 0.043$, 95% *CI* [−0.1; −0.01], showing greater support for the climate change policy among left-wing participants. Figure 1 shows the main effect of the scenario manipulation at different levels of belief in climate change.

We then replicated the same regression model, but this time with biospheric values as the moderator of the effect of the scenario manipulation. We found a main effect of the scenario manipulation approaching statistical significance, $B = -0.16$, $SE = 0.09$; $t = -1.72$, $p = 0.087$, 95% *CI* [−0.35; 0.02]. We also found a significant main effect of the endorsement of biospheric values, $B = 0.64$, $SE = 0.14$; $t = 4.42$, $p < 0.001$, 95% *CI* [0.35; 0.92], while, again, the interaction with the scenario manipulation was not significant, $B = -0.18$, $SE = 0.14$; $t = -1.22$, $p = 0.223$, 95% *CI* [−0.46; 0.11], showing that the effect of the scenario manipulation was not moderated by the endorsement of biospheric values. The full results of the two regression models are reported in Table 2.

To sum up, our results corroborated our *H1* hypothesis. The counterfactual message employed by the spokesperson of party B resulted in lower support for the climate change policy when participants had previously read that past public expenses had been devoted to fight the COVID-19 emergency than when they had simply read a message on past public expenses. Therefore, the counterfactual argument against the adoption of the climate

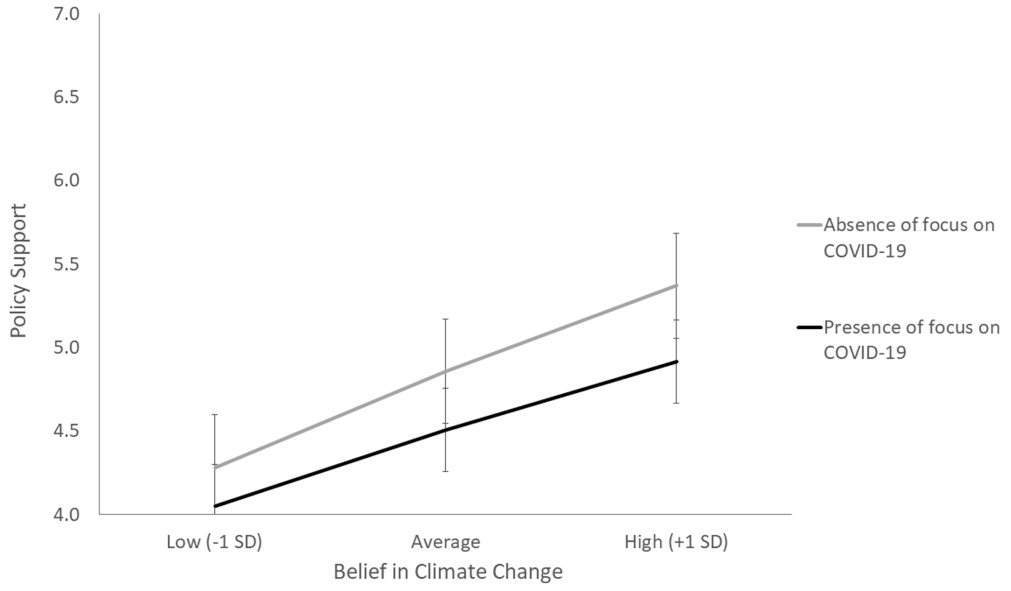

FIGURE 1
Policy support as a function of the experimental manipulation of the scenario and participants' belief in climate change.

TABLE 2 Hierarchical regression models of support for the climate change policy (Study 1).

	Model 1						Model 2					
	B	S.E.	*t*	*p*	LL 95% *CI*	UL 95% *CI*	*B*	S.E.	*t*	*p*	LL 95% *CI*	UL 95% *CI*
(Constant)	5.062	0.207	24.441	0.000	4.65	5.47	5.079	0.212	23.983	0.000	4.66	5.50
Political Orientation	−0.053	0.026	2.039	0.043*	−0.011	0.000	−0.057	0.028	2.135	0.035	−0.11	0.00
Counterfactual Focus	−0.175	0.090	1.935	0.055	−0.35	0.00	−0.161	0.094	1.972	0.049*	−0.35	0.00
Belief in Clim. Ch.	0.400	0.090	5.578	0.000**	0.26	0.54						
Biospheric values							0.638	0.144	4.42	0.000**	0.35	0.92
CF Focus × Belief in Clim. Ch.	−0.046	0.073	0.626	0.532	−0.19	−0.10						
CF Focus × Biospheric values							−0.177	0.145	1.22	0.223	−0.46	0.11

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

change policy employed by Party B was more effective when the "abnormal" element of the pandemic had been previously introduced in the scenario than when it had not. This effect was not moderated by participants' beliefs and values related to climate change.

Study 2

In Study 2, we tested whether the persuasiveness of the counterfactual message against the adoption of a climate change policy would be increased, or instead reduced, in a new condition in which party A and Party B discussed the pandemic-related efforts before discussing the climate change policy, with Party B claiming that "if costly anti-COVID measures had not been enacted, we would have suffered a much higher human cost." The anti-COVID measures described in the scenario were reminiscent of those adopted in Italy (i.e., participants' own country of residence), and included social distancing, use of personal protective equipment, travel restrictions, etc.…). We expected that this introduction of a downward counterfactual message hinting at an "immoral road not taken" (Effron, 2014) would trigger either a moral licensing or a moral consistency effect on support for the climate change policy, depending on participants' own stance on the anti-COVID measures.

Consequently, we formulated the following hypothesis.

> *Hypothesis 2*: After exposure (versus non-exposure) to downward counterfactuals on past economic efforts to tackle a looming problem with consequences on a wide range of levels (such as the COVID-19 pandemic), participants with low endorsement of measures aimed at addressing such a

problem show lower support for future economic efforts to implement a climate change policy (*H2*a, moral licensing effect). Conversely, after exposure (versus non-exposure) to the same downward counterfactuals, participants with high endorsement of the abovementioned measures show higher support for economic efforts to implement a climate change policy (*H2*b, moral consistency effect).

Methods

Participants and procedure

One hundred forty-seven Italian participants (47.2% males, 52.8% females, and 0.7% other, age $M = 40.4$, $SD = 16.2$) took part voluntarily in the study. The procedure was the same of Study 1, with participants being presented a fictional debate between two parties.

Participants in the experimental condition ($N = 68$) read two excerpts of the debate between Party A and Party B. In the first excerpt, the two Parties discussed the public health measures adopted in the country to fight the COVID-19 pandemic. Party A stressed the importance of the economic expenses made to increase social distancing, the use of personal devices and the restrictions on mass gatherings, including shutting down pubs and restaurants, and public events. Party B further remarked that "if those expenses had not been made, there would have been much more severe negative consequences on citizens' health." The full text of this exchange is reported in Table 3. Then, participants were presented the same exchange between Party A and Party B employed in Study 1, with Party B again arguing that the renewable energy plan would have been possible, if only the nation had not already sustained severe economic repercussions from the adoption of anti-COVID measures. Participants in the control condition ($N = 79$) read only this second excerpt. All participants were then asked to answer some questions on what they had just read. A small number of participants ($N = 16$) failed an attention check and were consequently excluded from the main analyses.

Measures

The same items employed in Study 1 were used to measure support for the climate change policy, Chronbach's $\alpha = 0.745$, biospheric values, $r\ (128) = 0.698$, $p < 0.001$, and political orientation. Basic socio-demographic information was collected, as well.

Endorsement to anti-COVID measures

The respondents' opinion about anti-COVID19 policies was assessed using two items: "I think that it is fair that the Government limits its citizens' freedom of movement for health reasons"; and "Related to COVID-19 pandemic, the restrictions imposed by the Government to contain the spread of the virus are appropriate." Agreement with each statement was recorded on a 7-point scale ranging from 1 ("Completely disagree") to 7 ("Completely agree"). The two item scores, $r\ (126) = 0.580$, $p < 0.001$, were averaged into a single anti-COVID measures endorsement index.

Results

Preliminary analyses

As in Study 1, participants were on average moderately supportive of the climate change policy, $M = 5.00$, $SD = 1.13$. Support was positively correlated with both biospheric values ($M = 4.59$, $SD = 0.56$), $r\ (128) = 0.408$, $p < 0.001$, and endorsement of anti-COVID measures ($M = 5.02$, $SD = 1.28$), $r\ (127) = 0.296$, $p = 0.001$, and negatively correlated with political orientation, $r\ (128) = -0.218$, $p < 0.001$, indicating that left-leaning participants supported the proposed policy more than right-leaning participants.

Predictors of support for the climate change policy

To test our research hypothesis, we ran a regression model with the experimental condition as the main predictor, the endorsement of anti-COVID policies as a moderator, and participants' support for the climate change policy as the

TABLE 3 Additional text presented to participants in the experimental condition (Study 2). Counterfactuals are highlighted in italics.

Below are two statements describing the respective positions of Party A and Party B on the issue of public health policies. The messages are excerpts of declarations by the two parties' spokespeople.
Party A
Regarding the issue of health, our party intends to continue along the line followed in recent months by most of the world's governments to tackle the Covid-19 pandemic. We intend to finance the development of new medicines, to treat existing cases, and to continue testing vaccines to prevent the spread of the virus. As long as these treatments are available, however, we will have to continue to maintain existing measures, such as social distancing, the use of personal protective devices and restrictions on gatherings in public places. This could include other periods of closure for certain types of venues, the suspension of public events such as matches, shows and concerts, and other restrictions on transport and freedom of movement.
Party B
Our stance on health is similar to that of our opponents. *If we had not incurred serious economic costs in these months to tackle the pandemic, the consequences on citizens' health would have been worse*. If we had not imposed restrictions on many businesses, with the loss of jobs and the closure of many companies, the number of sick and dead citizens would have been greater. If we had not increased the public debt by worsening the state accounts, the health situation would be worse.

dependent variable. Biospheric values and political orientation were included in the model as covariates, based on the findings form Study 1 where both variables independently predicted support, but did not interact with the manipulated message.

The results of the full regression model are reported in Table 4. The strong positive association between biospheric values and support for the climate change policy found in Study 1 was found also in Study 2, $B = 0.66$, $SE = 0.17$; $t = 3.90$, $p < 0.001$, 95% *CI* [0.32; 1.00], whereas no significant association with the endorsement of anti-COVID measures, $B = -0.36$, $SE = 0.21$; $t = 1.69$, $p = 0.094$, 95% *CI* [−0.79;0.06], or political orientation, $B = -0.02$, $SE = 0.03$; $t = 0.61$, $p = 0.543$, 95% *CI* [−0.08; 0.04], emerged.

Results showed no main effect of the experimental condition, $B = -0.03$, $SE = 0.18$; $t = 0.18$, $p = 0.854$, 95% *CI* [−0.39; 0.32], while the predicted interaction effect was found, $B = 0.36$, $SE = 0.14$; $t = 2.58$, $p = 0.011$, 95% *CI* [0.08; 0.64]. Consistent with our *H2*a, participants with lower endorsement of the anti-COVID measures showed lower support for the policy in the experimental condition than in the control condition (Figure 2), as indicated by the negative conditional effect of the manipulation at low levels (−1 *SD*) of endorsement, $B = -0.50$, $SE = 0.26$; $t = 1.95$, $p = 0.054$, 95% *CI* [−1.00; 0.01]. Conversely, and consistent with our *H2*b, participants with higher endorsement of the anti-COVID measures showed higher support for the policy in the experimental condition than in the control condition, although the conditional effect at high levels of endorsement only approached significance, $B = 0.43$, $SE = 0.25$; $t = 1.71$, $p = 0.091$, 95% *CI* [−0.07; 0.93].

To sum up, the results of Study 2 confirmed our research hypothesis. The introduction of a downward counterfactual scenario according to which things could have been worse if it were not for their past effort to curb the COVID-19 pandemic determined opposite reactions as regards the adoption of a climate change policy, depending on participants' endorsement of anti-COVID measures. Among participants who did not consider the anti-COVID measures very useful and effective, the moral credit evoked by the "immoral road not taken" scenario hindered support for the climate change policy, thus showing evidence of a moral licensing effect. When reminded that things could have been worse if it were not for their past effort to curb the pandemic, these participants tended to refrain from committing to other future collective efforts to deal with the issue of climate change. Conversely, among participants who considered the anti-COVID measures useful, exposure to the same scenario increased support for the policy, suggesting the presence of a moral consistency effect. When reminded of the moral value of their past deeds (i.e., the costly, but life-saving measures to curb the pandemic), these participants extended the same commitment to other future efforts to save the planet.

General discussion

Our results showed that, overall, upward counterfactual economic arguments focused on the unforeseen public expenses to curb the COVID-19 pandemic (i.e., "We could have done it, if it were not for COVID-19") can be used as an excuse to convince citizens to withdraw their support for future climate mitigation efforts. Upward counterfactual arguments were indeed more convincing when presented in the context of an extra-ordinary, routine-breaking event such as the COVID-19 pandemic, compared to when they merely referred to past economic expenses (Study 1). When this type of excuse was combined with a downward counterfactual argument focused on the negative public health consequences avoided by such past expenses, however, a moderation effect of participants' attitude toward anti-COVID-19 measures emerged (Study 2). Among participants with low endorsement of these measures they reduced support for a proposed climate change policy, which is consistent with an inter-domain moral licensing effect. Conversely, among participants with high endorsement of the measures they increased support for the climate change policy, which is consistent with an inter-domain moral consistency effect.

These findings advance our understanding of communication in the domain of climate change policies, and in particular the effects of economic arguments against said policies, and how downward counterfactuals can trigger moral licensing or consistency effects across different domains.

First, whereas past research already indicated that economic arguments based on the future costs of climate change policies can be critical in undermining agreement with them (Bertolotti et al., 2021), results on how communication about public expenses sustained in the past can affect decisions about future public expenses were still missing. In our studies, counterfactuals regarding the economic and human costs of governmental

TABLE 4 Hierarchical regression model of support for the climate change policy (Study 2).

	B	S.E.	*t*	*p*	LL 95% *CI*	UL 95% *CI*
(Constant)	2.108	0.861	2.450	0.026	0.405	3.812
Biospheric values	0.660	0.170	3.895	0.001**	0.325	0.996
Political orientation	−0.019	0.031	0.610	0.543	−0.080	0.042
Presence versus absence downward *CF*	−0.033	0.179	0.184	0.854	−0.388	0.322
Endorsement of anti-COVID measures.	−0.361	0.214	1.688	0.094	−0.785	0.063
Presence versus absence downward *CF* × Endorsement of anti-COVID measures	0.365	0.142	2,575	0.011*	0.084	0.645

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

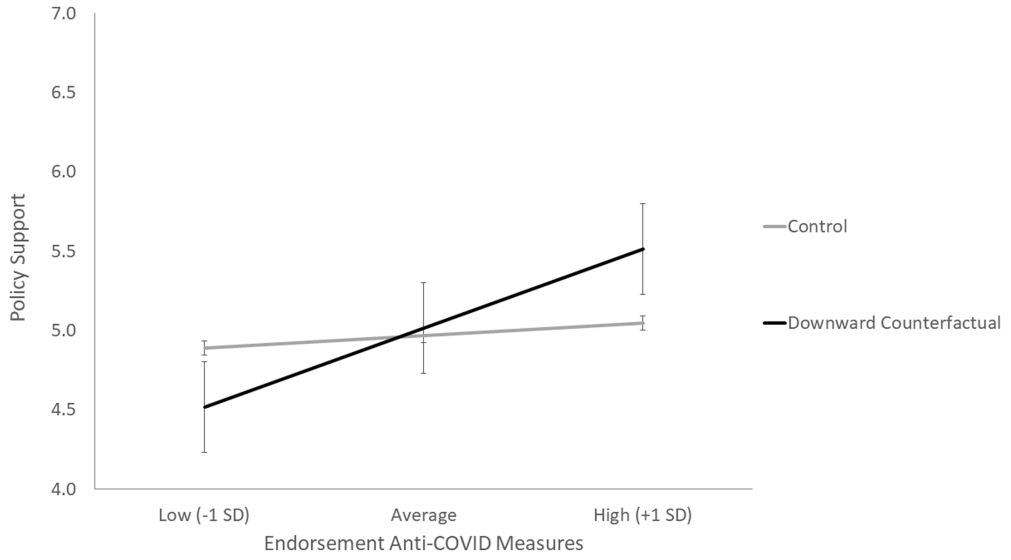

FIGURE 2
Policy support as a function of the experimental manipulation and participants' endorsement of anti-COVID measures (Study 2).

measures imposed to handle the COVID-19 pandemic were used to alter support for a future policy dealing with climate change. Past research has already established that counterfactual thinking can significantly affect reasoning and evaluative processes (Epstude and Roese, 2008), as individuals (and groups, Milesi & Catellani, 2011) are able to critically reassess past events, particularly those with negative, unexpected and unwanted outcomes, and imagine how things could have gone better. Further research has shown that this process can be strategically triggered by communication, focusing the audience's attention on what a certain actor could or should have done in the past, to change the audience' attributions and attitudes (Bertolotti et al., 2013; Bertolotti and Catellani, 2018; Catellani et al., 2021). Counterfactual excuses (Markman and Tetlock, 2000; Catellani and Bertolotti, 2014) can successfully deflect responsibility from oneself to a convenient external target, which can be consequently blamed for undesirable results, or indefensible behavior. Findings from our Study 1 indicate that the same mechanism can be used not only to excuse past behavior, but also to excuse future behavior (i.e., inaction in the daunting challenge to tackle global climate change). Furthermore, we found that the COVID-19 pandemic, being a negative, unforeseen, and uncontrollable event, provides a very convenient focus (Gerstenberg et al., 2012) for this type of counterfactual communication. Remarkably, this effect seemed to hold for all participants, including those with high endorsement of biospheric values, indicating that this type of argument might work not only for those who have relatively little interest in the issue of climate change (including the so-called climate skeptics, Maibach et al., 2011), but also for those who would otherwise strongly support all forms of climate action.

Second, our results on the effects of downward counterfactual arguments complement the existing research on moral licensing effects and their moderating individual factors. They show that counterfactual communication can be used to elicit a cross-domain moral licensing effect, but also that this effect can be substantially altered, and even reversed, by the pre-existing convictions on the domain where a moral credit is claimed. The factor we considered here, that is, the endorsement of the set of preventive measures adopted to counter the spread of the COVID-19 pandemic, might be seen as corresponding, at the collective action and policy level, to the intrinsic motivation for individual behavior investigated in previous research on the moderators of the moral licensing effect (Jordan et al., 2011; Conway and Peetz, 2012; Simbrunner and Schlegelmilch, 2017). Reference to a "immoral road not taken" can effectively convey one's reluctance and skepticism on a previous collective effort to a future one, resulting in disengagement and reduced support for it. If, instead, the past commitment to one issue is high, the moral credit framing conveyed by the counterfactual argument seems to make the moral norms underlying the former effort more salient, and their relevance to another domain more compelling.

As counterfactual thinking is known to enhance motivation and preparation in future self-relevant behaviors (Epstude and Roese, 2008; Ferrante et al., 2013; Hammell and Chan, 2016; Roese and Epstude, 2017), this mechanism might help explaining the inconsistent findings of past research on the consequences of claiming moral credits for past actions on future intentions and behaviors, particularly in the pro-environmental domain (Gholamzadehmir et al., 2019; Urban et al., 2019). Counterfactual communication might focus the attention on the moral dimension that the public health and environmental crisis have in common and empower citizens by making one averted disaster salient, helping them realize that another one can be prevented (thus

representing an instance of the so-called "*spillover effect*," Thøgersen and Crompton, 2009).

Our research has some limitations. A first limitation is the hypothetical nature of the scenario employed, which reduced the ecological validity of our findings. Furthermore, past research found that moral licensing effects appear to be weaker in hypothetical decisions than in real-world decisions (Batson and Thompson, 2001; Blanken et al., 2015). This implies that we might have been able to observe even stronger effects, if we had employed a more realistic scenario, and measured participants' actual decisions in it. Future research might explore this possibility, using additional measures to assess the intra-personal processes associated with these decisions (e.g., attitudinal changes, self-justification, or moral image bolstering, Effron, 2014; Barkal et al., 2015). A second limitation derives from the non-representative samples used in our two studies. Our research was conducted in Italy, which, as a YouGov survey showed (YouGov, 2020), is one of the countries where the dualism between prioritizing environmental transition vs. economic recovery was perceived as most critical, which might have made the Italian participants of our studies very sensitive to the type of communication employed in our experimental scenario. Future research might replicate a similar paradigm in different national and cultural environments, where different types of arguments in favor and against climate change policies are likely accessible to citizens (e.g., based on ideological or value-related polarization, Wolsko et al., 2016; Leiserowitz et al., 2021).

Conclusion

To conclude, our results show that counterfactuals regarding the expenses for facing the COVID-19 pandemic can affect citizens' attitudes toward an equally urgent but seemingly unrelated item in the global agenda, that is how to handle the environmental crisis. As the COVID-19 pandemic and its social and economic consequences are likely to continue dominating the public sphere for some time, we should expect it to interfere with climate change communication also in the future. The results of our research might give policy makers, governments, and public and private actors some insights on how to confront this additional hurdle to the adoption of urgently needed climate change policies. As our results demonstrated, whereas communication increasing the salience of recent collective economic sacrifices might hinder support for climate change policies, getting citizens to know that their past efforts were morally rightful, and did make a difference, might help them find new motivations to act responsibly also in the environmental domain.

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 CERPS (Ethics Committee for Research in Psychology) Catholic University of the Sacred Heart, Milan. The patients/participants provided their written informed consent to participate in this study.

Author contributions

MB: conceptualization, study design, data analysis, writing and editing. LV: data analysis, writing and editing. PC: supervision, conceptualization, study design, writing and editing. All authors contributed to the article and approved the submitted version.

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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Nature play in early childhood education: A systematic review and meta ethnography of qualitative research

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Play in nature-based environments in childhood education has positive benefits for child development. Although previous reviews showed the benefits of play in nature-based environments for child development they did not attempt to understand how and why nature-based environments contribute to play quality. This review aims to explore the value of play in nature-based environments compared to non-nature-based environments for developmental outcomes of young children (2–8 year). We searched for studies that investigated the relation between play and nature-based environments on the databases PsycINFO, ERIC, and Web of Science. Inclusion/exclusion criteria were: (1) the study focused on play in/on a nature based environment, (2) the study included participants between the age of 2–8 years, (3) it was an empirical study, (4) the study was conducted in the context of early childhood education (ECE), and (5) the study included participants without special needs or disabilities. Using these criteria we selected 28 qualitative studies with an overall sample size of N = 998 children aged 2–8 years. The studies were synthesized using an adaptation of Noblit and Hare's meta-ethnographic approach. Three overarching themes were found: (1) the aspects of play quality that are related to nature-based environments, (2) the aspects of nature-based environments that support play, and (3) the aspects of teacher-child interactions that contribute to nature play quality. The meta themes resonate with play theories and theories of the restorative value of nature. We draw on the qualitative data to refine and extend these theories, and to come up with a definition of the concept "nature play." This systematic review also sets a base for future research on play interventions in nature-based environments. We argue that (1) research will benefit from thoroughly conceptualizing the role of play in the development of young children, (2) using the affordances theory research will benefit from

moving beyond the individual play actions as a unit of analysis, and (3) from an educational perspective it is important to shift the focus of nature play to its benefits for children's cognitive development.

KEYWORDS

play, nature-based environment, play environment, early childhood education, nature play, cognitive development

Introduction

In early childhood education (ECE), play and learning are inextricably intertwined (Hirsh-Pasek, 2008). Play is often considered as a context for young children's learning and development, and can take place indoors (e.g., in a classroom) as well as outdoors (e.g., in a nature-based environment). However, outdoor play in ECE is often done for its value to relax and recover from the important play and learning time that takes place indoors. As a result, in ECE play in outdoor settings is not often valued for its potential benefits for children's learning development (Miranda et al., 2017). Recently, many studies have focused on play and learning in nature-based environments. Based on these studies, this review aims to explore the value of play in nature based environments in ECE. The research for this review was guided by the following question: what is the value of play in nature-based environments compared to non-nature-based environments for developmental outcomes of young children (2–8 year).

Play as a context for child development, three perspectives

In most cultural communities, play is a major aspect of children's life (Roopnarine, 2012). Most play researchers agree on the importance of play in early childhood. In fact, play is seen as a key element of child development because it is the context for the development of cognition (including language), motor skills and social-emotional competence (Rubin et al., 1983; Golinkoff et al., 2006; Nathan and Pellegrini, 2010).

To affirm the importance of play, in Article 31 of the United Nations Convention on the Rights of the Child (United Nations, 1989) play is viewed as a fundamental need and right of children. This need for and right to play needs to be respected in the lives of young children. Consequently, article 31 challenges us to understand play from the perspective of children's needs and rights.

Before play ended up as a fundamental right in the Children's Rights Treaty, the critical role of play has been studied by many scholars using different theoretical frameworks. According to Wynberg et al. (2022), roughly three theoretical perspectives can be distinguished. First, Piaget describes in *Play, Dreams and Imitation in Childhood* (Piaget, 2013), how children incorporate objects and events of the world around them in their play, creating a mental model of the world. In this genetic epistemology perspective, children's level of cognitive development is reflected in types of play (functional and constructive play, symbolic/fantasy play and games with rules). Piaget's theory of cognitive development suggests four phases in which intelligence changes as children grow. For early childhood the first three are relevant: children (0–12 year) grow from sensorimotor intelligence (e.g., children understand the external world only by sensing and touching objects that are present), into preoperational intelligence (e.g., during this period children are thinking at a symbolic level but are not yet using cognitive operations, they still need to act in the external world to perform these operations) into concrete operational intelligence (e.g., children can use logic and transform, combine and separate concepts on a mental level) In this way, children's play can be classified on the basis of their cognitive development, but children's play is not seen as a context for new development. Therefore, this theoretical perspective does not explain how children's play quality and the physical environment are related.

Secondly, in contrast to Piaget's view that play reflects the actual level of children's cognitive development, in Vygotsky's cultural historical activity theory (CHAT), play is considered a social activity in which children meet and interact with the social cultural environment. With help of parents, educators and peers, children gain in play a driving force for further cognitive, social-emotional, and motor development (Nicolopoulou, 1993).

Leontiev advanced Vygotsky's theory by differentiating play actions from play activity. Play actions are performed to achieve a single goal. A play activity is a set of related play actions that meet children's need to get to know the world around them and be able to contribute to it. Their play activity derives its meaning from the satisfaction of fulfilling this need, which is the motive for their activity. However, the goal of a play action does not necessary coincide with the motive of the activity. In fact, the single goal of an action often comes apart from this motive. For instance, children in a nature-based environment collect sticks (action) to build a pretend bonfire (activity) to fulfill their need to get the feel of making a bonfire (not because they were cold or needed to cook).

Within CHAT, tool use is an important aspect of play activity. Tools help children to fulfill their need and these (symbolic) tools link the action (collecting sticks) to their motive (getting to know bonfires by pretending to make one). In other words, children are motivated by these tools. In the play context, tools have agency to achieve goals (Bodrova and Leong, 2015; Wynberg et al., 2022) and motivation to use the tools is what makes children act, think and develop (Nicolopoulou, 1993; Deci and Ryan, 2008; Bakhurst, 2009). As a result of engaging in play, the perceptual world–i.e., the world the child meets through perceptually interacting with it–becomes a conceptual world of meaning and value. In this process, the child develops the mental power to understand the (meaning of) the world that surrounds him/her. The perceptual world invites or affords play activity (Bakhurst, 2009). In the example of children building a bonfire, the sticks mediate between the perceptual and conceptual world, children use their mental power to imagine the real fire and the heat that comes from it, while building the bonfire and gathering around it. Although CHAT accounts for the role of the physical environment in children's play, the environment is mostly viewed as situated in a socio-cultural environment.

Thirdly, Gopnik (2020) describes childhood from an evolutionary perspective as a time for the human mind to explore the unpredictable range of human possibilities. To develop the capacity to navigate the perceptual world, in other words to get the feel or hang of it, children actually have to feel the world and hang around in it. During childhood, children are especially prone to explorative and "active" learning. While involved in messy and intuitive play actions, children gather new information about the world around them, learning and adapting without using adult intelligence, such as planning or focused attention. Instead, they get involved with all their senses to imagine even far-away and unlikely hypotheses, such as using objects during play in a creative way, not being hindered by experience of the usual function of the object (Gopnik and Wellman, 2012; Schulz, 2012; Wente et al., 2019). Within the evolutionary perspective childhood is an extended time for exploration of an environment that is variable, with a mix of predictability and unpredictability. In the same way as the CHAT, within the evolutionary perspective the focus is on cultural learning, i.e., obtaining information from other humans and not so much from the interaction with the nature-based environment.

Although these three perspectives differ in focus and methodology, they all acknowledge play as important for child development. During play children find out the meaning of the world that surrounds them, including the physical world, and learn how they can interact with it. In this way they develop as human beings with cognitive, social, emotional, and motor competencies.

Defining play

In this review, we focus on play and how the quality of play might be supported by the physical environment where children play. Therefore, we need a definition to distinguish play behavior from other behavior. As we have seen in the literature on play there is no defining key factor that connects all actions that are recognized as play actions. In *the Oxford handbook of the development of play*, Burghardt (2012) comes up with a set of five criteria that characterize the play of all animals: (1) It is not fully functional in the form in which it is expressed; play actions can look functional but the actions do not contribute to survival; (2) It is spontaneous, voluntary, intentional, pleasurable, and done for the sake of playing; (3) Play differs from functional behavior in structure or timing in at least one respect: incomplete, awkward, and precocious; (4) It is performed repeatedly but not in a stereotyped way; and (5) It is initiated when the animal is "relaxed": well fed, warm and safe. These five criteria partly overlap with the dispositions described by Rubin et al. (1983). They define play as: (1) intrinsically motivated; (2) for the sake of play(ing); (3) deriving pleasure from it, and; (4) having the freedom to modify the rules within the play (Rubin et al., 1983). For this review, we will combine the aforementioned criteria and include all behaviors that can be classified as a child's interaction with the environment, while being highly involved, intrinsically motivated, deriving pleasure from it, and having the freedom to modify the rules (cf., Rubin et al., 1983).

The quality of the physical environment in relation to play quality

The physical environment where children play is part of their play. The value of explorative and active play is directly related to both the complexity of the physical environment and the opportunity to incorporate the environment in play (Gopnik, 2020). In other words, an environment not only serves as a play décor, but it also serves as a place that affords play. For example, findings from systematic reviews consistently demonstrate that a nature-based environment affords different play behavior compared to non-nature-based environments (Gill, 2014; Dankiw et al., 2020; Zare Sakhvidi et al., 2022). How can this be explained?

The affordances theory of Gibson (2014) is a way to describe an environment in terms of the distinctive features that offer possibilities for play behavior for a child or a group of children. An affordance is something that refers to both the environment and the skills of a child at that moment. The affordance theory helps to understand why nature-based environments differ from non-nature-based environments. For instance, a tree can afford leaning for a 1-year old, hiding for a 5-year old and climbing for a 7-year old. Heft (1988) and Kyttä (2002) advanced the

affordances theory into a functional taxonomy, by describing the distinctive functional properties of an environment, properties that are both objectively real and psychological relevant. It is a way to describe the setting, the person (the child with her skills at that moment) and the action as a "system." According to Heft (1988), the functional possibilities for meaningful play that children perceive in nature-based environments are different from the possibilities they perceive in non-nature-based environments.

In addition to the affordances theory to describe the assets of nature-based environments for play, two complementary theories from research on nature-based environments are related to aspects of play (quality) as well: the Stress Recovery Theory (SRT) and the Attention Restoration Theory (ART) (Ulrich, 1983; Kaplan, 1995; Berto, 2014). SRT is a psycho-evolutionary theory that states that since humans evolved over a long period in natural environments, people are to some extent physiologically and perhaps psychologically better adapted to nature-based environments as to non-nature based environments. ART is a psycho-functionalist theory that states that humans have an innate predisposition to pay attention and respond positively to natural content (e.g., vegetation and water) and to settings that helped survival during evolution. Both theories state that nature-based-environments are more restorative than non-nature-based environments; according to SRT, nature-based environments relieve physiological stress whereas according to ART, nature-based environments restore mental fatigue. In this way nature-based environments contribute to play quality as we look at the criteria for play quality mentioned above: a child can only initiate play when it is relaxed, and play asks for involvement and attention.

Defining nature-based environments

As we see how the quality of the play activity of a child is intrinsically linked to the nature-based environment, we need a definition to distinguish a nature-based environment from other environments. As it is difficult to find one key factor to define play, there is also no such key factor that connects all environments recognized as nature-based environments. To describe such an environment the affordances theory of Greeno (1994), Gibson (2014), and Lerstrup and Konijnendijk van den Bosch (2017) makes it possible to look at an environment in terms of affordances. He described five affording features of an environment: (1) places, (2) attached and (3) detached objects, (4) substances, and (5) events. In this review, we use these features to distinguish nature-based environments from non-nature-based environments. Nature-based environments (1) have a surface (place) that is the basis for growth of living elements, (2) provide possibilities for interacting with living, non-man-made elements like plants, trees, and insects, (3) these living elements "provide" loose materials to play with, such as sticks, seeds, feathers, and shells (attached and detached "objects"), (4) non-living elements are part of a nature-based environment as these elements are connected to the biosphere of the living elements such as water, rocks, and soil (substances), and (5) weather elements such as fresh air, rain, wind and sunshine, or seasonal elements such as blooming or decay are the features that ensure change (events) (Gill, 2014; Chawla, 2015; Dankiw et al., 2020).

The role of the teacher

For this review, we also investigated the role the teacher has in designing and/or choosing the play environment. The motivation and the capacity to be taught by the world is not totally innate. It needs to be nurtured and sustained by adults. Early childhood teachers are part of the play context and have a role in mediating between the child and the world. In this context they also have a role in the acquisition and use of language during play. While the perceptual world with its structure and rules becomes a conceptual world in play the acquisition and use of language makes it possible to store the concepts in the mind (Huizinga, 2014). Most play theories agree on the role early childhood teachers have in guarding children's play, enriching children's play environment, and protecting children for dangers, but there is considerable debate on the question if and how adults should participate in children's play activities (van Oers, 2013).

Reason for this review

Reasoning from play theories and the environmental psychologist theories we might expect that nature-based play environments, as an indivisible part of children's play actions, can contribute to children's cognitive, social-emotional, and motor development.

In the last decade, many studies have been conducted into the relation between a healthy development of children and engagement in nature-based environments. Most of these studies have focused on health and physical activity. The reviews of Gill (2014), Chawla (2015), and more recently Dankiw et al. (2020) have provided overviews of the benefits of nature for children's development. These reviews were focused on children between 1 and 12 years old. First, the systematic review of Gill showed the benefits of children's engagement with nature on mental health as well as physical activity. Second, Chawla's work was not so much a systematic review but a thorough reflection on research into the benefits of nature contact for children. She placed the research in the context of changing research approaches, thus showing how different research questions and methods shape our understanding of the benefits of access to

nature for children. Third, Dankiw's review investigated the impacts of children's engagement with unstructured nature play, finding that unstructured nature play may have a positive impact on different aspects of child development. By focusing on developmental outcomes of quantitative studies, this study did not attempt to understand how or why unstructured nature play is related to these positive outcomes. A systematic review of qualitative studies can synthesize findings and advance the knowledge base of how nature-based environments contribute to play quality. Synthesizing the fragmented literature will contribute to a useful resource for guiding future research on this topic and inform early childhood educational practices, valuing nature-based play environments as intrinsically linked to play quality.

We systematically reviewed studies into play in nature-based environments in ECE. These studies may contribute to our understanding of the experiences of children and teachers in ECE when going outside to play in nature-based environments. Moreover, these experiences set out a basis for understanding the possibilities of playing in nature-based environments for cognitive, social-emotional, and motor development in ECE. We reviewed studies in early childhood educational settings since in these settings play is an important part of the curriculum.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Page et al., 2021) was adopted for the purposes of the present review. A PRISMA checklist is provided in **Supplementary File 1**.

Inclusion and exclusion criteria

Articles were included if they met the following selection criteria:

(1) The study focused on play in/on a nature based environment (studies were excluded if the exposure to nature was not specified as "interaction" or "play" or if the environment where the children played did not match our criteria of nature based environments as stated in our introduction).
(2) The study included participants between the age of 2–8 years.
(3) It was an empirical study.
(4) The study was conducted in the context of ECE (studies were excluded if they were not conducted in a center for ECE, such as day care centers and preschools).
(5) The study included participants without special needs or disabilities.

Databases and search query

Databases PsycINFO, ERIC, and Web of Science were used to identify studies that investigated the relation between play and nature-based environments. To ensure the quality of the studies we only included empirical studies that were published in peer-reviewed journals. Furthermore studies written in English that were published between May 1995 and 2022 were included. We combined keywords on the two major concepts of this review: play and nature-based environments. To ensure a comprehensive search the following keywords were used for play or activity: manipulative play, object play, relational play, block play, loose part play, outdoor play, free play, unstructured play, rough and tumble play, explorative play, creative play, construction play, physical play, gross motor play, role play, pretend play, social play, imaginative play, socio dramatic play, social pretend play, as if play or physical activity, unstructured activity, explorative activity, physical activity, construction activity, and gross motor activity. For the nature-based environment, the following keywords were used: green or natural environment, playground, landscape playscape setting area or space, school garden, school forest, school wetland, school wilderness, school grassland, greenery, garden, forest, wetland, wilderness, grassland, tree cover, tree canopy, biodiverse school ground, and nature based. Boolean operators were used to ensure that each possible combination of keywords was included. The search query is provided in **Supplementary File 2**.

Selection procedure

The primary search resulted in a selection of 5,961 articles. Next, duplicates were removed, and titles, abstracts, and keywords of the remaining articles were manually screened. Many studies in this first selection were either in the field of environmental science or health, and did not concern playing children. After removing the studies that obviously did not meet our selection criteria we assessed 166 articles for eligibility. We excluded 107 studies for reasons of age. We also screened studies with participants between 2 and 8 years as well as participants beyond this age. We did not include them because it was impossible to decide if the results were specific for the group of children between 2 and 8 years. A random selection of twenty articles of the 166 articles were checked with two researchers, both members of a research group performing a systematic review in the field of ECE. They checked if the article met the criteria of our definition of play and nature based environment as stated in our introduction. Quality appraisal was made through the Joanna Briggs Institute (JBI) Critical Appraisal Tool for Qualitative Studies (Lockwood et al., 2020) (see **Supplementary File 2**). Using this tool we were surprised by the innovative and creative ways these studies adapted to respect

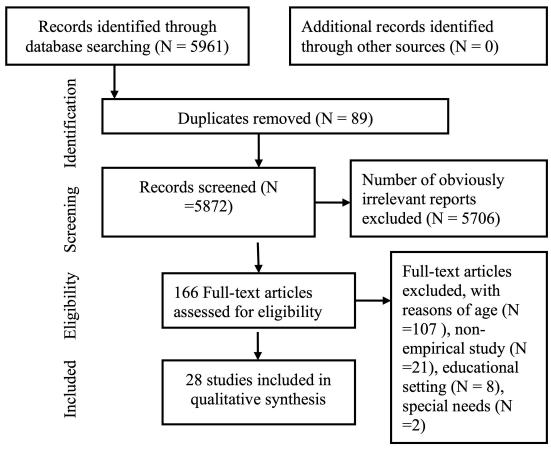

FIGURE 1
Study selection process.

the voice of young children. We ended up with a final selection of 28 studies with an overall sample size of $N = 998$ children aged 3–8 years. See **Figure 1** for an overview of the study selection process.

Data extraction and synthesis

The selected studies were analyzed and synthesized in four steps based on Noblit and Hare's meta-ethnography method and adapted for this study (Agar, 1990; Noblit and Hare, 2012; Nye et al., 2016): Step 1: The studies were read and re-read to gain a detailed understanding of their theories and concepts and their findings according to the following categories: (1) Design/method, (2) theories and conceptualization, and (3) outcomes. **Supplementary Table 1** gives an overview of the 28 studies, specified according to these categories. To retain the meaning of the primary concepts within individual studies and to define the relations between these concepts we developed codes regarding the experiences of children and teachers while playing in nature-based environments during ECE (i.e., authors' interpretation of the data and "second order constructs").

Step 2: In order to determine how the studies were related, the initial codes were grouped according to key aspects of (1) play quality, (2) the nature-based environment, and (3) the teacher-child interactions. These key concepts from individual studies were synthesized, which resulted in lists of overarching themes for each of the three groups (see **Figure 2**).

Step 3: Studies were translated into one another to produce "meta-themes" across the different aspects of play in nature-based environments. To draw out the findings under each meta-theme, some studies were chosen as "index" papers from which we extracted findings. These index papers stood out in terms of their conceptual richness. Their findings were then compared to and contrasted with the findings of a second study, and the resulting synthesis of these two studies were then contrasted with a third study, and so forth. This is referred to as "reciprocal translation" (Noblit and Hare, 2012; Nye et al., 2016). For example Lerstrup and Konijnendijk van den Bosch (2017) advanced Gibsons and Hefts theory of affordances and functional classes of outdoor features into "key activities" afforded by classes of the outdoor environment. These new concepts were used for the translation of concepts from other papers that were related but not conceptualized in this way.

Step 4: The meta-themes from step 3 were synthesized according to aspects of quality of ECE. *Via* interpretive reading of these meta-themes we developed a "line of argument" synthesis regarding the value of play in nature-based environments for improving developmental outcomes of ECE. This is presented in the discussion.

Results

Meta method analysis

During step 1 we analyzed the study designs of the 28 included studies. The studies into play in nature-based environments in ECE all aimed to get more insight into the relation between children's play and nature-based environments in ECE. The studies aimed to study a myriad of educational outcomes, such as physical activity, cognitive, social-emotional, and motor development as well as health. The relevance of these studies is motivated by concerns about changes in the practice of playing outside as healthy practice for young children's physical and mental wellbeing. Opportunities for outdoor play have diminished drastically since the mid-20th century, due to cultural changes such as parental control and fear, inadequate access to outdoor playgrounds, screen time and the focus on cognitive development in ECE.

The studies included in the present review can all be characterized as small-scale studies using observations of play behavior in nature-based environments and interviews with teachers and children to explore their experiences of playing in nature-based environment. Participating early childhood settings in the studies were sampled based on their outdoor play practices including the design of their playgrounds. These studies can be divided into two groups: one that compared play on a nature-based (part of the) playground to play on (part of the) traditional designed playground and one that compared forest school practice to indoor/outdoor classroom practice.

In all studies, except for one, the sample size was given and ranged between $N = 4$ and $N = 198$, with a total of $N = 998$ and a mean of $N = 36$. Twelve of the studies had a sample size of $<N = 20$, 13 had a sample size between $N = 20$ and $N = 100$, one study had a sample size of $N = 198$, and one had a sample of teachers $N = 63$ teachers. One study did not specify the sample

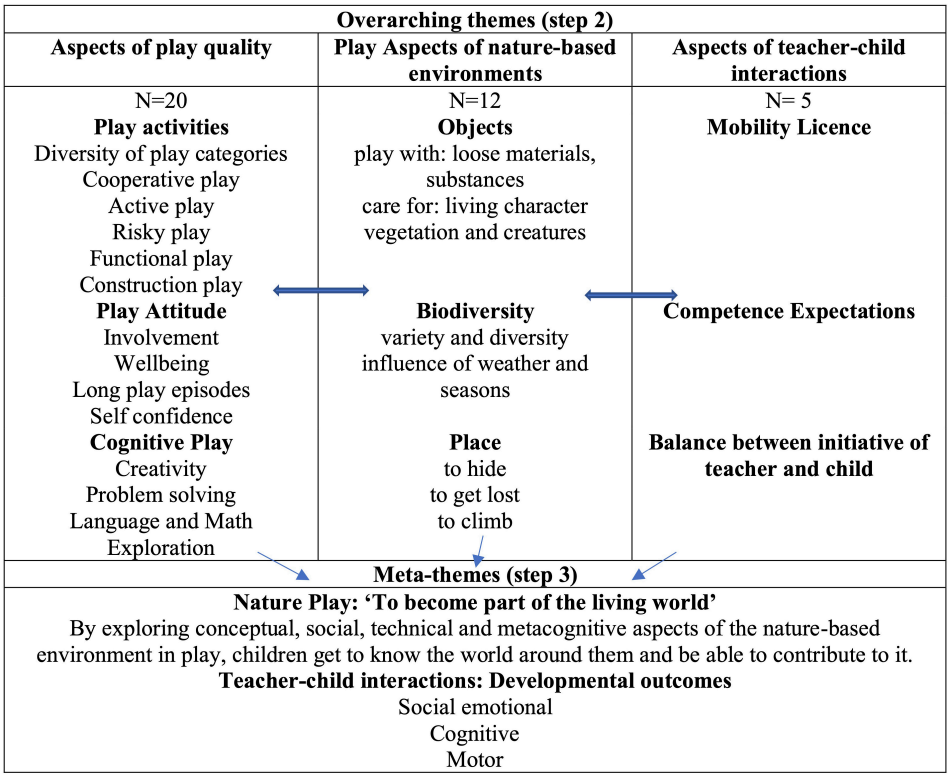

FIGURE 2
Meta-synthesis of key concepts into three themes and two Meta-themes.

size. The relatively small sample sizes of most studies can be explained by the fact that the studies had an explorative and qualitative research design.

Seventeen studies used play observations describing different aspects of the relation between children's play behavior and nature-based outdoor environments, to get more insight in how children use outdoor environments during outdoor play activities. In most studies these observations were characterized as phenomenological, ethnographical, and participatory. Blanchet-Cohen and Elliot (2011) for instance described how participatory observation was a primary method of listening to young children in unmediated ways to get insight in how the children used the nature based environment. In the studies of Moore et al. (2019) and Dyment and O'Connell (2013) observation was done by using event sampling or taking scans with an observation tool, making it easier to observe a higher number of participants.

In the studies where children's views on their outdoor play experiences were explored, a mosaic approach was used to get insight into the views of young children, using arts-based data techniques while interviewing children. These studies were inventive and respected the way young participants are able to express their own views. For example, in the study of Streelasky (2019), drawings, paintings, and photographs were used during child interviews to support them in expressing their views. In the study of Moore et al. (2019), the children gave a tour around the yard to express their views on the value of the nature-based environment. Four studies also collected data from teachers, to explore their views and their interaction with children when playing outside in nature-based environments.

Although most studies used open observations to investigate the play activities of the children, some used validated instruments, such as the system for Observing Play and Leisure Activity in Youth (SOPLAY). This system is used by Fjørtoft (2001) as well as by Dyment and O'Connell (2013) and is a way to label children's activities, for instance to assess the diversity of their activities, but it does not capture how these activities are related to the play environment. Another way to assess the quality of the play activities is in terms of involvement, freedom, and joy. In two studies, the Leuven Child Involvement Scale was used to analyse children's play in terms of involvement and joy. Other studies (Luchs and Fikus, 2013, 2018; Morrissey et al., 2017) used the duration of the play episodes as a measure of the quality of the play: The longer children played, the higher the quality of their play episode.

In three studies instruments were used to assess the play potential of the nature-based outdoor environment. Mårtensson et al. (2009), for example, used the outdoor play

environment categories (OPEC) tool, which gives a higher score to environments with large integrated spaces with plentiful greenery and varied topography compared to small areas where open spaces, play structures and vegetation are placed in separate parts of the environment. Richardson and Murray (2016) used the early childhood environment rating scale (ECERS) to assess the nature-based environment, but this tool is developed to assess indoor classrooms and is not adapted for outdoor spaces.

Four of the five studies that also used quantitative data, measured children's physical activity in a quantitative way using accelerometers, and one study measured if features of the natural environment correlated with measures of inattentiveness.

Data analysis techniques were specified in all of the studies. In most of them (24 studies) comparative thematic analysis was used as data analysis technique. In the five mixed method studies, several statistical tests were used as well.

Details about strategies to address validity were not often mentioned, but four of the studies used focus groups of teachers to discuss the finding of the studies and to perform a member check.

Meta concept and theory analysis

During step 2, we synthesized key concepts in the studies. The studies in this review were selected based on two conceptual criteria, one of them was the *nature-based environment*, the other concept was *play* (or aspects of play). Most studies used a specific theoretical framework and/or a philosophical perspective to explain and understand the expected relation between nature-based environments and play. These theories help us to conceptualize about and generalize the findings within the specific studies and help us to understand the limits of these generalizations.

Play

Seven studies used a specific theory in which the concept of play was embedded. Most of these studies used Vygotsky's sociocultural theory, from which play can be defined as a mode of activity. However, the concept "activity" was mostly used as "the things children do" or, in other words, children's actions. Certainly, the theory was not used to place play in the larger cultural-historical context. Other studies used a criterion- based definition of play, such as it was "free" or child initiated. For example, in the study of Brussoni et al. (2017) play was described in terms of activities chosen by the children. Different aspects of these activities in nature-based environments were explained, such as hierarchy between peers during play, the complexity of the play or the duration of play episodes. Other studies defined play as consisting of different play categories, some of them cognitively more complex. For example, in the study of Dyment and O'Connell (2013) play was described using five categories: functional, constructive, symbolic, self-focused, and talking, whereas the constructive and symbolic category was also coded as creative and imaginative. In the studies that focused on a specific type of play, such as physical play, risky play, or sociodramatic play, it was easier to extract the specific play concept. Morrissey et al. (2017) for instance, used a detailed description of the concept of sociodramatic play: involving two or more players, providing a crucial everyday context in which children are motivated to engage socially with peers, and practice skills in communication, negotiation, symbolic, and creative thinking.

Nature based environment

Twelve studies used Gibson's affordances theory to distinguish nature-based environments from non-nature-based environments. Lerstrup and Konijnendijk van den Bosch (2017), for instance, used the affordances approach to operationalize how play actions are afforded by a specific feature of the environment and a specific user (a child of the preschool participating in their study) of that feature. In this way, the environment is not viewed as a separate object, but as something children take with them in their own experiences. Sandseter (2009) assessed how a nature-based environment affords risky play for pre-schoolers, using the concept of affordances, but adding the role of the educator to the equation.

Some studies used the concept "play opportunities" instead of affordances, to operationalize the relation between children's play behavior and a nature-based environment. Canning (2013), for example, made observation notes of the play behavior during den-making sessions and focused on the conversations between children to explore how the environment offers opportunities for creative thinking. In the den-making context the nature-based environment is an integrated part of children's play experience in the same way as the environment in the affordances approach. In short, in most of the studies the relation between nature-based and children's play behavior is operationalized as observed activities afforded by nature-based outdoor environments.

Although all of the studies aimed to explore if and how (aspects of) children's play behavior is afforded by nature-based outdoor environments, there is no generally accepted description of the concept "nature-based environment" and it is hardly operationalized in most of the studies. Fourteen studies (**Supplementary Table 1** nrs. 2, 3, 6, 8, 11, 12, 14, 19, 20, 23, 24, 25, 27, and 28) used a comparator outdoor play environment to compare the nature-based environment with. The comparator environment that was referred to as "traditional" or "usual," always contained man-made or manufactured elements such as a climbing structure and a sandpit. Another similarity in the description of elements that the non-nature-based environment consisted of was the character of the surface: it was paved, concrete, or hard. This is a kind of surface that afforded

functional play: riding bikes, running around. These comparator environments can serve as a starting point to describe the (operationalized) characteristic elements of the nature-based environments in the studies.

In contrast, the elements of the nature-based environment were in the first place described as elements that were not man-made and do change, grow or die (even) without the intervention of humans. For instance, in the study of Brussoni et al. (2017) the "seven C's system" for assessing the quality of the outdoor environment was used. One of the C's stands for change: How does the play environment change over time? Second, although nature based environments can change, grow or die without human intervention, at the same time the elements of the nature-based environment are more sensitive to human intervention than man-made elements in an a non-nature based environment, for instance a climbing structure. Therefore, nature-based environments ask for care when playing with and in it, which interferes with the children's play actions. Third, the surface of the nature-based environment is referred to as "biodiverse, soft, and diverse." An example of this is the study of Puhakka et al. (2019). In this study, the greening of day-care yards consisted not only of adding green elements, but also of replacing the complete surface area of a day-care yard by forest floor, sod, peat blocks, and planters for vegetable growing, making the surface more biodiverse.

Related to the surface as an important element of the nature-based environment, in many studies natural loose parts found in or on this surface were a vital element of the nature-based environment affording specific play activities. Harwood and Collier (2017) even went a step further by not operationalizing the observed activities of the children afforded by nature-based outdoor environments, but by operationalizing the activities that the natural loose parts performed in the child's play narrative. In this view, the agency of sticks in children's multi modal texts was afforded by the children. This post-humanist perspective (as they called it) was interesting as it described how the agency of the children was enriched by focusing on the agency of the stick. To acknowledge the agency of nature-based environments might be a key factor in describing the special way it affords play, compared to other environments.

Three studies used a theory of place. These theories account for the fact that a child's identity is nurtured and shaped by place (Gruenewald, 2003; Adams and Savahl, 2017; Crippen, 2017). Children have strong attachments to the places they play in and actively construct places for imaginative play (Hart, 1979).

Meta data analysis

In step 3 we compared and contrasted the key concepts found in the studies to one another to establish overarching themes (reciprocal translation). Most of the studies showed that aspects of children's play quality are related to aspects of nature-based environments which might lead to benefits for child development if mediated in certain ways by early childhood educators. However, this relationship is complex and it is not easy to isolate the elements of the physical environment from all other factors that influence play quality. In order to find how the outcomes of studies were related, we grouped the studies according to (1) aspects of play quality (2) aspects of nature-based environment, and (3) aspects of teacher-child interactions.

Theme 1: Aspects of play quality: play actions, play attitude, and cognitive play

All studies pointed out that there was a relation between children's play actions and nature-based environments. Firstly, compared to a non-nature-based environment, there was more variety in play categories while children played in nature-based environments. In the studies, a non-nature-based environment mostly afforded a more physical type of play whereas nature-based environments afforded more diversity in type of play. For instance, Luchs and Fikus (2018) observed that children showed play patterns in which they combined different play types. Six studies reported more socio-dramatic play in the nature-based environment. In the study of Coates and Pimlott-Wilson (2019), for example, children reported that the forest site where they played offered them opportunities to make things and be creative, and enact their own stories.

Secondly, the vast majority of the studies reported how play in nature-based environments was related to children's social-emotional attitude during play. Interesting were the studies that included children's own perspectives on their play experiences in nature-based environments: Children often reported joy, wellbeing, and enthusiasm. For instance, in the study of Moore et al. (2019) they included "stories of agency" in which children demonstrated a strong sense of comfort and self-confidence with the nature-based environment, by telling about the freedom they felt to make footprints anywhere or to cool down in the grass. This sense of confidence was also found in the studies that observed more risky play in nature-based environments, or a higher degree of risk afforded by nature-based environment. In the study of Mcclain and Vandermaas-Peeler (2015), the degree of "wilderness" of the environment (a creek compared to a river) afforded the degree of challenge and risk in the observed play behavior. Some studies emphasized the possibility of the nature-based environment to sustain the play story, resulting in longer play episodes, compared to episodes on the non-nature-based playground. But also in using more play space, as the nature-based environment helped them to meander from one area to another. This relates to the studies that pointed to more explorative play behavior or higher involvement and engagement during play in nature-based environment. For example, McCree et al. (2018) found high scores of involvement during play sessions on a forest school site.

Thirdly, besides the fact that playing in a nature-based environment interacts with how children play in such an environment, five studies described how this is related to children's cognitive development. In early childhood, cognitive development as an outcome of play activities is highly dependent on how much a child is involved in play and the extent to which the child experiences wellbeing. Seven studies observed explorative play behavior, problem solving and creativity and related this to the nature-based environment. For example, in the study of Puhakka et al. (2019), increasing biodiversity and the amount of greenery of school yards led to more explorative play, more multi-sensory play experiences, and better pre academic skills (i.e., counting) than before the intervention. In the longitudinal study of McCree et al. (2018) an improvement in academic attainment (i.e., reading, writing, and maths) was seen after 3 years of attending weekly forest school sessions compared to their non-participating peers at school. Richardson and Murray's (2016) study was the only study that measured richer language use during forest school sessions, in terms of noun diversity, and the use of adjectives and verbs.

To summarize this step of reciprocal translation: when children play in nature-based environments, the quality of their experiences during play is improved. This is shown by a greater diversity in play actions while at the same time the duration of the play episode was extended, compared to their play in non-nature-based environments. Children's involvement and wellbeing during play was intensified while playing in nature-based environments. Furthermore, they were not only physical active but also used different cognitive skills in their play.

Theme 2: Play aspects of nature-based environments

Although in theme 1 we showed that playing in nature-based environments relates to higher play quality, it was not yet connected to specific aspects of the nature-based environment. Theme 2 reveals that this higher play quality is connected to specific aspect of the nature-based environment. Most of the studies indicated a clear relation between nature-based environments and playing with loose or fixed natural materials. Playing with loose materials often leads to construction play. For instance, in the study of Puhakka et al. (2019) the researchers observed that children were doing more arts and crafts with the loose natural materials. In many other studies we reviewed, sticks were mentioned as natural materials with special interest. For instance, in Canning's (2013) study children used sticks to lay out a ladder and to pretend to climb in it. In the study of Harwood and Collier (2017) the sticks even had agency, for instance they were friends carried and cared for by the child, being able to change the play narrative of the child. In four studies play with small creatures was mentioned (e.g., insects, worms, and snails), as well as care for plants and vegetation. These studies also pointed to the importance of the notion of abundance of natural materials as opposed to the notion of scarcity (for example of toys) in non-nature-based environments. Zamani (2013) described how the living character of nature-based zones sparked curiosity and wonder, and invited play with critters and plants. Also in the study of Wight et al. (2015) the fact that nature "lives" made children caring for it. In three studies the notion of place was connected to the possibility to immerse or hide in it, for instance a shrub or high grass, or to offering objects (leaves and sticks) that can be used to transform the space into a place of imagination for sociodramatic play.

Reciprocal translation led us to conclude that when children played in nature-based environments, specific aspects of the nature-based environment, such as the abundance of materials and substances to play with might be connected to quality of children's play activities, which is related to the cognitive outcomes mentioned above. At the same time the nature-based environment owns agency in play, "it/he/she plays back, nature instigates play.

Theme 3: Teacher-child interactions

In most of the studies in this review, children's play in nature-based environments was child initiated, not teacher led. However, the role of the teacher is part of the children's play environment and in four studies this teacher's role in nature-based environment was specifically investigated (Mawson, 2014; Mackinder, 2017; Akpinar and Kandir, 2022). They found that the role of the teacher influences play quality. In the study of Mawson (2014) the outcomes of a hands-off approach to teacher child interactions, where children could freely roam throughout the woods, was compared to a hands-on approach with teacher-led activities. These two approaches resulted in differences in child behavior. In the hands-off approach, children were taking more risk and challenged themselves more and also engaged in more socio-dramatic play, while in the hands-on approach the teacher was directing children's attention toward objects for play and shared more factual information.

It is important to also consider other factors that support possibilities of nature-based environments for children's learning and development. Specifically, including assessments of teachers perceptions of their children's underachievement, along with their supervisory/teacher style. In the study of Maynard et al. (2013), most of the children in the study that were perceived as "underachieving," changed their behavior while playing in a nature-based environment to such extent that this "underachievement" was not seen anymore. To be outdoors in nature with more space and less constraining by teachers offered the children the opportunity to show differences in social, emotional, and learning behavior, for instance children were more cooperative, showed more pro-social behavior and remained more on task.

Reciprocal translation led us to conclude that when children play in nature-based environments, the character of the teachers' mediation between children and between children and the

environment influences how the affordances of the nature-based environment are actualized in play. When children received greater independent mobility license from their teachers (Kyttä, 2004) it not only offered more opportunities for risky play, but also for more independence in being creative, explorative, and self-confident. Moreover, teacher's mediation itself is impacted by the nature-based environment: the nature-based environment changed their expectations of children's skills and behavior, which in turn influenced children's independent mobility license. The more affinity with the nature-based environment teachers had, the more they were able to reinforce children's mobility and agency toward the nature-based environment, by balancing between child initiative and teacher initiative, transferring some of their own initiative to the nature-based environment.

Discussion

Taken together our qualitative synthesis suggests that the affordances for play in nature-based environments experienced by children and teachers are not only different from the affordances for play in non-nature-based environments, which is obvious, but the affordances of the nature-based environment might also improve the quality of play. This is interesting for ECE teachers, since high quality play will yield children's learning and development (Rubin et al., 1983). The studies also indicated that the relation between a nature-based environment and play quality is complex. Although the body of research into this topic is growing, more work needs to be done. The qualitative studies reviewed in this article forms a useful complement to the most recent systematic review on this topic from Dankiw et al. (2020), which reviewed primarily quantitative studies. Insights from the current review can support our understanding of the meaning of play that is enabled and sustained by the nature-based environment for children in ECE. Taken together, our review gives a first indication of the importance of play in nature-based environments for children's cognitive, social-emotional, and motor development.

Qualitative research can thus unravel how children's play and the nature-based environment are mutually constitutive and how play processes are mediated by teachers to support children's cognitive, social-emotional, and motor development. Through an interpretation of the synthesis, below we present a "line of argument"–step 4 in the meta-ethnography–about how nature play can promote child development. We refine parts of play theory, by elaborating on the importance of the distinctive living character of the nature-based environment and its ability to "play back." Besides, we will use the affordances theory to reframe the concept "afforded play actions." We argue that reciprocity and diversity are unique qualities of nature play, contributing to child development if teachers permit and support children to explore the conceptual, social, technical, and metacognitive aspects of the nature-based environment in play.

Line of argument, the value of nature play

Play theories explain how children's active engagement with the surrounding world (i.e., play) results in knowledge of different aspects of the world, while in the meantime they learn to take part in it (Bakhurst, 2009; Piaget, 2013; van Oers, 2013). This qualitative synthesis illuminates the uniqueness of nature-based environments for meaningful play activity which is largely ignored in play theories Firstly the "living character" of the nature-based environment, the fact that it has a life of its own, accounts for reciprocity and diversity in children's play. Secondly the fact that children use tools (or toys) during play is commonly accounted for in play theories, whereas nature-based environments provide an ample and diverse supply of loose parts (Speldewinde and Campbell, 2022). Which results in creative and imaginative play. Furthermore, both the stress reduction theory (SRT) as well as the ART account for the special connection between humans and nature-based environments (Ulrich, 1983; Kaplan, 1995; Adams and Savahl, 2017). These theories imply that being in nature contributes to wellbeing, but do not refer to interactions with nature. For children, being in an environment leads to interaction with it, and play theory shows that the quality of these play interactions is important (Burghardt, 2012; Speldewinde and Campbell, 2022). The current synthesis shows that, for children, not only *being* in nature but also *interacting* with nature is important, as they experience that these interactions are reciprocal. Nature has agency in these interactions and is adaptive toward diversity in children's needs. Children listen to and tune into the nature-based environment, for example they gather sticks, pile them up for the imaginative bears to crunch them up during tea time. As such the environment instigates and enriches play.

In line with Gibson's affordances theory, this review acknowledges how play actions are afforded by specific features of the physical environment and a specific user. However, we found that the affordances theory might overlook the complexity of the concept of "play" as it tends to look at individual play actions afforded by specific environmental features, such as a tree trunks affording jumping off. Using the affordances theory in this way, the attention will automatically be drawn to physical actions. Based on this qualitative synthesis, we argue that nature-based environments afford play activity on a more complex level than physical play actions alone. As we saw in the example of the children serving imaginative bears sticks during tea time, nature affords not only play actions, but also play scripts. The individual play actions are part of play activity that guides children to transform the perceptual world into a conceptual world. Our review indicates that nature-based

environments afford the conditions for play, wellbeing, and involvement, as well as sociodramatic play and cognitive play, while in the meantime serving as a communicative context for sharing concepts together.

Our line of argument helps us to answer our research question: what is the value of play in nature-based environments compared to non-nature-based environments for developmental outcomes of young children (2–8 year). Our answer lays in defining how nature-based environments afford play in a distinctive way resulting in the concept of "nature play": "play" in a nature-based environment consisting of natural loose and fixed elements (trees, vegetation water, sand, sticks, and stones) where children have the opportunity to engage in activities in which they are highly involved and where they have (some) freedom to develop their own play script, while interacting with and tuning into the affordances of the nature-based environment. Nature play has outcomes for cognitive, social-emotional, and cognitive development. In nature play, children have the possibility to find out how they are part of a **living** system. Early childhood educators are key actors in how children engage in play in the nature-based environment. They can support them to discover the conceptual, social, technical, and metacognitive aspects of nature-based environments. They need to expand children's independent mobility to encourage them to explore the environment as well as to mediate between the child and the environment.

Strengths and limitations

The strength of this systematic review is that it synthesized the meaning of play in nature-based environments in ECE across qualitative research. It is worth noting that although the synthesized studies were small-scale studies, these studies were particularly respectful to the way children interact with the world and sincerely tried to give voice to the view of these children and their teachers. Nevertheless, small scale studies are often context-specific lacking the scale to "follow through to the implied logical entailed conclusion" (Nye et al., 2016). Synthesizing the findings of these studies helps us to present new understandings of our topic, by drawing relationships between the individual studies. We acknowledge that the way we have refined and extended theory is not without its problems. A possible bias in the range and nature of qualitative research synthesized here is that outdoor play in ECE is mostly done for the reason of recess and to relax. For example, the strong emphasis on wellbeing and physical play in both the experiences of teachers and children, might reflect a western view on outdoor play in nature-based environments. Therefore, the reciprocal translation of the findings around cognitive skills were harder to synthesize although the importance of these findings for ECE should not be underestimated. Certainly, the strength of the meta-ethnographic approach is that it combines findings from multiple sources to increase validity and takes it a step further than primarily providing a narrative review of individual studies. Instead, it develops higher-order explanations. The consistency in the findings of studies in this meta ethnography supported its value, as the studies were undertaken in different educational settings, with nature-based environments varying in size and design. Another limitation is that in our attempt to translate themes across studies to arrive at higher order concepts during "step 2" of the synthesis, we may have lost some of the meaning and depth of key concepts and themes. However, we sought to preserve individual authors' interpretations in our reciprocal translation of all the key concepts by memoing the key concepts. These memo's contained comments on how the concepts were developed, connecting these concepts into meta themes, meanwhile we re-aligned our line of argument with the findings of the individual studies.

Future research

This systematic review provides some suggestions for future research. The first promising line for new research would be to include a deep theoretical understanding of play for the development of young children when studying interventions in nature-based environments. Although the affordances theory seems to explain how the environments afford play actions, it is not sufficient to move beyond the individual play actions. From an educational perspective we argue it is important to shift our view of outdoor play from "letting off steam" to playing in nature-based environments for children's cognitive development.

From a methodological perspective, future research could benefit from the post humanist view in the study of Harwood and Collier (2017). Taking the agency of the nature-based environment in the play of young children seriously, we might find new perspectives on how humans and nature are connected. This is in line with the movement of acknowledging the rights of nature, as was done for the first time with the Te Urewera Act in New Zealand (Parliamentary Counsel Office, n.d.). In this act, it is acknowledged that Te Urewera has an identity in and of itself, inspiring people to commit to its care. In a western view of nature-based environments we tend to look mostly at the human perspective of interaction with the nature-based environment, whereas in this synthesis it is clear that children experience nature as something that "plays back."

Conclusion

Results of this systematic review using a meta ethnographic approach indicates that playing in nature-based environments not only supports young children's healthy physical

development (e.g., physical activity and motor development), but might also support their social-emotional, motor, and cognitive development. Although the studies we reviewed were mainly explorative and small-scaled, they do indicate that nature-based environments have far more to offer than only a space to relax or let off steam. Nature-based environments function as a play partner that helps children to transform the perceptual world into a conceptual world, because it diversifies play, is sensory rich and it plays back. When playing in nature-based environments, children have the possibility to connect with it in an interactive way. When teachers know how to mediate children's interactions with the nature-based environment, these interactions will have developmental value. Therefore, we encourage early childhood teachers to change their practice of playing outdoors into "nature play" as a daily activity that supports cognitive, social-emotional, as well as motor development. Finally, as we have seen the value of nature-based environments for play, in line with in Article 31 of the United Nations Convention on the Rights of the Child (United Nations, 1989) we might even consider nature play as a fundamental need and right of children. A need for and right to play in nature based environments that needs to be respected in the lives of young children.

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

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

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Personality traits and meat consumption: The mediating role of animal-related ethical concerns

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Prior research suggests that personality traits are associated with meat consumption. However, this association is not uniform across all types of meat. For instance, Big Five personality traits such as openness and agreeableness are negatively associated with red meat consumption but positively associated with fish. Using a large sample of Chilean university students (N =1,149), we examined whether these differential meat consumption patterns can be explained by an intermediary variable of animal-related ethical values. Structural equation modeling was employed to test the hypothesized associations. The results suggest that animal-related ethical values mediate the effect of certain personality traits on the consumption of beef and poultry.

KEYWORDS

animal ethical concerns, differential meat consumption, personality traits, animal ethics and welfare, big five personality

Introduction

Environmental problems related to a steady increase in meat consumption have become one of the most pressing global environmental issues (Gardner, 2005; Steg and Vlek, 2009; Koger, 2010). To keep global warming below 2°C, a plethora of research suggests that a shift toward diets with a lower carbon footprint, especially plant-based diets, is necessary (Girod et al., 2014; Verain et al., 2015; Bryngelsson et al., 2016; Godfray et al., 2018). The increase in meat consumption also is noted to impact quality of life through human health outcomes (Micha et al., 2010; Bouvard et al., 2015; Domingo and Nadal, 2017), and to trigger concerns about the correct ethical treatment of animals involved in agricultural and livestock production (Cornish et al., 2016).

In some respects, the goal of more plant-based diets is increasingly out of reach (Howes et al., 2017). Latin America's emerging middle classes have been aligning their lifestyles with those of the United States and European middle classes (Khara et al., 2020). This has led to a significant increase in high emission private consumption behaviors such as meat-based diets in demographically expanding populations (Williams and Anderson, 2020). Chile, where our study was situated, is a perfect example of this dynamic: Historical research indicates that meat consumption passed from annual consumption of around 30 kg per

person of meat in the 1930s to over 90 kg per person in the 2010s. This increase has been especially stark since the 1990s (Llorca-Jaña et al., 2020). The Chilean case epitomizes that it is essential for the deployment of effective global environmental policies to investigate human dietary behavior in emerging economies. However, most studies on environmentally sustainable diets have been conducted in Western industrial countries.

Diverse research focusing on the interplay of psychological and social factors that influence meat consumption is therefore valuable to advance a broad range of sustainable development goals. Along with sociodemographic factors such as age, gender, income, and educational level (Lea and Worsley, 2001; Gifford and Nilsson, 2014) and attitudes toward meat consumption (Dhont and Hodson, 2014; Piazza et al., 2015; Monteiro et al., 2017), recent research has suggested that animal-related ethical concerns (Hölker et al., 2019a,b) and personality traits play an active role concerning whether or not and how often meat is consumed (Keller and Siegrist, 2015; Pfeiler and Egloff, 2018b, 2020).

In the present study, we extended this literature by examining if and how individual differences in the Big Five personality traits (McCrae et al., 2018) and animal-related ethical concerns (Hölker et al., 2019a,b) are interrelated and associated with different types of meat consumption in a Chilean sample. The main objective of the present study was to investigate a potential mediating role of animal-related ethical concerns between personality traits and different types of meat consumption. This aspect is still missing in the current debate. While there are existing studies dealing with the association between animal welfare ethics and meat-based diets (e.g., Schulze et al., 2018; Ohlau et al., 2022) as well as studies dealing with the association of personality traits and meat consumption (e.g., Keller and Siegrist, 2015; Pfeiler and Egloff, 2018b, 2020), empirical research on personality traits that combines both perspectives is missing. This is, in part, because studies that investigate how personality traits are connected to animal-related ethical values are still very rare. We herein contribute some of the first empirical evidence on this subject. Furthermore, since this study is the first of its kind to be carried out in a Latin American country, we aimed to assess if the antecedent role of personality traits on meat consumption that has been established in previous samples of Western industrial societies can be reproduced in the Chilean context.

In summary, the present study tries to shed light on the understanding of meat consumption by contributing novel evidence to the two ongoing but for the most separate debates that relate personality and animal-ethical values to meat consumption by combining both views in one study.

Theoretical background

Animal-related ethical concerns and meat consumption

Animal-related ethical concerns are among the most cited motivations for a reduced or meatless diet in Western culture (Ruby, 2012). Recent studies have suggested that omnivores' beliefs concerning the ethics of meat-eating are a strong predictor of their meat consumption, whereas environmental and health-related determinants are much less predictive (Roozen and Raedts, 2022). Leveraging animal-related ethical concerns to promote meat-reduced diets still presents several difficulties, however. For instance, animal-related ethical concerns cannot be assumed to be homogeneously and consistently present across populations (Alonso et al., 2020). The concerns also tend to vary according to the species considered. The attribution of sentience, for instance, is often stronger for domestic animals, such as cats and dogs, than it is for livestock, fish, and insects (Hellyer et al., 1999; Hölker et al., 2019a). Moreover, beliefs about animal welfare ethics cannot be reduced to a single unidimensional construct.

Recent studies have revealed that these inconsistencies and complexities can be assessed more accurately when animal-related ethical concerns are considered through the lens of domain-specific values rather than through attitudinal information (Hölker et al., 2019a). Attitudinal information is often limited to a specific object (Eagly and Chaiken, 2005), whereas domain-specific values are strongly embedded in individual value systems and do not change as quickly as attitudes. At the same time, due to their concentration on a thematic complex, domain-specific values are relatively well-linked to specific consumer behaviors. This means that domain-specific values should offer a better prognostic quality and permit a higher degree of generalizability (see Hölker et al., 2019a). Nevertheless, research such as De Backer and Hudders' (2015) study that uses domain-specific values as a predictive approach for meat consumption is still scarce.

A notable exemption is a seminal study carried out by Hölker et al. (2019a). It reveals that the consumer's domain-specific animal-ethical values can be captured by seven distinct but correlated dimensions. These range from original anthropocentrism ("Humans are allowed to rule over animals as they please") and anthropocentrism with indirect duties ("Humans are allowed to treat animals as they please, however, without cruelty, in order to avoid brutalizing humans"), through relationism ("Duties towards animals depend on their relationship to humans``) and utilitarianism ("Positive consequences of animal use have to outweigh its negative consequences"), to new contractualism ("Humans are allowed to use animals but should guarantee them, in turn, a good life"), animal rights ("Animals, as sentient beings, have inalienable rights"), and abolitionism ("The use of animals for human purposes should be abolished completely" (Hölker et al., 2019a). This conceptual frame allows for a more fine-grained understanding of individual animal-related ethical values than traditional attitudinal measurements. For instance, the domains can capture how participants who score high on the dimension of "relationism" attribute moral status to animals depending on their relationship to humans. This specific dimension captures a tendency toward positive attitudes toward the exploitation of farm animals, such as cows and chicken, but negative attitudes toward the exploitation of companion animals,

such as dogs. Hölker et al. (2019b) argue that, in particular, those dimensions of animal-ethical beliefs that are related to the overall rejection or acceptance of the exploitation of animals are causally relevant for meat consumption. For instance, individuals who score high on the dimension of "abolitionism" attribute inalienable rights to animals. They believe that animals, being sentient and thus akin to humans, should be free from all forms of exploitation. In contrast, individuals who score high on "original anthropocentrism" believe in human exceptionalism and the right to exploit all animal species for any human purpose (Hölker et al., 2019a). Both dimensions, for this reason, are related to the inclination to eat animal-based products (Hölker et al., 2019b).

Moreover, following this novel approach to measure animal-ethical values, results of a recent experimental intervention in Chile suggest that pro-animal-ethical values such as abolitionism are related to the differential patterns of meat consumptions (Schobin et al., 2022). When "nudged" by friendly-looking animal cartoon faces, very abolitionist individuals were more likely to reduce the choice of red meats but not of fish. This suggests that meatless or meat-restricted diets, at least in the Chilean context, are motivated by the interplay between domain-specific values and personal ideas of the traits that certain species share with humans (Santos and Booth, 1996; Kenyon and Barker, 1998; Kubberød et al., 2002).

To extend this literature, we proposed the following hypotheses:

> *H1a*: Abolitionism is negatively associated with beef and poultry consumption, but unrelated to fish consumption.
> *H1b*: Original anthropocentrism is positively associated with beef, poultry, and fish consumption.

The Big five personality model and meat consumption

Personality traits are relatively stable individual characteristics through which patterns of behavior, belief, and emotion converge and manifest in different situations (Parks-Leduc et al., 2015). In personality psychology, there exist several commonly-used scales to assess an individuals' personality traits such as the Minnesota Multiphasic Personality Inventory (MMPI-2; Butcher et al., 1990), the 16 Personality Factor Questionnaire (16PF; Cattell, 1989), and the Big Five Personality Inventory (BFPI; Roccas et al., 2002). In methodological terms, there is a considerable overlap between the models that underlie these instruments: They all consider that an individual's personality is a latent multidimensional construct. They mostly differ in the precise delimitations between and the exact number of personality dimensions.

For the present research, we opted for the BFPI's five-factor personality model to facilitate the comparison with previous research. The BFPI is the most used personality assessment instrument in general and also in studies that specifically relate meat consumption to personality traits. The five-factor model considers five major personality traits: openness, conscientiousness, extraversion, agreeableness, and neuroticism (Goldberg, 1990; McCrae and John, 1992; McCrae and Costa, 1997).[1] According to McCrae et al. (2018), the five-factor theory underlying the BFPI "offers a framework for causal explanations in personality psychology" (p. 152), conceiving personality traits as "abstract potentials, hypothetical psychological features of the individual that, over time and in specific situations, come to be manifested in concrete realizations" (McCrae et al., 2018, p. 152). Consistent with this claim, previous research underscores that BFPI traits are important predictors of many health and eating habits (Mõttus et al., 2012, 2013; Pfeiler and Egloff, 2020). They have been frequently used to identify patterns in individual meat consumption (Mõttus et al., 2012, 2013; Keller and Siegrist, 2015).

For example, Mõttus et al. (2012, 2013) report that meat-based diets are associated with lower openness scores and higher neuroticism scores after controlling for sociodemographic factors. Similarly, in a random sample ($N = 951$) of a Swiss population, overall meat consumption was negatively associated with openness and agreeableness Keller and Siegrist (2015). Analogous results were found by Pfeiler and Egloff (2018a). They investigated the personality correlates to a single-item assessment of general meat consumption in two representative German samples ("How often do you eat meat, fish, poultry, or sausages?" and "On how many days per week have you usually eaten meat, including poultry and various meat products such as sausages?"). Overall meat consumption was negatively associated with openness and agreeableness in both samples and negatively associated with conscientiousness in the second sample (Pfeiler and Egloff, 2018a).

Although these studies provide consistent evidence that personality is correlated with meat consumption—with lower levels of openness and agreeableness being related to greater meat consumption—meat consumption was assessed therein on single global scales. This reduces the precision of the findings, primarily because participants must combine different meat categories,

1 Openness describes individuals who tend to appreciate new art, ideas, values, feelings, and creativity (McCrae and John, 1992) and characterizes "the breadth, depth, originality, and complexity of an individual's mental and experiential life" (John et al., 2008, p. 120). Agreeableness, as Digman (1990) notes, is "a dimension that appears to involve the more humane aspect of humanity—characteristics such altruism, nurturance, caring, and emotional support" (p. 422). Agreeable people are also fair, trustful, and empathic (Goldberg, 1990). Conscientious people tend to behave in organized, dutiful, and responsible ways (Goldberg, 1990; John et al., 2008) and "stay healthier, thrive, and live longer" (Friedman and Kern, 2014, p. 731). Extraversion is defined by the tendency to be talkative, sociable, and to enjoy others' company (McCrae and John, 1992) and implies "an energetic approach toward the social and material world" (John et al., 2008, p. 120). Finally, neurotic people are insecure, guilt-ridden, and tense individuals (Goldberg, 1990). Neuroticism also relates to frequent negative emotions such as anger, worry, and sadness and to interpersonal sensitivity (McCrae and John, 1992).

which may obscure specific variation related to personality (Pfeiler and Egloff, 2018b). To remedy this issue, a few studies have evaluated the consumption of different types of meat separately. A recent study by Pfeiler and Egloff (2018c), for instance, examined the differential correlational patterns between red meat consumption, processed meat consumption, poultry consumption, fish consumption, and BFPI traits. The researchers asked participants to rate the frequency with which they consumed each of these four types of meat (Pfeiler and Egloff, 2018c). The findings highlighted that the association between meat consumption and BFPI traits is not uniform. Openness, conscientiousness, and agreeableness were all negatively correlated with red meat and processed meat consumption. Extraversion was positively related to poultry consumption. Neuroticism was negatively associated with red meat, processed meat, and poultry consumption. However, all BFPI traits were positively associated with fish consumption (Pfeiler and Egloff, 2018c).

Since one objective of the present study was to investigate the antecedent role of BFPI traits on meat consumption, the following hypotheses were proposed:

> *H2a*: Openness and agreeableness are negatively associated with beef consumption.
> *H2b*: Openness and agreeableness are negatively associated with poultry consumption.
> *H2c*: All personality traits are positively associated with fish consumption.

Personality traits and animal-related ethical concerns

Although personality traits and personal values correspond to two different constructs, they have been found to have consistent and significant theoretical relationships (Parks-Leduc et al., 2015). However, published, peer-reviewed, and quantitative research that explains the relationship between personality traits and animal-ethical values is rare (Herzog and Mathews, 1997; Eckardt Erlanger and Tsytsarev, 2012). Most research in this area has focused on attitudinal data regarding experimentation on animals or animal slaughter. Therefore, the association between animal-related ethical values and personality traits is a novel research field, particularly regarding how the moral development of the human-animal relationship interacts with underlying personality dimensions in motivating individuals to consume less or more meat.

Previous attitudinal research has found some patterns in the relationship between animal welfare ethics and personality traits. Herzog and Mathews (1997) administrated the 16 Personality Factor Questionnaire (Cattell, 1989) and the Animal Attitude Scale (Herzog et al., 1991) to a small undergraduate student sample ($N = 99$). The results yielded weak correlations: sensitivity and imaginativeness, which may be associated with the BFPI traits of agreeableness and openness, were related to animal welfare attitudes (Herzog and Mathews, 1997). Next, Eckardt Erlanger and Tsytsarev (2012) examined empathy, BFPI traits, and attitudes toward non-human animals. High scores in empathic concern and personal distress were related to discomfort with animal cruelty. Additionally, individuals with higher levels of BFPI openness were more likely to oppose utilitarian uses of animals (i.e., animal experimentation, hunting, and slaughtering). In a similar study, Furnham et al. (2003) found that all BFPI traits except for conscientiousness were associated with a negative attitude toward animal experimentation. Agreeableness was the strongest predictor. The authors explain that agreeable individuals are more sensitive to pain in others (Furnham et al., 2003) and are more likely to have high empathy, specifically empathetic concern, which is the extent to which one suffers when others are distressed (Furnham et al., 2003).

The theoretical explanation for these results is that first, people with higher levels of agreeableness also have higher levels of empathy and are thus more likely to demonstrate benevolent attitudes toward animals. Second, people with higher levels of openness are more flexible in opting for harmless alternative methods in areas like animal production (Eckardt Erlanger and Tsytsarev, 2012). Despite the differences between attitudinal data and domain-specific values, this theoretical-empirical background allowed us to generate certain theoretical resemblances. We assumed that the domain-specific dimensions of "abolitionism" and "original anthropomorphism" are linked to certain attitudes about animal suffering and death, and, consequently, are also related to the specific BFPI traits of agreeableness and openness.

We, thus, proposed the following hypotheses regarding the relationship between BFPI traits and animal-related ethical domain-specific values:

> *H3a*: Openness and agreeableness are positively associated with abolitionism.
> *H3b*: Openness and agreeableness are negatively associated with original anthropocentrism.

The mediating role of animal-related ethical concerns

Personality traits represent a broad range of individual differences that provide limited results across behavioral domains at the expense of specific predictive ability (Saucier and Goldberg, 2004). BFPI traits can adequately predict broad types of behaviors (e.g., environment and health) but not more specific behaviors in specific domains (e.g., consumption of different types of meat; Epstein, 1980). Studies using the BFPI traits to examine the relationship between personality and differential meat consumption have assessed reliable interindividual differences (Keller and Siegrist, 2015; Pfeiler and Egloff, 2018a,b). However, they have failed to explain why certain traits are associated with certain types of meat consumption and others are not. The present study proposes that one way to address this limitation is to include

mediating mechanisms responsible for the personality-behavior link.

As noted previously, personal values influence food choices (Graham and Abrahamse, 2017). Recent research has found that animal welfare ethics can be modeled as domain-specific values, with original anthropocentrism and abolitionism having significant direct effects on meat consumption (see Hölker et al., 2019a,b). However, the mediating role of these values in the relationship between personality traits and meat consumption has not previously been studied. We theorize that including such a mediating role could allow for more precise causal results. Abolitionism and original anthropocentrism are seen as negatively correlated but not mutually exclusive elements of the individual value system. The theoretical mediation model for this study thus conceptualized abolitionist and original anthropocentric ethical values as opposing mediators between BFPI traits and meat consumption, as seen in Figures 1–3, leading to the following hypotheses:

> *H4a*: Abolitionist ethical values mediate the relationship between high openness and agreeableness and low consumption of beef, poultry, and fish.
> *H4b*: Original anthropocentric ethical values mediate the relationship between low openness and agreeableness and high consumption of beef, poultry, and fish.

Materials and methods

Data collection and sample characteristics

Young, socially ascending individuals from the emerging economies of Latin America, Southeast Asia, and Africa are the most significant meat consumers of tomorrow (Sans and Combris, 2015). They are a growing demographic with a growing purchasing power. Understanding factors and dynamics that determine the meat consumption of university students in emerging economy contexts is, therefore, of central importance for the design of environmental policies. In the present study, we examined the association between personality traits, animal-related ethical concerns, and varied meat consumption in a large undergraduate university sample in Chile ($N = 1{,}149$).

Measures

Sociodemographic information

The researchers analyzed gender (1 = male or diverse, 0 = female) and parents' educational levels (1 = secondary education, 2 = tertiary education, 3 = Bachelor's or equivalent level, 4 = Master's or a higher degree level). Gender was recoded from three into two variables because the number of individuals who did not identify as either male or female was very low. This could lead to these individuals being identified, which must be avoided because in Chile, non-gender-conforming individuals suffer from high levels of minority stress. Because all participants were enrolled at the university, the researchers decided to use parental educational levels as a reliable proxy variable of the participants' socioeconomic backgrounds. In Chile, educational level is tightly associated with social mobility and income. The participants thus provided the highest level of education attained by one of their parents.

Personality

Personality traits as constructs are generally more difficult to observe than demographic and socioeconomic information, yet they often have higher predictive power (O'Fallon and Butterfield, 2005). We concentrated on the standard personality measure of the BFPI. The traits of openness, conscientiousness, extraversion, agreeableness, and neuroticism were measured using a 21-item abbreviated scale based on Rammstedt and John (2005). After conducting confirmatory factor analysis, we dropped seven items for better fit (RMSEA = 0.054). The final 15-item scale consisted of questions rated on a 5-point Likert scale that ranged from 1 ("absolutely incorrect") to 5 ("absolutely correct"). The Cronbach's alphas were as follows: openness ($\alpha = 0.67$), conscientiousness ($\alpha = 0.66$), extraversion ($\alpha = 0.49$), agreeableness ($\alpha = 0.59$), and neuroticism ($\alpha = 0.73$).

Meat consumption

This study used an abbreviated Food Frequency Questionnaire adapted from Thompson et al. (2002) to assess the participants' consumption of four different meat-based products. Each question consisted of the following statement: "In a typical week, how frequently do you consume [beef; poultry; fish or shellfish]?." The response levels were 1 = "Never," 2 = "1 or 2 times a week," 3 = "3 or 4 times a week," and 4 = "5 times or more per week."

Animal-related ethical concerns

The novel Animal Ethical Intuition (AEI) scale developed and validated by Hölker et al. (2019a,b) was administrated to assess the participants' related domain-specific values. Hölker et al. (2019a) strove through the AEI scale to make a philosophical position useful for consumer studies, with two assumptions: First, ethical positions are based on complex argumentation schemes that cannot be captured entirely by a unidimensional construct. Second, society will not agree to animal-ethical positions without contradiction, meaning that respondents may advance more than one position. Thus, the AEI scale captures complex animal-related ethical concerns through seven correlated (nonorthogonal) dimensions. We translated and adapted the original AEI scale to the Chilean context and tested whether it had the same factor structure as in previous research (Schobin et al., 2022). The study was designed to focus on the two most extreme of the seven animal-ethical intuitions because the polarizing intuitions of original anthropocentrism ("Humans are allowed to rule over animals as they please") and abolitionism ("The use of animals for human purposes should be abolished completely") have been found to most significantly affect the consumption of animal-sourced foods

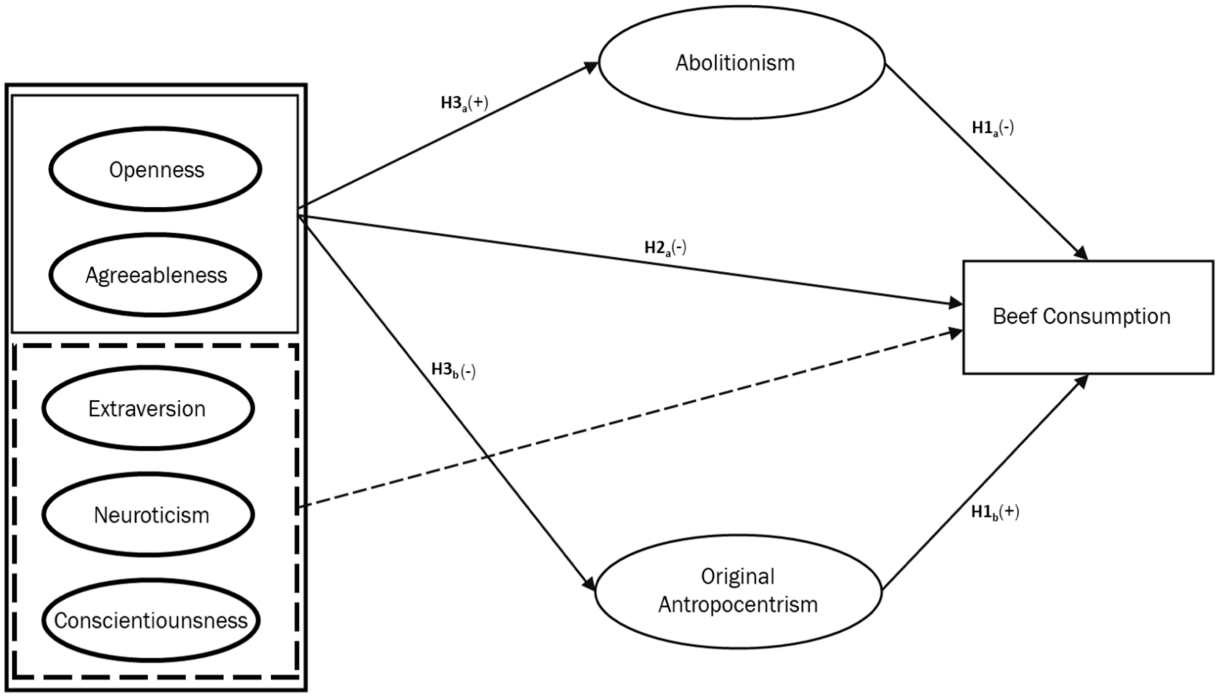

FIGURE 1
Conceptual model depicting the hypothesized relationships between the big five personality traits. Abolitionist ethical intuition, and frequency of beef consumption.

(Hölker et al., 2019b). All six items were measured on a 5-point Likert scale from 1 = "strongly disagree" to 5 = "strongly agree."

Analytical procedures

Anderson and Gerbing's (1988) two-stage procedure was followed for confirmatory factor analysis and structural equation modeling using RStudio (RStudio Team, Version 4.2.0, 2022) with the lavaan package version 0.6–11 (Rosseel, 2012). To assess the measurement model, we performed a confirmatory factor analysis that tested the relationships between items and their corresponding latent constructs. Average variance explained (AVE) and maximum shared variance (MSV) were administered to investigate the convergent and discriminant validity, respectively, whereas composite reliability (CR) was used to assess the internal consistency among scale items. According to Hair et al. (2013), AVE represents satisfactory convergent validity if >0.5 and discriminant validity if AVE > MSV and CR > 0.7.

Moreover, we specified and compared two measurement models to evaluate the appropriate factor structure of the modified AEI scale. Sample size-independent model fit indices included root mean square error of approximation (RMSEA < 0.07), comparative fit index (CFI > 0.90), standardized root mean square residual (SRMR < 0.08), and the Tucker-Lewis Index (TLI > 0.90; Hair et al., 2013). We controlled for confounding effects of common method bias by applying an unmeasured latent method factor to the measurement model (i.e., gender and parental education level; Podsakoff et al., 2003). Finally, a bias-corrected bootstrap procedure with 5,000 resamples was run to test for any specific indirect effects of BFPI traits on meat consumption *via* abolitionism and original anthropocentrism.

Results

Reliability and validity of measures

To assess the appropriate factor structure of the AEI scale, we specified two measurement models, and their model fit was compared. The first model specified abolitionism and original anthropocentrism as a single unidimensional factor (immediate items reverse-coded). This model was underfitted: $\chi^2(9) = 218.08$, RMSEA = 0.14, CFI = 0.71, SRMR = 0.09, TLI = 0.51. The second model assumed, in accordance with prior research (Hölker et al., 2019b; Schobin et al., 2022), two correlated factors (i.e., abolitionism vs. original anthropocentrism). The model fit improved significantly: $\chi^2(8) = 23.01$, RMSEA = 0.04, CFI = 0.98, SRMR = 0.03, TLI = 0.96. Hence, a two-factor representation of the AEI scale was retained for further analysis.

The full measurement model included seven latent constructs: abolitionism, original anthropocentrism, openness, conscientiousness, extraversion, agreeableness, and neuroticism. The initial model fit was suboptimal: $\chi^2(303) = 1610.46$,

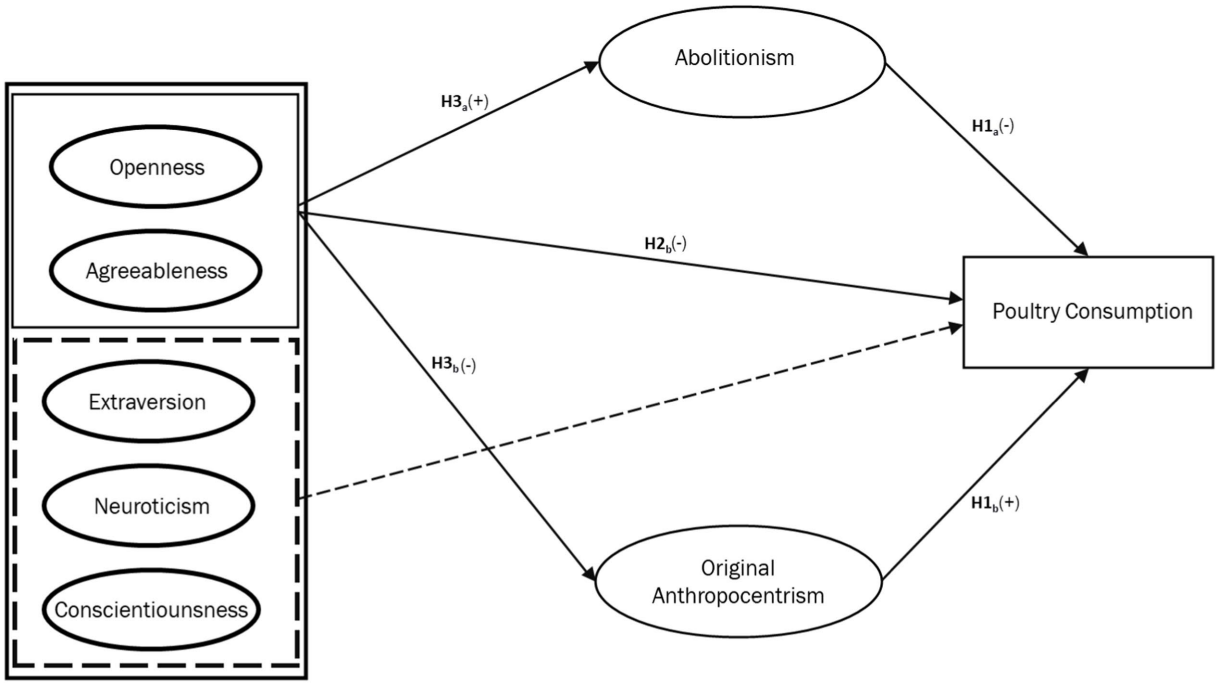

FIGURE 2
Conceptual model depicting the hypothesized relationships between the big five personality traits. Abolitionist ethical concern, and frequency of poultry consumption.

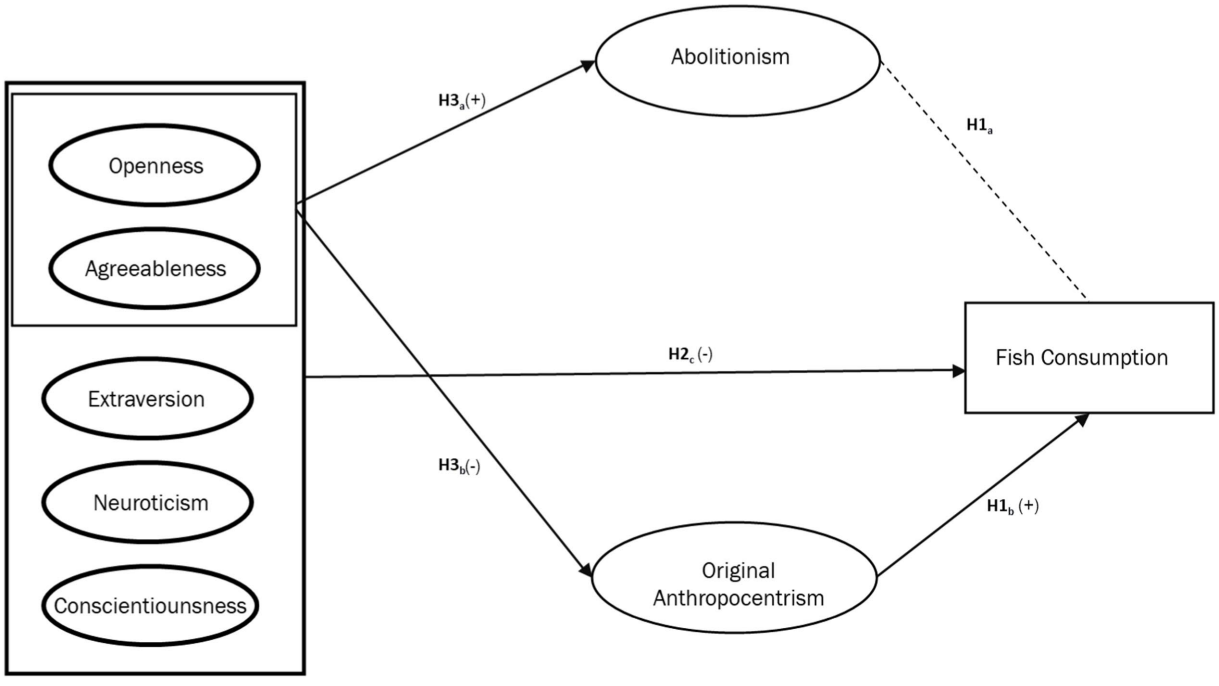

FIGURE 3
Conceptual model depicting the hypothesized relationships between the big five personality traits. Abolitionist ethical concern, and frequency of fish consumption.

RMSEA = 0.06, CFI = 0.75, SRMR = 0.062, TLI = 0.71. To improve the model fit, we screened the measurement model for problematic items (i.e., low factor loadings and high error correlations). Consequently, two items from three latent BFPI constructs—extraversion, conscientiousness, and neuroticism—were omitted. The final measurement model had a significantly improved fit: $\chi^2(149) = 472.56$, RMSEA = 0.04, CFI = 0.91, SRMR = 0.04, TLI = 0.88. Modification indices suggested some correlated error terms, which would improve model fit. However, allowing for correlated error terms—especially between items measuring different latent constructs—is usually not advised without a grounded theoretical reason (Landis et al., 2009; Hermida, 2015), and therefore, we did not implement such modifications.

Abolitionism and original anthropocentrism reported convergent validity (AVE > 0.50 and AVE > MSV). Both factors were below the CR threshold of 0.70. Openness, conscientiousness, agreeableness, and extraversion demonstrated adequate convergent validity (< 0.50) but were just below the CR limit (CR < 0.70). Neuroticism reported inadequate convergent validity (AVE = 0.44) and an appropriate CR value (> 0.70). The researchers considered it inappropriate to omit additional items to achieve a better overall fit and adequate validity and reliability estimates, based on the assumption that the latent constructs would only be reflected by one item and, hence, uncorrelated on their own (e.g., Howell et al., 2007). Table 1 presents the final measurement model.

Last, descriptive measures indicated that the prevalent gender was female (67%), over male (33%) or diverse (< 0.1%), and ages ranged from 18 to 42 years old ($M = 21.80$, SD = 2.57). On average, participants considered abolitionist ethical concerns related to human-animal relations (mean abolitionism = 3.61) more important than anthropocentric belief (mean original anthropocentrism = 1.26).

Test of structural models and direct effects

To represent each type of meat, four structural equation models were specified and assessed, controlling for the sociodemographic variables of gender and parental educational level. The researchers analyzed a total of 12 models. The first research objective was to evaluate the relationship between the AEI scale's domain-specific values (i.e., abolitionism and original anthropocentrism) and differential beef, poultry, and fish consumption. Model 1 therefore specified abolitionism and original anthropocentrism as predictors of varied meat-eating types.[2] For Model 1a, as seen in Table 2, goodness-of-fit measures were optimal: $\chi^2(20) = 42.81$, RMSEA = 0.03, CFI = 0.98, SRMR = 0.03, TLI = 0.97. Abolitionism ($\beta = -0.22$, $z = -3.98$, $p < 0.000$) was significantly negatively associated with beef consumption, whereas original anthropocentrism ($\beta = 0.23$, $z = 2.90$, $p < 0.001$) was significantly positively associated with beef consumption. For Model 1b, as seen in Table 3, goodness-of-fit measures were adequate: $\chi^2(20) = 38.28$, RMSEA = 0.03, CFI = 0.98, SRMR = 0.03, TLI = 0.98. Abolitionism ($\beta = -0.22$, $z = -4.04$, $p < 0.000$) was significantly negatively associated with poultry consumption, but original anthropocentrism ($\beta = 0.04$, $z = 0.49$, $p > 0.05$) had no significant association with poultry consumption. Finally, for Model 1c, as seen in Table 4, had adequate fit indices: $\chi^2(20) = 31.43$, RMSEA = 0.02, CFI = 0.99, SRMR = 0.02, TLI = 0.99. Both abolitionism ($\beta = -0.08$, $z = -1.64$, $p > 0.05$) and original anthropocentrism ($\beta = 0.15$, $z = 1.87$, $p > 0.05$) were not significantly associated with fish consumption. These results fully support H_{1a} and support H_{1b} for beef consumption alone.

The second objective was to investigate the link between the BFPI traits and differential meat consumption patterns. Model 2 assessed the effects of openness, conscientiousness, extraversion, agreeableness, and neuroticism on beef, poultry, and fish consumption frequency. For Model 2a, as seen in Table 2, openness ($\beta = -0.174$, $z = -2.19$, $p < 0.010$) and agreeableness ($\beta = -0.18$, $z = -2.04$, $p < 0.010$) were negatively and significantly related to beef consumption, while neuroticism, extraversion, and conscientiousness were not significantly related to beef consumption. Model fit was adequate: $\chi^2(99) = 337.63$, RMSEA = 0.05, CFI = 0.92, SRMR = 0.04, TLI = 0.91. For Model 2b, as seen in Table 3, neuroticism ($\beta = -0.12$, $z = -1.97$, $p < 0.05$) and agreeableness ($\beta = -0.174$, $z = -1.94$, $p < 0.0.5$) had a negative and significant association with poultry consumption. The model had adequate fit indices: $\chi^2(99) = 336.40$, RMSEA = 0.05, CFI = 0.92, SRMR = 0.04, TLI = 0.91. For Model 2c, as seen in Table 4, none of the BFPI traits were significantly associated with fish consumption, with an adequate model fit: $\chi^2(99) = 332.17$, RMSEA = 0.05, CFI = 0.92, SRMR = 0.05, TLI = 0.92. These findings support H_{2a}, partially reject H_{2b}, and fully reject H_{2c}.

Test of structural equation models and indirect effects

After introducing to the models, the concept of the BFPI traits as precursors of abolitionism and original anthropocentrism, the researchers ran six additional analyses. The first set of analyses assumed BFPI traits had only indirect effects on beef, poultry, and fish consumption *via* abolitionism and original anthropocentrism, constraining the direct paths to equal zero (Models 3a–3c, full mediation). The second set of models allowed all paths to be freely estimated (Models 4a–4c, partial mediation). A Chi-square difference test compared all meat pair-nested models (full mediation vs. partial mediation). Model 4a had significant improved model fit over 3a: $\Delta\chi^2 = 20.28$, $p = 0.001$. Model 4b had marginally improved model fit over 3b: $\Delta\chi^2 = 8.29$, $p = 0.030$.

2 Table 2 corresponds to the specifications of the models used to evaluate beef frequency consumption, Table 3 for to the models used to evaluate poultry consumption, and Table 4 to the models used to evaluate fish consumption.

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TABLE 1 Standardized factor loadings, reliability, and validity.

Construct and item	Factor loadings	Composite reliability	Average extracted variance
Openness		0.69	0.69
I am interested in many kinds of things.	0.53		
I am intellectually curious and like to contemplate things.	0.51		
I am very imaginative.	0.61		
I enjoy artistic and aesthetic expressions.	0.63		
I do not have much artistic interest.	0.58		
Neuroticism		0.73	0.44
I get depressed or discouraged easily.	0.95		
I am laid back and do not let myself be worried about stress.	+		
I worry too much.	+		
I easily become insecure and nervous.	0.91		
Agreeableness		0.51	0.68
I tend to criticize others.	0.53		
I trust another easily and believe that people are inherently good.	+		
I can be cold and distant in my behavior.	0.40		
I can be rude and devaluing to others.	0.75		
Conscientiousness	+	0.54	0.63
I strive to finish my homework well.			
I make things comfortable for myself and tend to be lazy.	+		
I am competent and work fast.	0.48		
The plans I make I carry out.	0.52		
Extraversion	+	0.48	0.64
I am usually modest and reserved.			
I am easily motivated and can easily motivate others as well.	0.68		
I tend to be the" strong guy with few words."	+		
I am extroverted.	0.57		
Abolitionism		0.51	0.71
We must not, under any circumstances, use animals for our own purposes.	0.86		
Custody of farm animals and pets should be abolished, because animals have the right to live in freedom.	0.61		
The use of animals for our own pleasure, such as equestrian sport, dog sports or for the circus, is wrong.	0.51		
Original Anthropocentrism		0.56	0.63
Humans are allowed to do whatever they want with animals.	0.46		
We are allowed to treat animals however we want, because they are just animals.	0.50		
We can inflict pain to animals at any time, because they are just animals.	0.30		

+indicates omitted items to improve model fit. Model fit: $\chi^2(149) = 472.56$, RMSEA = 0.04, CFI = 0.91, SRMR = 0.04, TLI = 0.88.

Model 4c significantly improved model fit over 3c: $\Delta\chi^2 = 26.82$, $p = 0.000$. Thus, improved overall fit indices were observed in all three partial mediation models compared to all three full mediation models.

In Model 3a, both abolitionism ($\beta = -0.29$, $z = -4.98$, $p < 0.000$) and original anthropocentrism ($\beta = 0.23$, $z = 2.81$, $p < 0.001$) were significant predictors of beef consumption. Similar results were found in Model 4a: Abolitionism ($\beta = -0.24$, $z = -3.50$, $p < 0.000$) had a significant negative association, while original anthropocentrism ($\beta = 0.23$, $z = 2.74$, $p < 0.001$) had a significant positive association. In Model 4a, which allowed for the direct effects of BFPI traits on meat consumption, the direct effect of Agreeableness ($\beta = -0.07$, $z = -0.74$, $p > 0.45$) was attenuated when compared to Model 2a. No other attenuation was found with beef consumption, either for openness ($\beta = -0.17$, $z = 0.08$, $p < 0.001$) or for other BFPI traits (compare Table 2).

In Model 3b, original anthropocentrism was not associated with poultry consumption ($\beta = 0.031$, $z = 0.41$, $p < 0.001$), whereas abolitionism ($\beta = -0.23$, $z = -4.25$, $p < 0.000$) had a significant negative association with poultry consumption. Model 4b also indicated that abolitionism ($\beta = -0.25$, $z = -3.51$, $p < 0.000$) had a significant negative association with poultry consumption and that original anthropocentrism ($\beta = 0.05$, $z = 0.55$, $p > 0.58$) had no association with poultry consumption. The direct effects of

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TABLE 2 Beef consumption structural equation models and fit indices, controlling for sex and parental education level.

		Model 1a			Model 2a			Model 3a (Full Mediation)			Model 4a (Partial Mediation)		
Relationship	**Hypothesis**	***β***	**SE**	***p*-Values**	***β***	**SE**	***p*-Values**	***β***	**SE**	***p*-Values**	***β***	**SE**	***p*-Values**
ABOL → BEEF	$H1_a$	−0.22	0.05	0.000***				−0.29	0.06	0.000***	−0.24	0.07	0.000***
ORIG → BEEF	$H1_b$	0.23	0.08	0.004**				0.23	0.08	0.005**	0.23	0.08	0.006**
O → BEEF	$H2_a$				−0.17	0.08	0.03*				−0.17	0.08	0.04*
A → BEEF	$H2_a$				−0.18	0.09	0.04*				−0.07	0.10	0.46
E → BEEF	$H2_a$				−0.16	0.18	0.38				−0.20	0.19	0.29
C → BEEF	$H2_a$				0.23	0.26	0.36				0.43	0.29	0.13
N → BEEF	$H2_a$				−0.05	0.06	0.44				0.03	0.06	0.65
O → ABOL	$H3_a$							0.14	0.06	0.03*	0.12	0.07	0.08
A → ABOL	$H3_a$							0.40	0.08	0.000*	0.39	0.08	0.000***
E → ABOL	$H3_a$							−0.07	0.14	0.63	−0.10	0.15	0.49
C → ABOL	$H3_a$							0.29	0.20	0.16	0.36	0.22	0.10
N → ABOL	$H3_a$							0.20	0.05	0.000***	0.20	0.05	0.000***
O → ORIG	$H3_b$							−0.05	0.03	0.116	−0.05	0.03	0.16
A → ORIG	$H3_b$							−0.17	0.04	0.000***	−0.17	0.04	0.000***
E → ORIG	$H3_b$							0.04	0.07	0.61	0.04	0.07	0.55
C → ORIG	$H3_b$							−0.14	0.10	0.16	−0.15	0.10	0.13
N → ORIG	$H3_b$							−0.07	0.03	0.007**	−0.07	0.03	0.007**
Model fit indices:													
χ^2 (*df*)		42.81(20)			337.63(99)			475.32(193)			455.04(193)		
RMSEA		0.03			0.05			0.04			0.03		
CFI		0.98			0.92			0.93			0.94		
SRMR		0.03			0.04			0.04			0.04		
TLI		0.97			0.91			0.93			0.93		
$\Delta\chi^2(\Delta df)$											20.288 (7)		

***$p < 0.001$, **$p < 0.010$, *$p < 0.050$. Beef = beef frequency consumption, O = openness, E = extraversion, C = conscientiousness, A = agreeableness, N = neuroticism, ABOL = abolitionism, ORIG = original anthropomorphism. Beta estimates are standardized.

agreeableness ($\beta = -0.10$, $z = -0.96$, $p > 0.34$) and neuroticism ($\beta = -0.06$, $z = -0.93$, $p > 0.35$) were attenuated in Model 4b when compared to Model 2b. Nonsignificant direct effects on poultry consumption thus result for any of the BFPI traits (compare Table 3).

In Model 3c, both abolitionism ($\beta = -0.05$, $z = -0.94$, $p > 0.35$) and original anthropocentrism ($\beta = 0.13$, $z = 1.65$, $p > 0.10$) were unrelated to fish consumption. However, Model 4c amplified the relationship of original anthropocentrism ($\beta = -0.17$, $z = 2.11$, $p < 0.05$) and fish consumption, while abolitionism ($\beta = -0.12$, $z = -1.90$, $p > 0.05$) remained unrelated. None of the BFPI traits were significantly related with fish consumption in the partial mediation model, which is consistent with Model 2c that only included the direct effects.

The researchers also modeled the effects of the BFPI traits on the AEI scale's domain-specific values. In Model 3a, openness ($\beta = 0.14$, $z = 2.22$, $p < 0.001$) was significantly positively associated with abolitionism, whereas in Model 4a, the relationship was only marginally significant ($\beta = 0.12$, $z = 1.74$, $p > 0.08$). Between Models 3 and 4, both agreeableness ($\beta = 0.39$, $z = 4.83$, $p < 0.000$) and neuroticism ($\beta = 0.20$, $z = 3.84$, $p < 0.000$) were significantly positively associated with abolitionism and negatively associated with original anthropocentrism ($\beta = -0.17$, $z = -4.36$, $p < 0.000$; $\beta = -0.07$, $z = -2.71$, $p < 0.001$). Extraversion and conscientiousness did not significantly relate to either abolitionism or original anthropocentrism in Models 3 and 4. Since the significant effects of BFPIs on AEI are very similar in Model 3b and Model 4b (see Table 3), as well as in Model 3c and Model 4c (see Table 4), their respective coefficients are not included in this section. These findings, for the most, support H_{3a} and H_{3b}.

This study's indirect effects are presented in Table 5. To summarize, four significant indirect effects of BFPI traits *via* abolitionism and original anthropocentrism were established. Agreeableness and neuroticism were associated with less frequent beef consumption indirectly *via* abolitionism and more frequent beef consumption indirectly *via* original anthropocentrism. Two significant indirect effects were established *via* abolitionism on poultry consumption. Low scores in agreeableness and neuroticism were associated with less frequent poultry consumption indirectly *via* stronger abolitionism. As no direct

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TABLE 3 Poultry consumption structural equation models and fit indices, controlling for sex and parental education level.

		Model 1b			Model 2b			Model 3b (Full mediation)			Model 4b (Partial mediation)		
Relationship	**Hypothesis**	***β***	**SE**	***p*-Values**	***β***	**SE**	***p*-Values**	***β***	**SE**	***p*-Values**	***β***	**SE**	***p*-Values**
ABOL → POUL	$H1_a$	−0.22	0.06	0.000***				−0.23	0.05	0.000***	−0.25	0.07	0.000***
ORIG → POUL	$H1_b$	0.04	0.08	0.63				0.03	0.08	0.68	0.05	0.08	0.58
O → POUL	$H2_b$				−0.03	0.08	0.69				−0.03	0.09	0.73
A → POUL	$H2_b$				−0.17	0.09	0.05*				−0.10	0.10	0.34
E → POUL	$H2_b$				−0.30	0.19	0.12				−0.34	0.21	0.96
C → POUL	$H2_b$				0.33	0.27	0.22				0.49	0.30	0.10
N → POUL	$H2_b$				−0.12	0.06	0.05*				−0.06	0.07	0.35
O → ABOL	$H3_a$							0.12	0.07	0.07	0.12	0.07	0.09
A → ABOL	$H3_a$							0.41	0.08	0.000***	0.39	0.08	0.000***
E → ABOL	$H3_a$							−0.05	0.14	0.70	−0.10	0.15	0.49
C → ABOL	$H3_a$							0.30	0.21	0.15	0.36	0.22	0.09
N → ABOL	$H3_a$							0.21	0.05	0.000***	0.20	0.05	0.000***
O → ORIG	$H3_b$							−0.05	0.03	0.17	−0.05	0.03	0.17
A → ORIG	$H3_b$							−0.17	0.04	0.000***	−0.17	0.04	0.000***
E → ORIG	$H3_b$							0.04	0.07	0.58	0.04	0.07	0.56
C → ORIG	$H3_b$							−0.15	0.10	0.13	−0.16	0.10	0.13
N → ORIG	$H3_b$							−0.07	0.03	0.006**	−0.07	0.03	0.006**
Model fit indices:													
X^2 (*df*)		38.28(20)			336.40(99)			459.15(200)			450.86(193)		
RMSEA		0.03			0.05			0.03			0.03		
CFI		0.98			0.92			0.94			0.94		
SRMR		0.03			0.04			0.04			0.04		
TLI		0.98			0.91			0.93			0.93		
$\Delta\chi^2(\Delta df)$											8.2962(7)		

***$p < 0.001$, **$p < 0.010$, *$p < 0.050$. Poultry = poultry frequency consumption, O = openness, E = extraversion, C = conscientiousness, A = agreeableness, N = neuroticism, ABOL = abolitionism, ORIG = original anthropomorphism. Beta estimates are standardized.

effects were observed in partial mediation model (Model 4b), this result suggests the full mediation of agreeableness (and neuroticism) on poultry consumption *via* animal welfare ethics (Zhao et al., 2010; Rucker et al., 2011). No indirect effects on fish consumption of BFPI traits *via* abolitionism or original anthropocentrism were found, indicating that these domain-specific values are unrelated when fish is measured as the outcome variable. These findings, therefore, partially support H_{4a} and H_{4b}.

Discussion

The herein-described study examined the simultaneous role of the BFPI traits and the animal-ethical values of abolitionism and original anthropomorphism in differential meat consumption patterns among a large sample of Chilean undergraduate students. Results were consistent with the hypotheses posed among all structural models.

Model 1a established a significant association of both abolitionism and original anthropocentrism with beef consumption. Less frequent beef consumption was associated with stronger abolitionist values and weaker original anthropocentric values related to the human-animal relationship. More frequent beef consumption was likewise associated with weaker abolitionist values and stronger original anthropocentric values. In the case of poultry with Model 1b, only abolitionist values indicated a significant negative association, while Model 1c revealed no significant relationship of fish consumption either with abolitionism or with original anthropocentrism. This gradual fading of significant associations is in line with prior research in the field (Hellyer et al., 1999; Hölker et al., 2019b; Schobin et al., 2022). Crucial differences between red meat and white meat can explain why different consumption patterns are expected. First, red meat comes from mammals, while white meat comes from birds or sea creatures. These species have very different degrees of phylogenetic relatedness to humans, and phylogenetic relatedness is associated with greater attribution of mental states (Herzog and Shelley, 1997) and empathy (Ingham et al., 2015). Therefore, human-like traits such as sensitivity and sentience or

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TABLE 4 Fish consumption structural equation models and fit indices, controlling for sex and parental education level.

		Model 1c			Model 2c			Model 3c (Full Mediation)			Model 4c (Partial Mediation)		
Relationship	**Hypothesis**	***β***	**SE**	**p-Values**	***β***	**SE**	**p-Values**	***β***	**SE**	**p-Values**	***β***	**SE**	**p-Values**
ABOL → FISH	$H1_a$	−0.08	0.05	0.10				−0.05	0.05	0.35	−0.12	0.06	0.06
ORIG → FISH	$H1_b$	0.15	0.08	0.06				0.13	0.08	0.10	0.17	0.08	0.034*
O → FISH	$H2_c$				0.11	0.08	0.16				0.11	0.08	0.17
A → FISH	$H2_c$				0.05	0.09	0.59				0.10	0.10	0.29
E → FISH	$H2_c$				0.10	0.18	0.59				0.07	0.18	0.70
C → FISH	$H2_c$				−0.08	0.26	0.75				0.05	0.26	0.84
N → FISH	$H2_c$				−0.04	0.06	0.53				0.01	0.06	0.91
O → ABOL	$H3_a$							0.11	0.07	0.10	0.12	0.07	0.09
A → ABOL	$H3_a$							0.40	0.08	0.000***	0.40	0.08	0.000***
E → ABOL	$H3_a$							−0.11	0.15	0.50	−0.11	0.15	0.48
C → ABOL	$H3_a$							0.38	0.22	0.08	0.38	0.22	0.09
N → ABOL	$H3_a$							0.21	0.05	0.000***	0.21	0.05	0.000***
O → ORIG	$H3_b$							−0.04	0.03	0.20	−0.05	0.03	0.17
A → ORIG	$H3_b$							−0.17	0.04	0.000***	−0.17	0.04	0.000***
E → ORIG	$H3_b$							0.04	0.07	0.53	0.04	0.07	0.56
C → ORIG	$H3_b$							−0.16	0.10	0.12	−0.15	0.10	0.13
N → ORIG	$H3_b$							−0.07	0.03	0.006**	−0.07	0.03	0.006**
Model fit indices:													
X^2 (*df*)		31.43(20)			332.17(99)			466.33(200)			439.51(193)		
RMSEA		0.02			0.05			0.03			0.03		
CFI		0.99			0.92			0.93			0.94		
SRMR		0.02			0.05			0.04			0.04		
TLI		0.99			0.92			0.93			0.93		
$\Delta\chi^2(\Delta df)$											26.826(7)		

***$p < 0.001$, **$p < 0.010$, *$p < 0.050$. Fish = fish frequency consumption, O = openness, E = extraversion, C = conscientiousness, A = agreeableness, N = neuroticism, ABOL = abolitionism, ORIG = original anthropomorphism. Beta estimates are standardized.

mammalian anthropomorphism seem to play a decisive role in weighting ethical values upon animal species.

In Model 2a, a significant relationship was found between more agreeable and more open individuals and less frequent beef consumption. These results are in consonance with prior literature on the field. No significant relationship was found with other BFPI traits. In Model 2b, more neurotic and more agreeable individuals indicated significantly less frequent poultry consumption. Although not hypothesized, an association between neuroticism and poultry consumption was thus found. In Model 2c, no significant association was found between any BFPI traits and fish consumption, which is in line with prior studies (Schobin et al., 2022). These results further extend previous studies (Keller and Siegrist, 2015; Pfeiler and Egloff, 2018b,c) by providing empirical evidence of the differential antecedent role BFPI traits exert on beef, poultry, and fish consumption and thus offer a broader understanding of these associations as compared to overall meat consumption assessments.

Next, openness, agreeableness, and neuroticism demonstrated significant relationships to abolitionism and to original anthropocentrism.[3] The directions of relationships were also in accordance with expectations in agreeableness and openness, whereas neuroticism's unexpected results may offer new explanatory possibilities if confirmed in future research. Agreeableness was positively associated with abolitionism and negatively associated with original anthropocentrism, suggesting that the more agreeable individuals are, the more considerate they are in attributing a high moral-ethical value to animals. Likewise, this suggests that less agreeable individuals are more likely to integrate moral positions into their personal values systems that support or justify animal reification due to human exceptionalism.

3 In the case of openness, a significant association was found only in Model 3a, while in Model 4a, the association was attenuated. Both neuroticism and agreeableness had consistent effects in the conceptualized structural models.

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TABLE 5 Estimates of the indirect effects.

Predictor	Mediator	Meat type	*B*	SE	*Z*	*p*
Openness	ABOL	Beef	−0.03	0.02	−1.68	0.10
Conscientiousness	ABOL	Beef	−0.09	0.06	−1.38	0.17
Extraversion	ABOL	Beef	0.02	0.04	0.66	0.51
Agreeableness	ABOL	Beef	−0.09	0.03	−2.99	**0.003*****
Neuroticism	ABOL	Beef	−0.05	0.02	−2.58	**0.01****
Openness	ORIG	Beef	−0.01	0.008	−1.31	0.190
Conscientiousness	ORIG	Beef	−0.04	0.029	−1.22	0.22
Extraversion	ORIG	Beef	0.010	0.017	0.56	0.58
Agreeableness	ORIG	Beef	−0.04	0.016	−2.42	**0.02****
Neuroticism	ORIG	Beef	−0.02	−0.008	−1.93	**0.05***
Openness	ABOL	Poultry	−0.03	0.026	−1.09	0.27
Conscientiousness	ABOL	Poultry	−0.09	0.082	−1.09	0.28
Extraversion	ABOL	Poultry	0.03	0.050	0.49	0.62
Agreeableness	ABOL	Poultry	−0.10	0.041	−2.37	**0.02****
Neuroticism	ABOL	Poultry	−0.05	0.023	−2.20	**0.03****
Openness	ORIG	Poultry	−0.002	0.009	−0.23	0.82
Conscientiousness	ORIG	Poultry	−0.007	0.034	−0.212	0.83
Extraversion	ORIG	Poultry	0.002	0.018	0.10	0.92
Agreeableness	ORIG	Poultry	−0.008	0.022	−0.36	0.72
Neuroticism	ORIG	Poultry	−0.003	0.010	−0.03	0.074
Openness	ABOL	Fish	−0.014	0.017	−0.83	0.41
Conscientiousness	ABOL	Fish	−0.05	0.53	−0.86	0.38
Extraversion	ABOL	Fish	0.01	0.30	0.45	0.65
Agreeableness	ABOL	Fish	−0.05	0.034	−1.39	0.16
Neuroticism	ABOL	Fish	−0.03	0.018	−1.38	0.17
Openness	ORIG	Fish	−0.008	0.012	−0.63	0.52
Conscientiousness	ORIG	Fish	−0.03	0.035	−0.75	0.45
Extraversion	ORIG	Fish	0.007	0.019	0.378	0.70
Agreeableness	ORIG	Fish	−0.03	0.022	−1.34	0.18
Neuroticism	ORIG	Fish	−0.01	0.010	−1.19	0.23

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, B = standardized estimate, SE = standard error, $p = p$-values, ABOL = abolitionism, ORIG = original anthropocentrism. Significant indirect effects in bold.

Similar patterns of association were evident for openness and neuroticism. This is broadly congruent with previous investigations that have examined the relationship between attitudes toward animal welfare and personality traits (Herzog and Mathews, 1997; Hellyer et al., 1999; Furnham et al., 2003; Eckardt Erlanger and Tsytsarev, 2012).

A comparison between the full and partial mediation models lent support for retaining the latter models following a significant Chi-square difference test. Interpretation of Model 4a suggests that neuroticism and agreeableness are associated with differing beef consumption frequency through their positive relationships to abolitionism and negative relationships to original anthropocentrism. Model 4b suggests that agreeableness and neuroticism exert a negative influence on poultry consumption solely *via* abolitionism, whereas nonsignificant effects were found in Model 4c for fish consumption.

In summary, the mediating role of animal-related ethical concerns as domain-specific values helps to explain why certain personality traits are associated with beef and poultry consumption and others are not. The domain-specific approach to animal-ethical concerns in the present study is interpreted as a sub-dimension of the personal value system of individuals and, therefore, as a construct that is correlated with personality traits. Agreeable individuals are characterized by qualities such as empathy and altruism (Hofstee and Goldberg, 1992; Soto and Jackson, 2013) and therefore are more likely to demonstrate benevolent attitudes and exhibit greater affinity for including animal welfare-orientated values in their belief systems. Individuals with higher levels of original anthropocentrism, however, were less agreeable. Personality traits such as empathy or benevolence would not be extensible to other sentient beings in this situation, restricting the ability to ascribe a moral status to other non-human animal species and leading them to consume more animal products.

Although the research did not expect a mediating role between neuroticism and low beef and poultry consumption, the significant

results resonate with previous studies related to anticipatory guilt on meat consumption (Wang and Basso, 2019). On the one hand, experimental evidence related to the "meat paradox" has revealed that anthropomorphizing animal meat can alter consumption attitudes and behavioral intentions and induce feelings of guilt (Wang and Basso, 2019; Schobin et al., 2022). On the other, neurotic individuals are characterized as insecure, guilt-ridden, and tense (Hofstee and Goldberg, 1992). In this regard, one way to explain the indirect effects of neuroticism through animal-ethical intuitions on beef and poultry consumption is that individuals with a high degree of neuroticism would tend to base their ethical values about animals, and therefore their human-animal relationship, on feelings of guilt, thus favoring the avoidance or restriction of such food choices. However, more studies are needed to further examine this relationship.

Finally, any effects of personality *via* animal-ethical intuitions disappear for the frequency of fish consumption, which provides additional evidence for a better understanding of the differential meat consumption patterns observed in prior research. As discussed earlier, individuals with high traits of agreeableness and neuroticism might not exhibit tension within their belief and value systems when consuming fish, since they do not experience closeness that invokes empathy or guilt with these types of species.

Conclusion

The present research considers the mediating role of animal-related ethical values in the association between BFPI traits and different types of meat consumption (i.e., beef, poultry, and fish). Evidence for several antecedent and mediation relationships emerged:

- First, our study adds to the growing evidence base that reveals animal-related ethical values to be an important antecedent of meat consumption.
- Second, our results confirm the findings of previous studies from societies with advanced economies such as (Keller and Siegrist, 2015; Pfeiler and Egloff, 2018c), and (Pfeiler and Egloff, 2020) that the personality traits agreeableness and openness are directly related to meat consumption.
- Third, our results indicate that agreeableness and neuroticism are linked differentially to the consumption of different types of meat through an effect that is mediated by the animal-related ethical values of original anthropocentrism and abolitionism.

By providing the first evidence for the entanglement of personality traits, animal-related ethical values, and meat consumption in an emerging economy context, the current study sheds light on a traditional blind spot in previous studies. It has been argued that religious motives, but also non-Western meat-eating norms, could override the association between personality traits and the frequency and type of meat consumed (Pfeiler and Egloff, 2018b). Considering the intermediary role of animal-related ethical values can, in part, further clarify this argument. This study provides a theoretical mechanism that explains how certain stable personality characteristics and certain domain-specific personal values interact to produce inclinations on the individual level to consume meat. Concretely, our research suggests that more agreeable and more neurotic individuals (and potentially also more open individuals, albeit our evidence is less conclusive in this regard) develop a higher propinquity toward pro-animal-ethical values. These, in turn, are strongly predictive of the consumption of animals that are perceived as human-like. The main takeaway from this is that it would be worthwhile to increase understanding of how personality traits predispose people toward animal-related ethical values and how animal-related ethical positions could be framed better to suit specific personality traits and thus promote dietary change.

Limitations and further research

Some limitations need to be addressed. Although the results point to a robust relationship with a mediating role of animal-related ethical concerns between personality traits and differential meat consumption, the analysis does not test the causal directions proposed by the mediation model directly. While there are well-documented limitations inherent in testing mediation with cross-sectional data regarding the causality and direction of the effect, decomposing the mediation effect in cross-sectional datasets presents an initial impression of the magnitude of the potential mediation (Preacher, 2015). An extension of the research to longitudinal data or even to experiments that intervene in animal-related ethical values, thus, seems warranted in future studies.

Concerning the type of sample, its characteristics present certain advantages and limitations. Since it corresponds entirely to undergraduate university students, it does not represent a broad subset of the population, so further studies are needed to assess if the results have a more generalizable scope. Nevertheless, this study is one of the first in its field to use participants from the Global South. It contributes to building an evidence base regarding the cultural differences that might underlie individual characteristics affecting the consumption of different types of meat. However, further comparative studies between advanced and emerging economy societies are necessary to elucidate differences or similitudes regarding the mediating effect of animal-related ethical values between personality traits and meat consumption.

Finally, our theoretical framework considers that animal species are attributed ethical values depending on how humans perceive them. While this is in line with previous research explaining that differences in the moral status of different species are mainly due to the affective or anthropomorphic proximity that animal species share with humans (Herzog and Shelley, 1997; Ingham et al., 2015), we did not test this auxiliary hypothesis or include variables that represent this mechanism. The present study and others in the field have, so far, failed to consider how anthropomorphic and affective proximity may interact with underlying personal or cultural factors that influence the acquisition of differential patterns of animal-related moral values. The inclusion of instruments of this type should, therefore, be considered in future research to understand in greater depth the association of animal-related ethics with the

human-animal relationship. If included in cross-country comparative research, this would also contribute to a better understanding of the cultural differences that could restrict or favor the consumption of food of animal origin.

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. Written informed consent from the patients/ participants or patients/participants legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

GH conceived and designed the analysis, collected the data, performed the analysis, and wrote the paper. JS conceived and designed the analysis, collected the data, contributed data or analysis tools, and wrote the paper. AR conceived and designed the analysis and contributed data or analysis tools. 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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Wood in office spaces: The impact of different wooden furniture on aesthetic evaluation

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In modern urban life, individuals are spending an increasing amount of time in the office. However, working in an uncomfortable office space for extended periods can affect the physical and mental health of employees. On this basis, it is particularly important for employees to build a comfortable and healthy office environment that is conducive to their work. The present study aimed to explore the use of wood in office furniture to build a comfortable and healthy work environment. The use of wood in office spaces can effectively relieve the mental fatigue of employees. Focusing on wooden office furniture, this study explores its influence on the aesthetic evaluation of wooden office spaces by manipulating the wood color and coverage of the wooden furniture placed in office spaces. Experimenting with these changes will optimize the application of wood in office spaces, improve employees' mental health. The results show that wood color and coverage significantly impact the aesthetic evaluation of wooden office spaces. People exhibit higher aesthetic evaluations of light and medium wood-colored office spaces and prefer spaces with low wood coverage. The findings of this study provide a reference for the use of wooden furniture to optimize workplaces.

KEYWORDS

office space, wood color, wood coverage, aesthetic evaluation, wooden furniture

1. Introduction

Due to technological and economic development, most people now work in offices (Lindberg et al., 2018). According the data from International Labor Organization (ILO), 2014 to 2020, Chinese workers worked an average of 42.95–47.77 h per week (Anttila et al., 2021), and 59% of Chinese employees worked in an office (Gensler, 2021). Working in an uncomfortable office space for extended periods would cause fatigue, negative emotions, and burnout (Johnson and Lipscomb, 2006; WHO, 2017; Haapakangas et al., 2018), and all of which impact workers' mental health. Employee health issues are a prevalent and pressing issue worldwide, with data suggesting that the major global economies lose 4–6% of their GDP annually due to work-related health problems (WHO, 2019). Therefore, it is important to improve office environments to protect workers' mental health.

As a space in which employees work inside for a long time, the physical characteristics of office spaces significantly impact employees' mental health (Clements-Croome, 2006; Zhang et al., 2017; CDC, 2018). Specifically, the satisfaction of the office furniture (such as color, texture, and comfort) will affect the employees' evaluation of the office environment (Kim and De Dear, 2012), while an office environment with a positive aesthetic evaluation is beneficial to the mental health of employees (Schell et al., 2011; Li and Yu, 2020). Therefore, there is a pressing need to optimize furniture design in office spaces to improve employees' aesthetic evaluation with office environment and consequently improve their mental health. To this end, this study aimed at investigating the effect of different furniture designs (e.g., designs with different wood colors and wood coverage) on employees' aesthetic evaluation with their office environment.

Environmental psychology research showed that built environments with natural elements were more popular and more positively evaluated by people (Ulrich, 1983; Brandt and Shook, 2005). Attention Recovery Theory (Kaplan and Kaplan, 1989) and Psychological Recovery Theory (also known as Stress Reduction Theory, Ulrich, 1991) posit that introducing natural elements into the built environment can effectively help people recover from psychological depletion and improve their psychological wellbeing more generally (Burnard et al., 2017; Li et al., 2022). Specifically, Attention Recovery Theory states that natural views provide stimulation which activates undirected attention and restores depleted attention system (Kaplan and Kaplan, 1989; Kaplan, 1995), while Stress Reduction Theory believed that natural environments could aid recovery from stressful events, block negative thoughts, and turn emotions to positive side, help people restore healthy cognition and behavior (Ulrich, 1983; Ulrich, 1991; Ulrich et al., 1991). So, from the perspective of Stress Reduction Theory, it was reasonable to argue that the natural environment can promote positive emotions and improve mental health. Some studies had examined bringing nature into the indoor environment. For example, Kahn et al. (2008) found that working in the office with a glass window on natural views had a better recovery of psychological stress compared to that with blank wall. Yin et al. (2018) found that participants' negative emotions decreased and positive emotions increased after they had used an office space with natural elements (such as natural lighting and plants). These suggest that the restorative environment built by introducing natural elements can help people recovery from psychological stress and improve their mental health. Therefore, the use of natural elements in the office space to create a restorative office environment where employees are satisfied is beneficial to their mental health.

There are many ways in which natural elements can be incorporated into buildings (e.g., views, water features, plants, natural materials, variations in shape, lighting, etc.). The introduction of natural material remains a simple and widely accessible means to bring nature elements to indoors environment (Kellert, 2008; Burnard et al., 2017). Wood is a widely used natural material that is often used in building structures, furniture, and decorative items due to its easy acceptance for consumers and easy processing properties (Noora et al., 2020). It has been found that wood has significant positive effects on people's health, such as improving concentration and comfort and enhancing sense of security (Sakuragawa et al., 2008; Grote et al., 2009; Fell, 2010; Alapieti et al., 2020; Lipovac and Burnard, 2021). Furniture is an essential and practical appliance in office spaces, and people has a positive attitude toward wooden office furniture (Ridoutt et al., 2002; Paluš et al., 2012). Therefore, this study took wooden furniture as an entry point to improve the aesthetic evaluation of employees in office spaces. Through the thoughtful use of wooden furniture to create a healthy and relaxing office environment for employees.

Aesthetic evaluation pertains to the participant's assessment of an object's aesthetic value; it is the embodiment of people's aesthetic attitude toward things (Zhu, 2012). Aesthetic evaluation is an essential reference point in the design optimization of wooden furniture, and an important indicator of design merit in product, spatial, and architectural design. Aesthetic evaluation is relatively complex, involving aspects of visual perception, affective responses, tendency to act, etc. (Ajzen, 2005). Specifically, visual perception is a person's sensory evaluation of the beauty of things derived from their content and form. Affective response is people's preference or satisfaction degree toward an object (Nyrud et al., 2010). Whilst, the tendency to act refers to an individual's willingness to use things.

People's evaluations of wood environments are closely related to the physical properties of wood, such as tree species, color, knot count, cover area, etc. (Nakamura and Kondo, 2008; Høibø and Nyrud, 2010; Fujisaki et al., 2015; Manuel et al., 2015). It should be noted that people exhibit different attitudes toward different types of wood. For example, oak is considered masculine, whilst mahogany is considered feminine (Blomgren, 1965). Tang (2021) divided the wood color into light wood colors (represented by oak and pine), medium wood colors (represented by basswood and teak), and dark wood colors (represented by hickory and black walnut) according to the material's brightness. Study has demonstrated that wood color has a notable impact on the overall effect of the wood environment. For example, Burnard et al. (2017) found that people using lighter colored oak office environment generated lower levels of stress compared to the darker colored walnut office environment, when all other physical conditions were the same. Therefore, different wood colors (light wood-colored, medium wood-colored, and dark wood-colored) were counted as an independent variable in the present study, to investigate its role in the aesthetic evaluation of wooden office spaces. Based on the study of Burnard et al. (2017), this study hypothesized

that lighter colored wooden office spaces have a more positive aesthetic evaluation.

Wood cover, another important variable affecting the evaluation of woody environments, is the ratio of wood surface area to space surface area (Rice et al., 2006; Nyrud et al., 2010; Lipovac et al., 2020). Elsewhere, a direct correlation between woody environmental assessment and wood cover has been identified (Masuda, 1988; Masuda and Nakamura, 1990; Nyrud et al., 2010). Tsunetsugu et al. (2007) found that the room with 45% wood coverage was the most favored among the three rooms (0, 45, and 90%), and the 90% covered room was rated as the most uncomfortable. Nyrud et al. (2014) found that hospital employees prefer the mediate levels of wood decoration in patient rooms (wood on the walls, floor), followed by traditional patient rooms without the inclusion of wood, and all-wood patient rooms (wood on all the walls, floor, ceiling, and furniture) were the least popular patient rooms. It seems lower coverage wood spaces were evaluated more positively than the higher coverage wood spaces. Therefore, this study hypothesized that the aesthetic evaluation of wooden office spaces with lower-coverage is more positive.

In summary, this study examined the aesthetic evaluation of wooden office spaces when different types of wood are used. It aimed to improve the mental health of employees by building the satisfying wooden office space through the reasonable use of wood in office furniture. However, in current furniture production, various wood-based composites are used to replace solid wood, such as plywood, particle board, MDF, etc. (Burnard and Kutnar, 2015). On this basis, the present study did not consider the wood species and number of knots in the wood environmental assessment. In addition, because wood knots are, to a degree, easily affected by wood color and deepening wood color can cover the defects of excessive wood knots on the surface. As such, wood knots were not considered in this article. To be precise, this study examined the effects of wood color and wood cover on the aesthetic evaluation of wooden office spaces. As noted above, the aesthetic evaluation involves three aspects of visual perception (people's sensory evaluation of the wooden office space), affective responses (degree of satisfaction) and tendency to act (usage willingness).

2. Materials and methods

2.1. Participants

This study recruited 185 adults aged 18–57 years (M_{age} = 28.37 ± 7.83 years, 78 men, 107 women) online to participate in this trial (**Supplementary Data Sheet 1**). Among them, the participants worked or studied indoors for an average of 7.77 ± 2.03 h per day, with an average of 6.21 ± 8.31 years of work experience. In the study sample, 30.30% of the participants had college degrees or below, 50.30% had bachelor's degrees, 16.80% had master's degrees, and 2.7% had doctoral degrees. All participants reported that they had normal vision and did not suffer from any no visual defects, such as color blindness. At the end of the experiment, each person was paid 10 RMB as compensation.

2.2. Experimental design

The experiment conducted in this research adopted a two-factor between-subject design of 3 (wood color: light #ECCD97, medium #ECB36C, dark #95582C) × 2 (wood coverage: low 12%, high 35%), with wood color and wood coverage as the independent variables. Meanwhile, sensory evaluation, satisfaction, and usage willingness of office space make up the dependent variables. In total, six experimental conditions levels were formed: light wood-colored and low-coverage wood (light and low), light wood-colored and high-coverage wood (light and high), medium wood-colored and low-coverage wood (medium and low), medium wood-colored and high-coverage wood (medium and high), dark wood-colored and low-coverage wood (dark and low), and dark wood-colored and high-coverage wood (dark and high).

Three hypotheses were consequently put forth in this study:

> **H1:** Wood color and wood coverage affect people's sensory evaluation of wooden office space, with people evaluating light wood-colored and low-coverage wooden office spaces more positively.

> **H2:** Wood color and wood coverage affect people's satisfaction with wooden office spaces, with people being more satisfied with light wood-colored and low-coverage wooden office spaces.

> **H3:** Wood color and wood coverage affect people's usage willingness of wooden office spaces, with people more willing to use light wood-colored and low-coverage wooden office spaces.

2.3. Materials

2.3.1. Video production

This study aims to examine people's sensory evaluation, satisfaction, and willingness to use different wooden spaces; as such, the setting of wooden offices is the crux of this experiment. In this experiment, Lumion8.0 software was used to produce six videos with a duration of 35 s and a resolution of 720 dpi to show the six kinds of wooden office spaces mentioned above

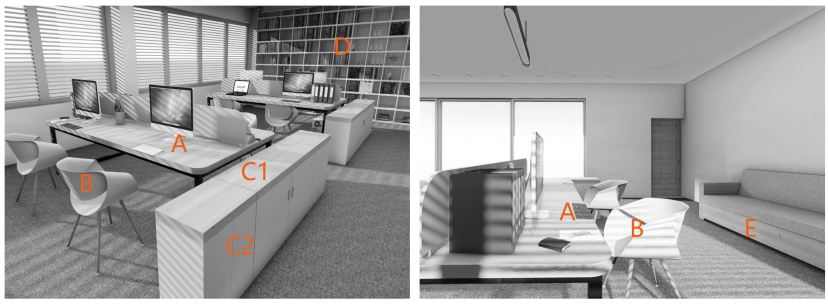

FIGURE 1
Wooden office space wood application location diagram. Reproduced with permission from https://www.6mo.cn.

TABLE 1 Wood colors and wood areas in office space.

	Desk top (A)	Office chair seat surface (B)	Counter top of storage cabinet (C1)	Cabinet body of storage cabinet (C2)	Bookcase (D)	Sofa stents (E)
Light and low	Light color wood	Plastic material	Light color wood	Metal material	Metal material	Light color wood
Light and high	Light color wood	Light color wood	Light color wood	Light color wood	Light color wood	Light color wood
Medium and low	Medium color wood	Plastic material	Medium color wood	Metal material	Metal material	Medium color wood
Medium and high	Medium color wood	Medium color wood	Medium color wood	Medium color wood	Medium color wood	Medium color wood
Dark and low	Dark color wood	Plastic material	Dark color wood	Metal material	Metal material	Dark color wood
Dark and high	Dark color wood	Dark color wood	Dark color wood	Dark color wood	Dark color wood	Dark color wood

(**Supplementary Videos 1–6**). In these six types of wooden spaces, except for wooden furniture, the interior construction (including ceiling, walls, floor, windows, etc.), lighting settings (including direction, heating and cooling, intensity, etc.), and the arrangement of other objects remained consistent.

The wooden spaces were each furnished with two desks, eight chairs, two storage cabinets, one floor-to-ceiling bookcase, and one sofa. Additionally, soft lighting with natural light illumination was used to highlight the appearance of typical natural office spaces. As shown in **Figure 1** and **Table 1**, wood was applied in six areas: desk top (A), office chair seat surface (B), counter top and cabinet body of storage cabinet (C1 and C2), bookcase (D), and sofa stents (E). In the high-coverage condition, all these areas were covered with wood, total 35% wood coverage for the overall office. In the low-coverage condition, only area A, C1, and E were covered with wood, other areas were used other material, specifically, B used beige (#E8D1A8) plastic material, C2 and D used beige (#E8D1A8) metal material, total 12% wood coverage for the overall office. It should be noted that the changes in wood color were also presented on these six areas. In total, six kinds of wooden spaces were formed: light and low, light and high, medium and low, medium and high, dark and low, and dark and high (**Table 1**). The final appearance of the six different experimental conditions is shown in **Table 2**.

2.3.2. Picture creation

To assist the study participants to imagine themselves working in a wooden office space, this experiment on the basis of the video to construct different scenes of the office spaces. Four scenes were produced for each wooden office space (**Supplementary Image 1**). A total of 24 scene pictures with resolutions of 300 dpi were produced for the six wooden office spaces using Photoshop 19.0 software (**Supplementary Image 1**, **Supplementary Figures 7–11**). **Supplementary Figures 7–11**, **Supplementary Videos 1–6**, **Supplementary Data Sheet 1**, and **Supplementary Image 1** were placed in the **Supplementary material**.

2.4. Measurements

2.4.1. Positive affect negative affect scale

This study measured the participant's state of emotional before the formal experiment in order to control the influence of emotion on the participant's sensory evaluation, satisfaction, and usage willingness. The scale of emotion was derived from

TABLE 2 The six different experimental condition.

	Light wood-colored	Medium wood-colored	Dark wood-colored
Low-cover wood			
High-cover wood			

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the Positive Affect Negative Affect Scale (PANAS), as by revised Qiu et al. (2008). This scale is divided into two dimensions, positive emotion and negative emotion, and consists of 18 adjectives. For example, positive emotions (Cronbach's α = 0.93) include "active," "enthusiastic," and "happy" et al. ("*at the present moment, I feel I am…* "), whilst negative emotions (Cronbach's α = 0.93) include "shame," "sadness," and "fear" et al. ("*at the present moment, I feel I am…* "). Items were scored on a 7-point scale, with higher scores indicating stronger positive or negative emotions.

2.4.2. Sensory evaluation scale

The sensory evaluation scale for wooden office spaces was adapted from scales utilized by Rice et al. (2006) and Yildirim et al. (2011) in their respective research. The scale in the present study consists of 10 adjectives: "bright," "spacious," "organized," "relaxing," "natural," "harmonious," "vivid," "comfortable," "beautiful," and "attractive," to match the question "*what do you think of the office environment?*" The Chinese version of the scale was revised by bilingual Chinese-American and corrected by professional translators. The scale is scored on a 7-point scale, with higher scores indicating better sensory evaluations. Moreover, the internal consistency reliability of the sensory evaluation scale was α = 0.93.

2.4.3. The satisfaction and usage willingness relating to wooden office spaces

Satisfaction with wooden office furniture in office space of this study is measured by administering two questions: "How satisfied are you with your office environment?" and "If you worked here, to what extent does this wooden furniture meet your demands for an office environment?" A 7-point scale was used to measure satisfaction, with higher scores indicating a greater degree of satisfaction. The Cronbach's α of these two items was 0.88. Meanwhile, the usage willingness an individual feels toward a wooden office space was also measured by two items: "How much do you like to work here?" and "How willing are you to work here?" A 7-point score was also used, and again, the higher the score, the greater the willingness to use the wooden office space. The Cronbach's α of these two items was 0.87.

2.5. Procedure

We recruited participants online, the questionnaire.com platform was used to present our research materials and measurements. Participants scanned the QR code or logged into the URL to participate in the present experiment. They were randomly assigned to one of six different experimental conditions. After carefully reviewing the study instructions, the participants first took a mood measurement (PANAS scale). They then watched a 35-s video of a wooden office space. After watching the video, the participants were asked to perform an imaginary task, that is, spend 1 min imagining themselves working and communicating in the office environment presented in the video. To assist with this, four drawings of the wooden office space were presented showing the scene from different angles. After completing the imagination task, the participants were asked to evaluate the office space in terms of sensory evaluation, satisfaction, and willingness to use. Finally, the participants filled in their demographic information, which marked the end of the experiment.

2.6. Data statistics and analysis

After examining the normality of the data, two-way ANOVA and non-parametric tests (Mann–Whitney test and Kruskal–Wallis test) were used as the methodology for statistical analysis. Wood color and wood coverage were taken as the independent variables, whilst sensory evaluation, satisfaction, and usage willingness were taken as the dependent variables. Positive and negative emotional states were used as covariates. Statistical

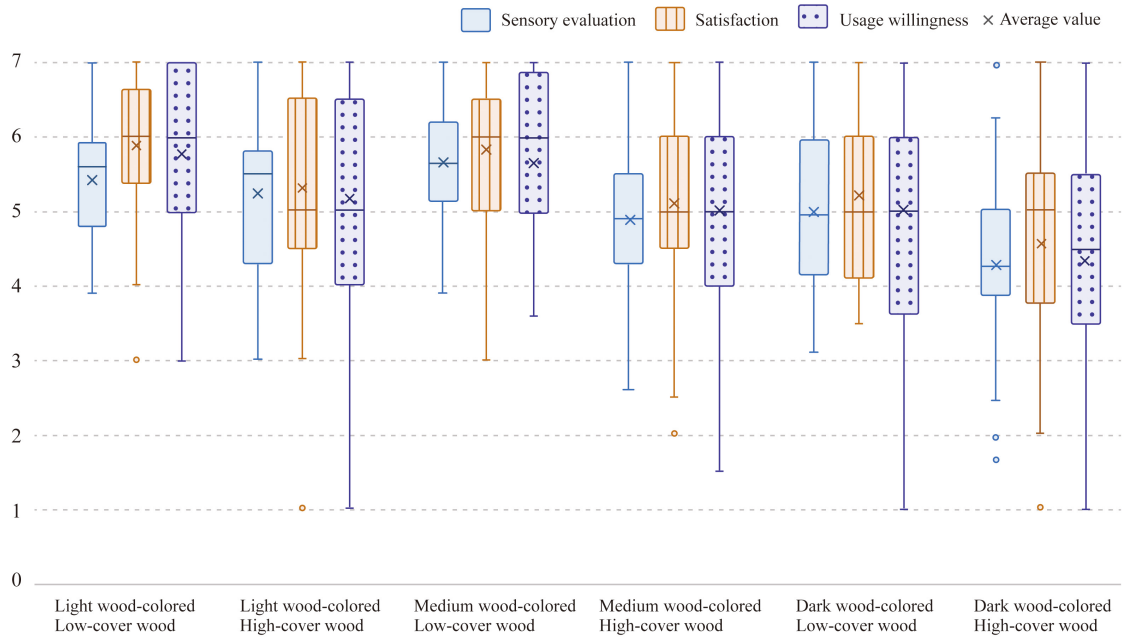

FIGURE 2
Aesthetic evaluation scores for the six different experimental conditions.

analysis was performed using SPSS 20.0. To verify hypothesis 1, 2, and 3, this study examined the main effects of wood color and wood cover on the participants' sensory evaluation, satisfaction, and usage willingness.

3. Results

3.1. Aesthetic evaluation of the six different experimental conditions

Figure 2 details the aesthetic evaluation scores for six different experimental conditions. Specifically, aesthetic evaluation includes three aspects: sensory evaluation, satisfaction, and usage willingness. The results showed that medium wood-colored and low-coverage wooden offices were the most highly rated in terms of sensory evaluation, whilst light wood-colored and low-coverage wooden offices received the highest scores in terms of satisfaction and usage willingness. By way of contrast, dark wood-colored and high-cover wooden offices received the lowest evaluations in the three aspects noted above.

3.2. The descriptive statistics and correlations among the variables

The correlation analysis was used to investigate the correlations among dependent variables, the results showed that there was a significantly positive correlation among sensory evaluation, satisfaction, and usage willingness, Table 3 details the correlations among variables.

3.3. Effects of wood color and wood coverage on sensory evaluation

Because null hypothesis was retained ($p = 0.20 > 0.05$) in the normal distribution test, which represents the distribution of sensory evaluation is normal, two-way ANOVA was chose as the statistical analysis method. The results passed Levene's test of equality of variances, $F(5,179) = 0.76$, $p = 0.576$ and showed a significant main effect of wood color, $F(2,177) = 6.95$, $p = 0.001$, $\eta_p^2 = 0.07$, indicating that wood color had a significant impact on sensory evaluation. *Post-hoc* tests (LSD) of wood color revealed significant differences in the visual perception of dark wood-colored ($M = 4.65 \pm 1.24$) and light wood-colored ($M = 5.34 \pm 0.89$) offices, and also between dark wood-colored and medium wood-colored ($M = 5.28 \pm 0.93$) offices, $p = 0.002$, $p = 0.001$. Contrastingly, no significant difference was found between light wood-colored and medium wood-colored wood, $p = 0.889$. The main effect of wood coverage was significant, with the visual perception of the low-coverage wooden space ($M = 5.38 \pm 0.96$) being significantly better than that of the high-coverage wooden space ($M = 4.83 \pm 1.10$), $F(1,177) = 7.22$, $p = 0.008$, $\eta_p^2 = 0.04$. However, the interaction between wood color and wood coverage was not significant, $F(2,177) = 1.72$, $p = 0.182$.

TABLE 3 The descriptive statistics and correlations between the variables.

	Sensory evaluation	Satisfaction	Usage willingness
Sensory evaluation	1		
Satisfaction	0.81**	1	
Usage willingness	0.82**	0.87**	1
M	5.11	5.35	5.16
SD	1.06	1.30	1.46

**Correlation is significant at the 0.01 level (two-tailed).

Table 4 presents the sensory evaluation scores under different experimental conditions.

3.4. Effects of wood color and wood coverage on satisfaction

Because null hypothesis was rejected ($p < 0.001$) in the normal distribution test, which represents the distribution of satisfaction is not normal, Kruskal–Wallis test and Mann–Whitney test were chose as statistical analysis methods. The Kruskal–Wallis H test showed that there was a statistically significant difference in satisfaction score among the different wood-colored offices, $\chi^2(2) = 11.95$, $p = 0.003$, with a mean rank satisfaction of 105.12 for light wood-colored offices ($M = 5.60 \pm 1.27$), 98.34 for medium wood-colored offices ($M = 5.48 \pm 1.21$) and 73.27 for dark wood-colored offices ($M = 4.88 \pm 1.31$). The Mann–Whitney U test indicated that satisfaction in the low-coverage wooden space ($M = 5.66 \pm 1.09$) was statistically significantly higher than the high-coverage wooden space ($M = 5.00 \pm 1.41$) ($U = 3{,}095.00$, $p = 0.001$). Table 5 details the satisfaction scores under different experimental conditions.

3.5. Effects of wood color and wood coverage on usage willingness

Because null hypothesis was rejected ($p < 0.001$) in the normal distribution test, which represents the distribution of usage willingness is not normal either, Kruskal–Wallis test and Mann–Whitney test were chose as statistical analysis methods. The Kruskal–Wallis H test showed that there was a statistically significant difference in usage willingness score among the different wood-colored offices, $\chi^2(2) = 12.93$, $p = 0.002$, with a mean rank usage willingness of 105.29 for light wood-colored offices ($M = 5.48 \pm 1.42$), 99.04 for medium wood-colored offices ($M = 5.36 \pm 1.32$) and 72.31 for dark wood-colored offices ($M = 4.59 \pm 1.52$). The Mann–Whitney U test indicated that usage willingness in the low-coverage wooden space ($M = 5.47 \pm 1.36$) was statistically significantly higher than the high-coverage wooden space ($M = 5.16 \pm 1.46$) ($U = 3250.00$, $p = 0.004$). Table 6 lists the scores of usage willingness under different experimental conditions.

TABLE 4 Sensory evaluation score.

Wood color	Wood coverage	*M* ± SD	*N*
Light wood-colored	Low-coverage	5.43 ± 0.80	34
	High-coverage	5.24 ± 1.00	31
	Total	5.34 ± 0.89	65
Medium wood-colored	Low-coverage	5.70 ± 0.79	32
	High-coverage	4.97 ± 0.90	31
	Total	5.34 ± 0.92	63
Dark wood-colored	Low-coverage	5.04 ± 1.19	28
	High-coverage	4.38 ± 1.19	29
	Total	4.71 ± 1.23	57
Total	Low-coverage	5.41 ± 0.96	94
	High-coverage	4.90 ± 1.08	91
	Total	5.16 ± 1.05	185

TABLE 5 Satisfaction score.

Wood color	Wood coverage	*M* ± SD	*N*
Light wood-colored	Low-coverage	5.87 ± 1.07	34
	High-coverage	5.31 ± 1.42	31
	Total	5.60 ± 1.27	65
Medium wood-colored	Low-coverage	5.83 ± 1.02	32
	High-coverage	5.11 ± 1.30	31
	Total	5.48 ± 1.21	63
Dark wood-colored	Low-coverage	5.21 ± 1.09	28
	High-coverage	4.55 ± 1.44	29
	Total	4.88 ± 1.31	57
Total	Low-coverage	5.66 ± 1.09	94
	High-coverage	5.00 ± 1.41	91
	Total	5.34 ± 1.30	185

4. Discussion

This study experimentally examined the research participants' aesthetic evaluations of wooden office spaces featuring different wood colors and wood coverage. Based on the results, there were significant differences in wood color in terms of sensory evaluation, satisfaction, and usage willingness. Compared with dark wood office spaces, the study participants exhibited better sensory evaluations, higher satisfaction levels, and a stronger willingness to use light and medium wood-colored office spaces. In addition, there are

significant differences in wood coverage rate in terms of sensory evaluation, satisfaction, and usage willingness: specifically, low-coverage wooden office spaces were found to be superior to the high-coverage wooden office spaces in terms of sensory evaluation, satisfaction, and usage willingness. From this, it can be concluded that light wood-colored furniture in low-coverage wooden office spaces is more aesthetically pleasing.

4.1. Wood color and wood coverage influence sensory evaluation

People exhibited a better, more positive sensory evaluation of light and medium wood-colored wooden office spaces than in dark wood-colored office spaces. The reason for this is most likely that light and medium wood-colored furniture with higher lightness creates wooden spaces that are bright, spacious, and relaxing. Contrastingly, dark wood-colored furniture with lower lightness creates wooden spaces that are dim, narrow, and tense. This is consistent with previous findings, namely that spaces created using light wood-colored oak are considered pleasant and comfortable, whereas spaces created with dark wood-colored black walnut are considered depressing and closed (Poirier et al., 2019). In addition, when given a choice of spatial color, the study participants tended to select brighter colors, regardless of hue (Hidayetoglu et al., 2012). The reason why low-coverage wooden spaces are evaluated more positively compared to high-coverage wooden office spaces may be that people perceive low-coverage wood spaces to be aesthetically pleasing and vivid, whilst too much wood coverage can be regarded as unduly constricting (Li et al., 2021).

As a natural material, the unique texture, color, and other surface characteristics of wood can allow people to perceive the beauty of nature, thus leading individuals in wooden spaces and environments to derive a comfortable, relaxed, and natural feeling (Rice et al., 2006). However, at the same time, the texture and color of wooden surfaces increase the complexity of space design. Therefore, moderate use of wood can enrich the design of a space and make it vivid and interesting. However, wood should be used thoughtfully, as excessive use tends to make the space appear narrow and complicated, resulting in a sense of depression and feelings of burden. This explains why the study participants preferred wooden office spaces with low-coverage over those with high-coverage. Previous studies have also found that spaces with wood coverage of around 45% also received the highest scores for comfort and relaxation (Masuda and Nakamura, 1990; Tsunetsugu et al., 2007).

4.2. Wood color and wood coverage influence satisfaction

Similarly, the participants were found to exhibit greater satisfaction with light and medium wood-colored office spaces compared to dark wood-colored office spaces. Notably, the participants were not only satisfied with the light (medium) wood-colored office spaces, but also with the light (medium) wood-colored furniture positioned in the space. This is consistent with previous studies that also verified this result, such as Scholz and Decker (2007), who observed that German consumers were most satisfied with light wood-colored oak furniture. In addition, light wood color oak furniture is not only more satisfying to consumers, but also helps to alleviate feelings of stress. For example, Burnard and Kutnar (2020) found that experiment participants produced lower concentrations of salivary cortisol in an oak office environment compared to a walnut office environment, when all other same physical conditions were the same. This indicates that oak office furniture can be used to generate lower levels of stress amongst office workers. However, it is worth noting that people are more satisfied with dark wood-colored wooden products in terms of product design (Wan et al., 2021); such a difference may stem from the fact that the general product is smaller in size and used alone. Although furniture falls within a category of products, it is bulky and often exists in the building space in combination with other products and fixtures. Compared with a single product, a complete set of furniture has a greater visual impact, thus leading individuals to be more satisfied with light and medium wood-colored furniture than dark wood-colored furniture. In terms of furniture coverage, people are more satisfied with low-coverage wood composite furniture than with high-coverage all-wood furniture. For example, Turkish consumers have been found to prefer wood composite furniture with partial use of wood to all-wood furniture. This is premised on their belief that all-wood furniture is expensive and wood composite furniture can reduce costs whilst also offering greater design possibilities (Guzel, 2020).

4.3. Wood color and wood coverage influence usage willingness

As indicated by the results, individuals demonstrated a stronger intention to use light (medium) wood-colored furniture and low-coverage wooden spaces, that is, they prefer to work in office spaces with light or medium wood-colored furniture and low-coverage wood. There are several possible reasons for this. Firstly, light and medium wood-colored conform to the aesthetic needs of employees. Many traditional Chinese-style residential environments use dark-colored woods to make residents feel stable and solemn. However, employees who are accustomed to a faster pace of life, heavy workloads, and excessive work pressure prefer to use relaxed and vivid natural light and medium wood-colored furniture in their office space. Secondly, the use of light and medium wood-colored can enhance the lighting of a space and create a warm atmosphere, thus reducing power consumption (Jafarian et al., 2018). This is an especially important consideration

TABLE 6 Usage willingness score.

Wood color	Wood coverage	$M \pm SD$	N
Light wood-colored	Low-coverage	5.78 ± 1.19	34
	High-coverage	5.16 ± 1.58	31
	Total	5.48 ± 1.42	65
Medium wood-colored	Low-coverage	5.69 ± 1.25	32
	High-coverage	5.02 ± 1.31	31
	Total	5.36 ± 1.32	63
Dark wood-colored	Low-coverage	4.83 ± 1.48	28
	High-coverage	4.34 ± 1.54	29
	Total	4.59 ± 1.52	57
Total	Low-coverage	5.47 ± 1.36	94
	High-coverage	4.85 ± 1.51	91
	Total	5.16 ± 1.46	185

at high latitudes and in cold climates. Thirdly, because the dimensional instability of wood exposed to wet conditions limits long-term use of wood (He et al., 2020), low-coverage wood spaces are more stable compared to high-coverage wood spaces, whilst also reducing the use of wood and alleviating wood supply shortages to a certain extent. The latter consideration is especially important for countries with scarce forest resources, such as China.

4.4. Theoretical contributions and practical implication

This study has its advantages in the exploration of the application of wood spaces. First, this study examined wooden spaces by the dual dimensions: wood color and wood coverage. It made the present research more comprehensive than others. For example, in the study by Burnard and Kutnar (2020), researchers compared people's stress responses to different wooden color furniture in office environments, and Song et al. (2016) examined people's preferences in different wooden office environments by changing the wood coverage in office spaces. However, both studies examined people's attitudes and responses to wood environments by just only controlling one physical characteristic of wood. Thus, neither study was not comprehensive enough. Second, this study set a specific wooden office space and identified its functional properties of the space, which made the present study more specific in the application of wood space. Li et al. (2021) explored the effects of different degrees of wooden use in interior spaces on people's psychological responses and visual impressions. Similarly, Strobel et al. (2017) investigated the best way to use wood in interior spaces. Both studies did not clarify the functional properties of interior spaces, which means they were not clear enough to study wooden spaces.

Rapid economic development has exposed both companies and employees to intense competition and tremendous stress, which has made mental health problems in the workplace prevalent worldwide (Mackenzie, 2019; Prada-Ospina, 2019; Herr et al., 2022). It is important to note that a good working environment is a prerequisite for employees' occupational health and occupational wellbeing (Danna and Griffin, 1999). While wood is an ideal material for restorative design, and the effective use of wood in interior environments is an important means of building restorative environments (Nyrud and Bringslimark, 2010; Derr and Kellert, 2013; Demattè et al., 2018). Moreover, many studies have demonstrated that the use of wood in architectural interiors generally produces positive effects on the physical and mental health of occupants, such as lowering heart rate and blood pressure, relieving psychological stress, and alleviating visual fatigue (Tsunetsugu et al., 2002; Fell, 2010; Zhang et al., 2016; Hirata et al., 2017). However, this does not guarantee that the use of one type of wood will improve health, nor does it mean that the more types of wood that are used, the better the results will be. Therefore, it is important to explore what kind of wood to use and how to use it.

This study examined ways to optimize the workplace *via* the sensible use of wood in office furniture, to enhance the satisfaction of workspaces and eventually benefit the mental health of employees. On the one hand, the results of this study provided guidance for the design of wooden office spaces and office furniture on a global scale. On the other hand, the findings provide scientific evidence for the rational and effective use of wood in restorative environment. Constructing restorative environments is helpful for recovery from psychological and physical stresses (Danna and Griffin, 1999), which may be the main reason for the increasing research on wood and its application in the fields of architecture, psychology, and design.

4.5. Limitations and future research

Although the results of this study have reference value for the design of wooden office spaces, it nevertheless is subject to certain shortcomings. First, there is a lack of consideration of the participant population and insufficient diversity within the study sample, thus limiting the generalizability of the study results. For example, there are differences in the needs of people with different working positions and different health conditions in relation to wooden office spaces. Second, the position of wood on wooden furniture may also affect people's attitudes. For example, Kayseri consumers favor wooden desk tops (Guzel, 2020). However, the consideration of the application position of wood was neglected in this study, so there is a

need to increase the consideration of the application position of wood in future studies of wooden spaces. Third, this study only involved the visual senses, and the participants may have a weaker sense of experience in the office context when exclusively examined in relation to the visual senses. Future research should focus on other forms of sensory evaluation, such as touch, smell, etc. Incorporating other sensory experiences may improve the problem of a weaker sense of experience and render the aesthetic evaluation of different wooden office spaces more comprehensive and objective. To help overcome the constraints of the environmental experience, in future studies, participants can wear immersive helmets or glasses to enable multi-person interaction, simulating real office scenarios. In addition, participants can also have the real touch feeling of wood by wearing tactile gloves. So as to enhance the experience of wooden office spaces. Last, to further explore people's sensory evaluation, affective responses, and tendency to act toward wooden spaces, future studies may take into account including eye-movement experiments and EEG experiments.

5. Conclusion

This study investigated the effects of wood color and wood coverage on the aesthetic evaluation (sensory evaluation, satisfaction, and usage willingness) of wooden office spaces. From the results, it was found that people exhibit better aesthetic evaluations of light and medium wood-colored office spaces and prefer wood office spaces with low wood coverage.

These findings could help designers to better live up to employees' expectations of wooden office spaces. Moreover, they can provide a useful reference for the rational use of wood, the optimization of office space design, and restorative environmental design. On the one hand, considering that China is a significant global consumer and producer of wood products, the present study might provide a valuable reference to local furniture manufacturers regarding the sensible use of wood in office furniture. On the other hand, this study also provided crucial information on enhancing employees' mental health from an interior design perspective in light of the widespread issue of mental health in the workplace.

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 authors.

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

YZ wrote the manuscript and involved in all steps of the research process. QW made a substantial, direct, and intellectual contribution to this work. FZ was responsible for experimental design, data analysis, and manuscript revision. 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.2022.986627/full#supplementary-material

SUPPLEMENTARY IMAGE 1
Schematic diagram of the use scene of wooden office furniture (medium and low).

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Cultivating green workforce: The roles of green shared vision and green organizational identity

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Introduction: The current study anchors on the social identity theory (SIT) and social exchange theory (SET) to investigate the association between green talent management (GTM) and employee retention (ER), mediated by green organizational identity (GOI). Further, the study projects the moderator effect of green shared vision (GSV) in the direct association between GTM and GOI, and the indirect link between GTM and ER through the mediator effect of GOI.

Methods: We collected time-lagged (i.e., three-wave) data from 495 frontline managers in the tourism service firms in Pakistan. Data are analyzed using SmartPLS SEM (V 3.3) to evaluate the measurement and structural models.

Results: Our results support all the projected associations and confirm the direct relationships between GTM and ER (β = 0.480, CIs = 0.494, 0.578), GTM and GOI (β = 0.586, CIs = 0.517, 0.670), and GOI and ER (β = 0.492, CIs = 0.425, 0.566). The findings further reveal that GOI significantly mediates the relationship between GTM and ER (β = 0.257, CIs = 0.184, 0.312). In addition, the moderator effect of GSV significantly underpins the direct association between GTM and GOI (β = 0.512, CIs = 0.432, 0.587) and the indirect association between GTM and ER, mediated by GOI (β = 0.526, CIs = 0.441, 0.590).

Discussion: This is the first study that explores a moderated mediation model to explain *when* and *how* tourism service firms can promote ER through inculcating GTM strategies. The findings indicate that service firms in the tourism industry must develop and retain green talent to exploit pro-environmental strategies.

KEYWORDS

green talent management, green organizational identity, employee retention, green shared vision, social exchange theory

Introduction

Challenged by the escalating pressures of governmental programs to address global warming trepidations and embed green practices across business activities, service firms in the tourism industry face an imperative to cultivate and retain talent to address organizational sustainability and global climate change (Gardas et al., 2019; Ogbeibu et al., 2021). The global "war for talent" and "how to manage talent" remain significant challenges for service firms, particularly given that green talent is needed to help service firms to cultivate environmental sustainability (Song and Xie, 2019). An essential element in the research on employee retention (ER) is the need to retain green talented staff (Gardas et al., 2019). A massive stream of research has been conducted in exploring general talent management strategies that affect ER, *including* Ambrosius (2018), Baharin and Hanafi (2018), Gupta (2019), Narayanan et al. (2019), and Pandita and Ray (2018). However, only a few studies have explored green organizational strategies that can be linked with

ER of green talent (Ogbeibu et al., 2021). Employee retention is defined as "keeping those members of staff that one wants to keep and not losing them from the organization for whatever reason, especially to the competitors" (Browell, 2003, p. 5).

This paper aims are to first examine the antecedent of ER with the primary focus on retaining green talent. In this milieu, we propose that green talent management (GTM) is a significant predictor that influences ER in tourism service firms. GTM or green soft talent management used interchangeably in this study, is defined as:

> "a humanistic aspect of talent management that actively supports, and is committed toward, the development and retention of green talent by boosting talents' commitment via effective communication, talent inclusiveness in decision-making process, organizational support for talent wellbeing and welfare, and effective and efficient leadership practices that inspire green talented team members to engender defined ecological initiatives for fostering environmental sustainability" (Ogbeibu et al., 2021, p. 1,474).

With an emphasis on the social exchange theory (SET, Blau, 1968), the present study contributes to the literature by predicting the association between GTM and ER. GTM, as an emerging concept, allows organizational leaders to advance green workplace initiatives by systematically attracting, nurturing, retaining, and deploying the right talent (Gardas et al., 2019). This corollary is based on the norms of reciprocity (Gouldner, 1960), which specifies that exchange relationships evolve when organizations take care of their employees (Narayanan et al., 2019). To the best of the authors' knowledge, this is the first study that examines the impact of GTM on ER in tourism service firms.

Second, in addition to assessing the direct relationship between GTM and ER, this study explores a causal mechanism through which effective GTM strategies culminate into amplified ER. We draw on the social identity theory (Ashforth and Mael, 1989), and propose the mediating role of green organizational identity (GOI). GOI refers to "an interpretive scheme about environmental management and protection that members collectively construct in order to provide meaning to their behaviors" (Chen, 2011, p. 388). Investigating GOI as a causal mechanism may present opportunities to grasp a comprehensive rational framework of an organization that offers the maximum capacity to effect the activities of its members.

Third, to develop a more nuanced understanding of the GTM-retention nexus, this study explores the boundary effects of green shared vision (GSV) that might also underpin the relationship. GSV refers to "a clear and common strategic direction of collective environmental goals and aspirations that has been internalized by members of an organization" (Chen et al., 2015, p. 1171). According to Chen et al. (2015), GSV leverages organizations to inculcate green initiatives across all business activities and strategies. We propose that GSV moderates the relationship between GTM and ER linkage, mediated by GOI.

Contributions of the study

The current study contributes to the extant knowledge on talent management in numerous ways. First, given an escalated gravity of interest in attracting and retaining talent in the 21st century organizations (Davern, 2021; Reis et al., 2021), characterized by increased accountability and responsibility toward environment (Saleh and Atan, 2021), organizations have increasingly put more emphasis on the sustainable talent management practices to foster environmental sustainability (Gaikwad et al., 2016; Jooss et al., 2021; Mitosis et al., 2021). This is in line with the increased governmental pressures to mitigate organizational impacts in global warming and surging instability of the 4th "industrial revolution" (Ogbeibu et al., 2021). In this regard, existing talent management practices with an overlooked emphasis on human capital sustainability offer limited explanation to meet the global sustainable development goals (Saleh and Atan, 2021). As a result, the HR practitioners warrant updating existing talent management practices by instilling "green human capital development programs" (also GTM) in order to deploy and retain the right talent that may advance workplace green initiatives forward (Malik et al., 2021). This turns out to be our second contribution to the general talent management literature.

Ogbeibu et al. (2021) argued that GTM, emerged as an organizational strategy, facilitates organizational sustainability goals through the systematic attraction, nurture, and retention of green talent. Further, Gardas et al. (2019) encapsulated GTM under the umbrella of "Sustainable Human Resource Management" (SHRM), which constitutes two pillars, i.e., "sustainability of individuals," and "sustainability of organizations." The prime focus of this study is on the GTM as a mean to nourish ER. In order to address inflating environmental issues, research studies are on a surge in the recent years that cast GTM as a valuable factor in influencing a wide array of individual (Malik et al., 2021; Ogbeibu et al., 2021) as well as organizational factors (Guillot-Soulez et al., 2022). Besides, related research streams focusing on sustainability have studied green recruitment (Pham and Paillé, 2020), green business practices (Sarkar et al., 2020), green human resource management (Paulet et al., 2021), green jobs creation (Sulich and Sołoducho-Pelc, 2022), as a mean to foster environmentalism through green workforce. The current study, thus, advances the research stream of sustainable human resource management by predicting GTM as a plausible factor influencing ER.

Third, our study advances the existing debate on talent management and ER by predicting GOI as the mediating variable between GTM and ER. In particular, it suggests that employees with high levels of GOI may be more capable of translating GTM into enhanced ER, which not only influences their future employment prospects but also their current commitment levels and attachment to their jobs. Last but not the least, our study proposes the moderator effect of GSV in the direct association between GTM and GOI, and the indirect association between GTM and ER, mediated by GOI. By investigating GOI as the intervening variable, this research enriches the understanding of the boundary conditions of the GTM–ER link, mediated by GOI, that is under what conditions the associations are more or less likely to pronounce. To the best of author's knowledge, this is the first study that examines the boundary conditions of GTM–ER link by projecting the mediating role of GOI and the moderating role of GSV.

The remainder of this study explains the link among the study variables (hypotheses development), followed by a justification of the research design, data collection and analysis, and discussion of the implications of the findings.

Literature review and hypotheses development

Relationship between GTM, GOI, and ER

Given talent management's critical role in ER, many prior studies have examined the talent management-retention link (Hughes and Rog, 2008; Chami-Malaeb and Garavan, 2013; Pandita and Ray, 2018; Narayanan et al., 2019). Despite eloquent findings obtained by previous studies, some critical questions still need to be addressed yet about *when* and *how* talent management acts to predict ER (Chami-Malaeb and Garavan, 2013; Narayanan et al., 2019). Correspondingly, the concept of GTM warrants considerable empirical scrutiny (Gardas et al., 2019; Ogbeibu et al., 2021) that might answer how GTM translate into enhanced ER.

According to SET (Blau, 1968), employees' attitudes and behavior depend on the exchange relationship with their organizations. When they perceive that their organizations invest in them, they feel a reciprocal obligation to exhibit positive attitudes and elevated performance (Narayanan et al., 2019). According to Dries and De Gieter (2014), organizations set tone for the exchange relationship with its employees through the selection in the talent pool. Narayanan et al. (2019) further corroborated that employees who develop positive feelings about their organizations achieve bigger performance targets, manifest dedication and intention to stay. This is because talent management (TM) is premised on finding and engaging the right person in the key positions, therefore, a superior performance is assured (Collings and Mellahi, 2009). It is argued that while determining attitudes, researchers should adopt a multidimensional aspect of attitude, which includes "cognitive," "affective," and "conative/behavioral" components (Ajzen, 1989). Among several attitudes that employees exhibit, the staying intention could be viewed as "conative/behavioral" component of employee attitude toward organization that practices TM (Narayanan et al., 2019). Thus, the intention to stay can predict ER (Narayanan et al., 2019). Besides, Chami-malaeb and Garavan (2013) endorsed that SET can provide a compelling reason for how TM translates into enhanced ER.

GTM, in a similar way, determines employees' intention to stay in the organization that practices GTM (Ogbeibu et al., 2021). In GTM, "climate action initiatives tend to be driven *via* a conducive work environment, adhocracy organizational culture and effective provision of relevant resources" (Berraies et al., 2020), thus, leveraging employees to demonstrate sustainable environmental behavior (Kalyar et al., 2021). Moreover, the findings from previous studies indicate that GTM is negatively related to the turnover intention of employees (Du Plessis et al., 2015; Barkhuizen and Schutte, 2017; Abdul et al., 2019). On contrary, Ogbeibu et al. (2021) investigated the impact of green hard and soft TM on turnover intention and found a positive association among them. The mixed findings from the past literature advocate further investigation of the phenomenon (Ogbeibu et al., 2021). Drawing on SET, we propose that GTM significantly predicts ER in service organizations. Therefore,

> *H1*. GTM is positively linked with ER.

The discussion of organizational identity is an extension of social identity theory, which describes social identity as "that part of an individual's self-concept which derives from his knowledge of his membership of a social group (or groups) together with the emotional significance attached to that membership" (Tajfel, 1978, p. 6). The concept of "organizational identity" is concerned with "collective identity" (Albert and Whetten, 1985). Mael and Ashforth (1995) defined organizational identification as "a perceived oneness with the organization and the experience of the organization's successes and failures as one's own; it generates self-referential or self-defining beliefs about one's organization." The construction of organizational identity is facilitated through symbols and language (Corley et al., 2006). According to Corley et al. (2006), organizational identity serves as a "metaphor" for describing organizations or an actual phenomenon and influences the actions of organizational members in fulfilling organizational goals.

Addressing the GTM strategy, GOI is subjected to a positive and distinct identity that strengthens the employee-employer bondage (Schlager et al., 2011). Earlier research on socially responsible human resource management practices implies that employees internalize organizational values when they perceive that their organization manifests environmental concerns (Newman et al., 2016). The inducement of such environmental practices pervades a sense of pride among employees (Hassan, 2007). Particularly, GTM practices result in increased levels of GOI. That is, "when concern for the environment becomes an integral component of organizational identity, environmental issues become harder to ignore" (Weick, 1988; Chen, 2011). Besides, social identity theory implies that employees develop a high sense of self-esteem due to the perception of their membership with a reputed organization that demonstrates environment-related concerns (Ashforth and Mael, 1989; Newman et al., 2016). By exploiting the GTM, organizations become more capable of elevating their positive image and reputation among its stakeholders as its employees are dedicatedly involved in the eco-friendly activities that benefit the external stakeholders. Hence, they feel proud to be a member of that organization (Bauman and Skitka, 2012), thus, inflating GOI. Therefore,

> *H2*. GTM is positively linked with GOI.

In consolidation, we also suggest a mediating role of GOI, such that employees' perception of their membership with an organization that manifests GTM practices enhances their likelihood of staying in the organization. The study proposes that employees with higher levels of GOI will more likely translate into enhanced ER. This is consistent with the social identity theory and SET, employees who perceive that they belong to an organization that shows concern for its stakeholders (Ogbeibu et al., 2021), and inculcate GTM practices to cultivate environmental sustainability; feel a reciprocal obligation to exhibit eco-friendly behaviors (Blau, 1968). Hence, GOI is a causal mechanism that translates GTM practices into increased ER. A host of recent research has found GOI's significant mediating role in the relationship between green innovation strategy and green creativity and innovation (Song and Yu, 2018). In short, the perception of GOI underpins the underlying GTM-ER nexus. Therefore,

> *H3*. GOI is positively linked with ER.
>
> *H4*. GOI mediates the relationship between GTM and ER.

The moderating role of GSV

Although we generally expect a positive link between GTM and GOI (and ER), the literature's variability in the relationship between GTM and employees' staying intention suggests the potential for moderators (Figure 1). We, thereby, expect a moderating effect of GSV on the relationship between (1) GTM and GOI and (2) GTM and ER through the mediating role of GOI. According to the social identity theory, GSV is a catalyst that facilitates the development of GOI because it provides a collective strategic direction that can navigate members' actions toward environmentalism (Chen et al., 2015). Furthermore, Mackie and Goethals (1987) argued that shared vision offers a common "strategic direction" that can divulge convergent goals.

According to Aragón-Correa (1998), an organization leverages shared vision by communicating the firm's goals to members and sharing the obligation to accomplish organizational objectives. Similarly, Pearce and Ensley (2004) contended that shared vision allows organizations to provoke desired conduct in members, thus ensuring the convergence toward long-term goals. However, "if managers fail to share their goals, visions may become purely rhetorical, resulting in disillusionment and distrust instead of inspiration and motivation" (Oswald et al., 1994, p. 479). Shared vision enhances improved environment-friendly initiatives through a repertoire of mutual interest and vision (Hart, 1995) through inducing GTM. Nevertheless, empirical research is scant in linking shared vision to adopting proactive environmental strategies (Alt et al., 2015), particularly concerning GTM. In addition, the authors advocated that the implications of shared vision extend beyond developing proactive environmental strategies (i.e., GTM) (Alt et al., 2015). Employees view their contributions as meaningful when they perceive their organizations indoctrinate GSV (García-Morales et al., 2011; Chen et al., 2015). Hence, they feel more comfortable in developing environmental strategies, establish a conjoint blueprint for forthcoming progresses, promulgate norms and values, and exceed performance marks (Chang et al., 2019).

Once proactive environmental strategies (i.e., GTM) are established, the extent to which these strategies will decipher into superior environmental performance will rely on the GSV between organization and its members, especially because it requires a high degree of employee involvement in its execution (Hart, 1995; Alt et al., 2015). GTM strategies entail change and innovation, which may not be viewed or welcomed as ineludibly significant by all internal stakeholders (Delgado-Ceballos et al., 2012). Divergence may ensue in the interpretation of such strategies due to diversity of interest among managers and employees (Calantone et al., 2002), departmental differences (Brown and Eisenhardt, 1995), and function "myopia" (Sinkula et al., 1997). This may undermine the implementation of GTM strategies, resultantly preventing firms' responses to market trends or environmental shocks. However, a shared vision can influence strategy implementation by mitigating conflicting interests and ambiguities (Jansen et al., 2008), teams and departmental coordination (Calantone et al., 2002), and redefining organizational purpose (Real et al., 2014). Thus, GSV serves as a stimulating variable that strengthens the association between GTM and GOI such that at high levels of GSV, the relationship is more potent than at low levels of green of shared vision. Therefore,

> *H5*. GSV moderates the association between GTM and GOI, such that the relationship is strong (weak) at high (low) levels of GSV.

Cumulatively, the above projections suggest a moderated mediation model (Sahabuddin et al., 2021). As argued above, GSV moderates the relationship between GTM and GOI. Hence, this engagement focusing on SET, in turn, predicts ER. We, therefore, submit that GSV intervenes in the indirect relationship between GTM and ER, mediated by GOI. Therefore,

> *H6*. GSV moderates the association between GTM and ER, such that the relationship is strong (weak) at high (low) levels of GSV.

Methods

Sample and procedure

The study gathered data by employing a time-lagged (i.e., "three-wave") research design from service employees in the tourism firms in Pakistan. The data were gathered in three waves with a time interval of eight weeks between each wave. This helped the researchers to minimize the possible biases that may arise due to the causal effects of the mediation mechanism that should be tapped over a period of time (Maxwell and Cole, 2007). However, failure to do so may lead to possible biases in measuring the estimates (Cole and Maxwell, 2003).

The authors administered questionnaires to the selected firms in the tourism industry, and front line managers were approached to participate in the survey. The study collected data through a purposive sampling technique aimed to collect arbitrary responses from the target respondents (Saunders et al., 2009). The participants were given the questionnaires along with the cover letters that explained the study's purpose. Further, they were assured about the confidentiality of their responses. It also detailed participants the request for their voluntarily participation in the survey, and they could discontinue participating in the survey without any reason if they want so. In addition, the cover letter contained the instructions to generate the key for each participant, e.g., using the first letter of their last name with their city codes.

As recommended by Hair et al. (2017), we observed the rule of thumb for the sample size consideration in SmartPLS SEM. According to the authors, the sample size should be equal to or greater than "10 times the maximum number of arrow heads pointing at the latent endogenous variables," or "10 times the largest number of the structural path" (Hair et al., 2017, p. 48). Several other well-cited studies employing SmartPLS SEM observed the minimum sample size of 207 to be appropriate for measuring the structural paths (e.g., Hassan and Ayub, 2019; Sahabuddin et al., 2021; Yao et al., 2022).

In the first wave, 600 questionnaires were administered to gather data for GTM, GSV, and demographic details of the respondents. Of which, the participants returned 554 questionnaires. The authors assessed the questionnaires and eliminated 18 incomplete and/or wrongly filled questionnaires. After eight weeks, the authors contacted those 536 respondents and collected responses concerning GOI. The authors received 514 completely filled questionnaires, of which 495 accorded with the original responses. In the third wave, the authors contacted the 495 participants and gathered data about ER.

Finally, we combined all the responses collected in each wave through the key generated by each participant. We processed 495 completed questionnaires ("response rate" 83%). Of the total respondents, 59% were men, and 41% were women participated in the survey; the mean age was 37.68 years with a standard deviation of 5.41 years. With respect to occupation, 35 and 65% of the respondents were in "lower" and "middle" managerial positions, respectively. Concerning tenure, 14% of the respondents worked in their organizations for "six to 12 months," 24% of the respondents worked for "1 year to 4 years," 29% have worked for "4 to 7 years," 17% have worked between "7 and 12 years," and 16% have worked for "more than 12 years." Also, 39% of the respondents worked for "public sector organizations," and 61% were from "private sector firms."

Measures

We adopted established scales from previous studies and disseminated them in the English language, as English is a "medium of instruction" at the schools/colleges/universities levels and is used as an official language in the business sector in Pakistan. The research instruments were measured on a five-point Likert scale from 1 ("strongly disagree") to 5 ("strongly agree") (Appendix I).

GTM

The instrument to measure GTM was adopted from Ogbeibu et al. (2021). Its measure includes seven items and the sample items are "my organization cares about my well-being and offers considerable support for my welfare when executing green centered initiatives," and "my organization offers me a considerable degree of autonomy when carrying out green related tasks."

GOI

The instrument to measure GOI was adopted from Chen (2011). Its measure includes seven items and the sample items are "top managers, middle managers, and employees of the organization are proud of its history regarding environmental management and protection," and "top managers, middle managers, and employees of the organization are knowledgeable about its environmental tradition and culture."

GSV

The instrument to measure GSV was adopted from Jansen et al. (2008). Its measure includes four items and the sample items are "there is commonality of environmental goals in the company," and "all members in the company are committed to the environmental strategies of the company."

ER

The instrument to measure ER was adopted from Kyndt et al. (2009). Its measure includes 11 items and the sample items are "I'm planning of working for another company within a period of 3 years," "it does not matter if I'm working for this company or another, as long as I have work," and "I love working for this company."

Control variables

Following the previous studies, individual demographics, such as age, gender, occupation, and tenure, were taken as controlled variables (reported in Table 1).

Data analysis

The study analyzed data using "partial least square structural equation modeling" (PLS-SEM) through SmartPLS (v 3.3). We justify the use of PLS-SEM over CB-SEM based on the following reasons. First, the study's objective is to assess the "predictive capability" of the structural paths, i.e., "to maximize explained variance in the latent endogenous variables rather than theory confirmation" (Hair et al., 2017). Besides, the study assessed a complex moderated mediation model, i.e., in addition to estimating the main effects, the study also assessed the moderator effect of GSV (Henseler and Fassot, 2010).

Results

Measurement model

The study assessed the "measurement model" using "internal consistency," "convergent," and "discriminant" validity criteria (Hair et al., 2017). For evaluating "internal consistency," in addition to the "Cronbach's alpha," the study measured the "composite reliability" (CR) of constructs, as recommended by Hair et al. (2017). Table 2 indicates that all the values of "Cronbach's alpha" and CR for GTM ($\alpha = 0.845$, CR = 0.890), GOI ($\alpha = 0.876$, CR = 0.901), GSV ($\alpha = 0.842$, CR = 0.880), and ER ($\alpha = 0.826$, CR = 0.874) are greater than the threshold value of 0.6 and 0.7 (Cronbach, 1951; Hair et al., 2017), thus, providing evidence of "internal consistency." For the "convergent validity," the authors evaluated "outer loadings" and AVE with the acceptable minimum threshold of 0.5 (Henseler et al., 2009; Chin, 2010). Results of the analysis show that all the values are above the minimum acceptable threshold, hence, ensuring "convergent validity" of the study.

In addition, the study assessed the "discriminant validity" that reflects the degree to which a latent variable empirically differs from other latent variables (Hair et al., 2017). For assessing "discriminant validity," the study examined the "Fornell-Larcker" criterion and "Heterotrait-Monotrait" (HTMT) ratio (Hair et al., 2017). Table 3 shows the results of "Fornell-Larcker." In addition, HTMT ratio were assessed using "bias-corrected and accelerated" (BCa) "bootstrapping technique," using a resample of 5,000 by employing a one-tailed *t*-test with 90% significance level (in order to warrant an error probability of 95%). Table 3 presents the HTMT ratio, all the values are lesser than the threshold value of $HTMT_{.85}$, thus, ensuring the "discriminant validity" of the study (see Figure 1).

TABLE 1 Effects on endogenous variables.

Hypotheses	β	CI (5, 95%)	SE	t-Value	p-Value	Decision	f^2	R^2	Q^2
Age[1]	0.014(*n.s.*)	(−0.042, 0.044)	0.023	0.532	0.405				
Gender[2]	0.069(*n.s.*)	(−0.010, 0.103)	0.022	0.468	0.345				
Occupation[3]	0.084(*n.s.*)	(−0.008, 0.128)	0.033	0.647	0.361				
Tenure[4]	0.025(*n.s.*)	(−0.040, 0.017)	0.019	0.457	0.456				
H1 GTM →ER	0.480***	(0.494, 0.578)	0.072	8.582	0.000	Supported	0.343	0.496	0.343
H2 GTM → GOI	0.586***	(0.517, 0.670)	0.051	7.234	0.000	Supported	0.181	0.614	0.534
H3 GOI → ER	0.492***	(0.425,0.566)	0.038	10.342	0.000	Supported	0.321		
H5 GTM × GSV → GOI	0.512***	(0.432, 0.587)	0.052	4.242	0.001	Supported	0.238		
H6 GTM × GSV → ER	0.526***	(0.441, 0.590)	0.062	9.243	0.000	Supported	0.302		

GTM, green talent management; GOI, green organizational identity; GSV, green shared vision; ER, employee retention; ***significance $p < 0.05$ (1.96).
[1]= control variables.
[2]= control variables.
[3]= control variables.
[4]= control variables.

Structural model

Further, we evaluated the "structural model" by analyzing the path analysis to examine the study's hypotheses. The study utilized a "non-parametric," "bootstrapping procedure." In addition to the "path coefficients," we also assessed the "structural model" by employing the following criteria, such as "coefficient of determination" (R^2), "predictive relevance" (Q^2), and the "effect sizes" (f^2). The value of "cross-validated redundancy" above 0 indicates the "predictive capability" of the model. In addition, we reported the effect sizes to ensure the "predictive accuracy" of the model. The results of the "structural model" are presented in Table 1. The analysis indicates that GTM has a significant positive association with ER ($\beta = 0.480$, $t = 8.582$, $p = 0.000$, $f^2 = 0.343$), supporting *H1*. Besides, GTM has a significant positive impact on GOI ($\beta = 0.586$, $t = 7.234$, $p = 0.000$, $f^2 = 0.181$), supporting *H2*. Moreover, GOI has a significant positive impact on ER ($\beta = 0.492$, $t = 10.342$, $p = 0.000$, $f^2 = 0.321$), supporting *H3*.

Moreover, the study employed a "two-stage approach" to examine the moderating effect (Hair et al., 2017). According to Henseler and Fassot (2010), the two-stage approach "exhibits a high level of statistical power," as compared to orthogonal or product indicator approach. We measured the moderator effect size using BCa bootstrapping approach with a resample of 5,000. Table 1 shows that the interaction term (GTM_GSV) has a significant positive impact on GOI ($\beta = 0.512$, $t = 4.242$, $p = 0.001$, $f^2 = 0.238$), with medium effect size; and ER ($\beta = 0.526$, $t = 9.243$, $p = 0.000$, $f^2 = 0.302$), with large effect size, supporting *H5* and *H6*. The SEM is presented in Figure 2.

Further, we plotted a simple slope analysis to understand the interaction effect of GTM_GSV on GOI and ER (Dawson, 2014) (shown in Figures 3, 4). The simple slope analyses illustrate that at high levels of GSV the direct association between GTM and GOI and the indirect relationship between GTM and ER, mediated by GOI, is more pronounced than at low levels of GSV.

In addition, we also predicted the mediating role of GOI in the relationship between GTM and ER. In order to evaluate the mediation analysis, we adopted Zhao et al. (2010) "mediation approach." We obtained point estimates of the indirect effect using BCa "bootstrapping technique" with a 5,000 resample (Hair et al., 2017). Table 4 shows that the total effect of GTM on ER is significant, with 95% CIs (0.657, 0.812) and the indirect effect of GTM on ER through the mediating role of GOI is significant, with 95% CIs (0.184, 0.312), indicating complementary mediation. In addition, we also assess "variance accounted for" (VAF) to assess the mediation analysis. The rule of thumb for VAF is as follows: <20% indicates "no mediation," between 20–80% indicates "partial mediation," >80% indicates full mediation (Nitzl et al., 2016). VAF value of 34.89% indicates that GOI partially mediates the relationship between GTM and ER, supporting *H4*.

Furthermore, the study also measured the "goodness-of-fit index" (GFI), using Tenenhaus et al. (2005) diagnostic tool. The authors defined GFI as "the geometric mean of the average communality and average R^2." GFI results are shown in Table 5 with a value of 0.501 greater than minimum threshold of 0.36 for a large effect size of R^2, ensuring a good model fit (Hoffmann and Birnbrich, 2012). Finally, we also examined the Stone-Geisser's Q^2 with an "omission distance" of 7. The analysis produced the value significantly greater than 0, thus establishing the model's "predictive relevance."

Discussion

Given the critical role of the tourism industry in ecosystem protection and development, developing and retaining green talent to enhance environmental sustainability has become an increasingly researched hotspot in environmental management (Gardas et al., 2019). Therefore, the chief contribution of this research is the theorization and evaluation of a hitherto unexplored moderated mediation model that may predict ER in the tourism industry. Hence, the study investigated the impact of GTM in determining ER through GOI's mediating role and GSV's moderating role. The study drew on social identity theory and SET to propose and test the theorized model, thus adding insights to environmentalism literature. As projected, the study found that GOI leverages meaning to members of an organization to implement

TABLE 2 Validity and reliability for constructs.

	Loadings	AVE	CR	Cronbach's alpha
Green talent management		0.582	0.890	0.845
GTM1	0.712			
GTM2	0.802			
GTM3	0.782			
GTM4	0.762			
GTM5	0.687			
GTM6	0.823			
GTM7	0.762			
Green organizational identity		0.551	0.901	0.876
GOI1	0.726			
GOI2	0.672			
GOI3	0.800			
GOI4	0.781			
GOI5	0.763			
GOI6	0.746			
GOI7	0.681			
Green shared vision		0.546	0.880	0.842
GSV1	0.664			
GSV2	0.803			
GSV3	0.751			
GSV4	0.732			
Employee retention		0.591	0.874	0.826
ER1	0.764			
ER2	0.782			
ER3	0.827			
ER4	0.784			
ER5	0.693			
ER6	0.810			
ER7	0.782			
ER8	0.694			
ER9	0.696			
ER10	0.790			
ER11	0.814			

GTM, green talent management; GOI, green organizational identity; GSV, green shared vision; ER, employee retention; AVE, average variance extracted; CR, composite reliability.

environment-related strategies, translating into enhanced ER. Moreover, the study found the positive impact of the boundary effects of GSV on the underlying linkage. Specifically, the findings of this study support the theorized projections such that:

The study demonstrated that *H1* which states that GTM has a significant positive influence on ER, is supported. The results of this study advance the prior research on the link between GTM and turnover intention (Ogbeibu et al., 2021), by projecting that GTM facilitates ER in the tourism industry. Moreover, another justification of *H1* explain that GTM leverages meaningfulness in one's job which serves as a mean to enhance ER. Further, we expect that our findings advance the impact of GTM on other employee outcomes, *such as* job satisfaction (Freire and Pieta, 2022) and engagement (Ababneh, 2021).

Similarly, the second hypothesis *H2* states that GTM has a significant positive influence on GOI. Extant research on organizational identification suggests that employees perceive that organizational identity dominates personal identity (Shah et al., 2021), and they view themselves as a larger whole. Therefore, GTM holds significant relevance in predicting GOI, which in turn, culminates into enhanced ER. This supports the hypothesis *H3*, which states that GOI mediates the link between GTM and ER. The result of this analysis is in harmony with prior research which found that organizational identification mediates the association between green human resource management and organizational citizenship behavior (Freire and Pieta, 2022).

In addition, the study predicted the moderating role of GSV in the association between GTM and ER, mediated by GOI (*H4* and *H5*). Our findings support the intervening role of GSV on the association between GTM and ER, mediated by GOI such that at high levels of GSV the relationships are more pronounced than at low levels of GSV. Our findings are similar to previous study on the moderating role GSV in the link between green HRM and green innovation. By investigating GSV, the study contributes to the literature of sustainable human resource management such as GSV infuses the internalization of workplace green initiatives by offering a mutual strategic direction that can divulge convergent goals, thereby, eliciting the association between GTM, GOI, and ER.

Theoretical implications

The study adds several unique contributions to the existing literature on environmental strategies in the tourism industry by determining the linkage between GTM and ER. First, this is the first study that examined the impact of GTM on ER in the tourism industry. Although prior studies have identified the connection between TM and ER (Hughes and Rog, 2008; Chami-Malaeb and Garavan, 2013; Pandita and Ray, 2018; Narayanan et al., 2019), however, the association between GTM and ER has remained unexplored to date. Though, a host of research in recent years has investigated the impact of GTM on turnover intention of employees (Ogbeibu et al., 2021). However, their findings provide divergent acumens such as the authors found GTM as a predictor of turnover intention. In juxtapose the findings of this study sanction a substantial impact of GTM on ER. With a focus on SET (Blau, 1968), the study also contributes to the theoretical underpinning of SET by extending its applicability to the underlying GTM-ER nexus.

In addition, we proposed that GTM may determine ER; however, the process is interceded by a causal mechanism. We examined the mediating role of GOI and found that employees' perception of environment-related organizational concerns leverages superior identity, which engenders GTM practices to achieve convergent goals. This turns out to be our second contribution such that by drawing on the social identity theory, we predicted that GOI offers maximum

TABLE 3 Discriminate validity.

	Fornell-Larcker criterion				HTMT criterion			
	GTM	GOI	GSV	ER	GTM	GOI	GSV	ER
GTM	0.762							
GOI	0.672	0.742			0.773 $CI_{0.900}$ [0.680;0.841]			
GSV	0.651	0.563	0.738		0.624 $CI_{0.900}$ [0.546;0.712]	0.762 $CI_{0.900}$ [0.695;0.847]		
ER	0.462	0.422	0.264	0.768	0.721 $CI_{0.900}$ [0.633;0.792]	0.512 $CI_{0.900}$ [0.440;0.584]	0.666 $CI_{0.900}$ [0.608;0.742]	

GTM, green talent management; GOI, green organizational identity; GSV, green shared vision; ER, employee retention; CI, bootstrapping 90% confidence intervals ($n = 5{,}000$) (one-tailed).

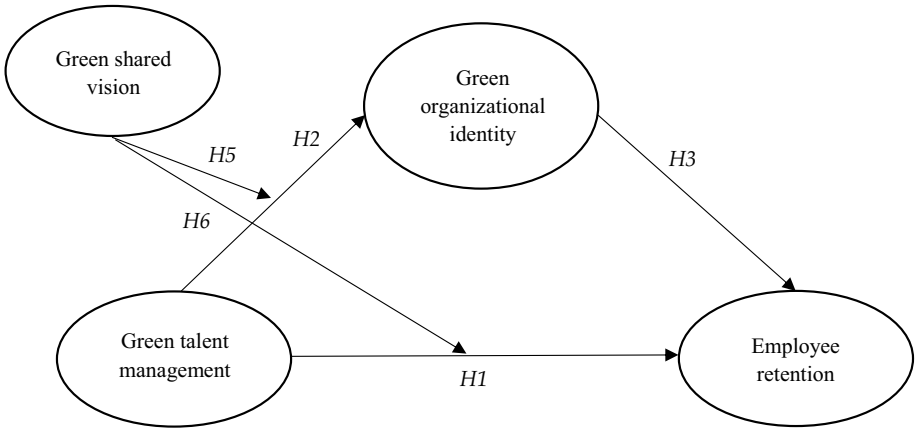

FIGURE 1
Conceptual model.

capacity to transform GTM strategies in the manifestation of eco-friendly business practices, ultimately enhancing employees' intention to stay in an organization, based on the promulgation of a collective identity (Chang et al., 2019). The findings of this study are in harmony with preliminary research on GOI. For instance, Song and Yu (2018) found a partial mediation effect of GOI in the relationship between green innovation strategy and green creativity.

Third, the study extends the boundary conditions of the GTM-ER nexus. With an emphasis on the social identity theory and SET, we found that GSV stimulates the direct relationship between GTM and GOI and the indirect relationship between GTM and ER, mediated by GOI. Assessing the boundary effects of GSV allowed us to address the variability in the previous findings of the divergent impacts of GTM on ER (Ogbeibu et al., 2021). For instance, we hypothesized that differences in interests among managers and employees might limit the potential impact of GTM practices on GOI and ER. However, shared vision can help organizational members to minimize ambiguities and conflicting interests, thus underpinning the association between GTM and GOI and ER. We expect that the findings of this study will advance preliminary incongruous discoveries on the underlying linkage.

Practical implications

The findings of this study provide meaningful insights for managers and service firms in the tourism industry. Given escalating gravity of embedding green practices across all business activities (Kalyar et al., 2021), service firms in the tourism industry require an imperative to develop and retain green talent to exploit pro-environmental strategies (Ogbeibu et al., 2021). As corroborated by Arshad et al. (2018), service firms in the tourism industry, in compliance with the UN's sustainable development goals, face severe governmental pressures to comply with environmentalism, prompting service organizations to induce GTM strategies. Findings of this study endorse that GTM strategies translate into enhanced ER; thus, apposite organizational interventions are warranted to manoeuver GTM that result in developing and retaining green talent. To ensure human capital that manifests heightened environmental concerns, managers should nurture and retain green talent in organizations in order to cultivate environmental sustainability (Ogbeibu et al., 2021). Further, there is a great need to converge organizational (i.e., "GTM") and employee levels (i.e., "talent perception," and "retention") objectives. Furthermore, the exclusivity of GTM strategy may gauge

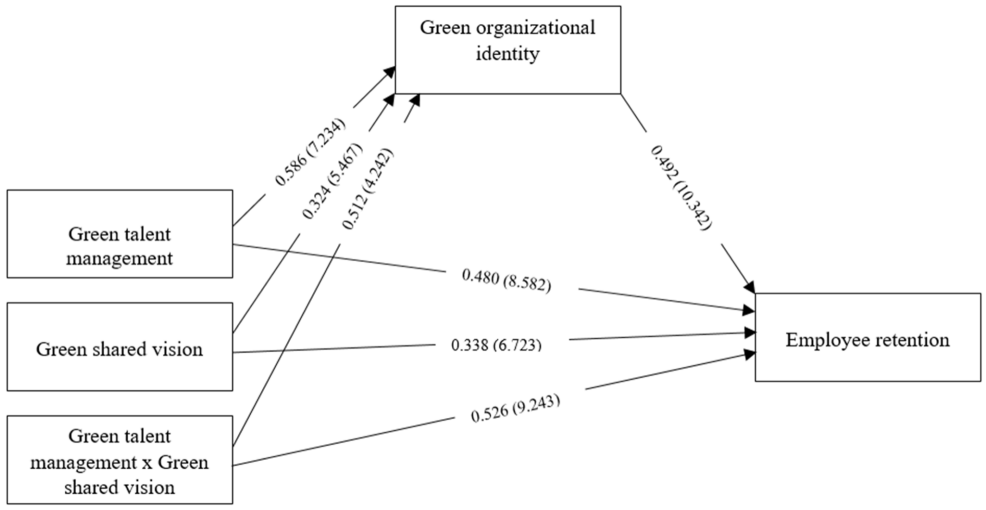

FIGURE 2
Structural equation model.

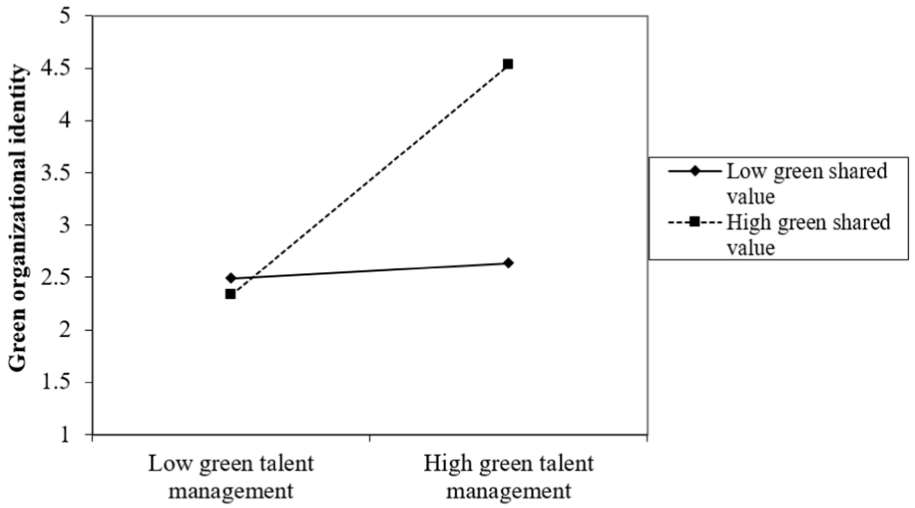

FIGURE 3
Interaction effect of green talent management and green shared vision on green organizational identity.

whether development initiatives are tailored to key people or positions or emphasize building more comprehensive organizational competence and social capital (Iles et al., 2010).

Second, our findings endorse that GOI offers a theoretically grounded explanation of *how* GTM predicts ER in the tourism industry. Managers can verify whether their firms' GTM contributes to enhanced ER by observing their firms' GOI. Although prior studies indicate that GTM could lead to turnover intention due to conflicting interests or ambiguities (Ogbeibu et al., 2021). Our findings indicate that GTM significantly affects ER through the sense of GOI. We thereby suggest managers to devise appropriate ways to foster GOI. In this milieu, Haslam et al. (2003) presented an all-inclusive model to nurture organizational identity. The authors proposed four phases of the development of organizational identity in their ASPIRe model of "Actualizing Social and Personal Identity Resources," to inflate organizational consequences. The first phase refers to "detection of relevant identities" for employees in a given organizational unit. The second and third phase reflects goals linked with the respective identities with respect to the convergence of relevant subgroups and organizational unit. In the fourth phase, the newly developed organic identities transform into superior organizational planning and direction. Through instilling GOI, organizations can translate GTM into enhanced ER.

Last but not least, our findings stress the critical role of GSV as a boundary condition of the GTM-ER linkage. To implement GTM strategies effectively, organizations should inculcate environmentalism in their shared vision that managers and employees should concede. One way to implement GSV is by giving autonomy and freedom to members of an organization to address environmental challenges and

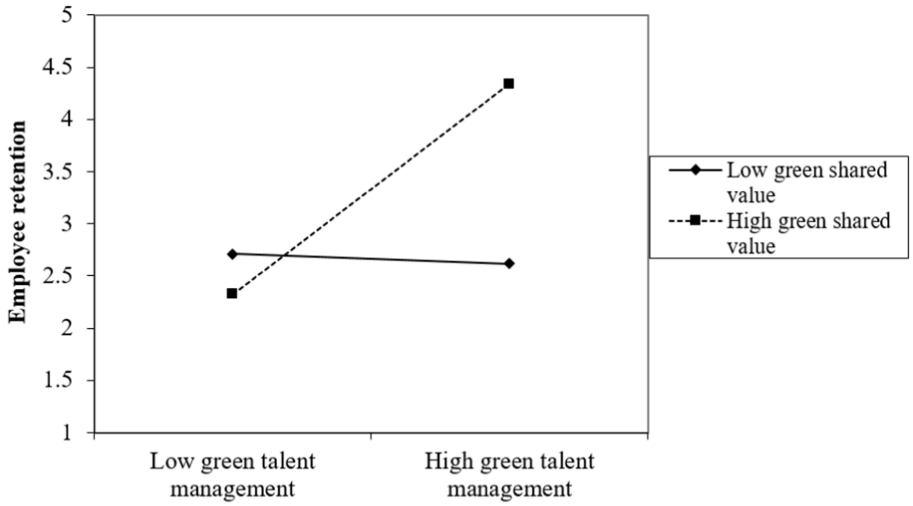

FIGURE 4
Interaction effect of green talent management and green shared vision on employee retention.

TABLE 4 Summary of mediating effect tests.

	Path	*t*-Value	BCCI		Path	*t*-Value	95% BCCI	Decision	VAF
Total effect GTM → ER	0.737	9.536	(0.657, 0.812)	Indirect effect *H4* GTM → GOI →ER	0.257	4.121	(0.184, 0.312)	Supported	34.89%

GTM, green talent management; GOI, green organizational identity; GSV, green shared vision; ER, employee retention; VAF, variance accounted for (indirect effect/total effect*) *total effect: direct effect + indirect effect).

TABLE 5 Goodness-of-Fit Index (GFI).

Constructs	AVE	R^2
GTM	0.582	
GOI	0.551	0.534
GSV	0.546	
ER	0.591	0.343
Average scores	0.570	0.440
$(GFI = \sqrt{\overline{AVE} \times \overline{R^2}})$	0.501	

AVE, average variance extracted; GTM, green talent management; GOI, green organizational identity; GSV, green shared vision; ER, employee retention.

concerns. In sum, organizations should establish a culture of GSV to strengthen the association between GTM, GOI and ER.

Limitations and future research directions

The findings of this study should be trumpeted with its limitations. First, this study employed a time-lagged design to collect data from employees working in service firms in the tourism industry in Pakistan. In spite of that all the study variables were not tapped at all periods. Second, the findings of this study indicate that GOI partially mediates the relationship between GTM and ER. Therefore, we invite future studies to determine the TM-retention nexus through the mediator effect of other factors, *such as* green CSR (Wu et al., 2018) and psychological empowerment (Hartmann et al., 2018), etc. Third, the present study examines the boundary effect of GSV in the GTM-ER linkage. We suggest future studies assess the boundary effects of other individual and/or contextual factors to examine the contingent effect. Furthermore, we suggest a finer-grain investigation of the GSV construct from a multilevel perspective. For instance, future studies should assess *how* individuals and teams from different functional units enact GSV. Last but not the least, the findings of this study should not be generalized in Western countries due to the examination in the non-Western contexts, therefore, this merits further studies to be conducted in Western countries.

Conclusion

The current study anchors on the SIT and SET to predict the association between GTM and ER through the mediator effect of GOI and moderator effect of GSV. In this milieu, the study investigates the boundary effects of individual as well as contextual factors that might influence the association between GTM and ER. Drawing on data collected from the service employees in the tourism firms, the analyses support all the study's hypotheses. For instance, GTM significantly influence ER through the mediator effect of GOI. Further, GSV moderates the underlying linkage between GTM and ER, mediated by GOI such that at high levels of GSV the associations are more potent

(and vice versa). The study presents unique and meaningful insights for theory and practice.

Data availability statement

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

Author contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree 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.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1041654/full#supplementary-material

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The effect of simulated natural environments in virtual reality and 2D video to reduce stress

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Stress is a common problem associated with poor physical and psychological health. Exposure to the natural environment is one method for reducing stress. The real and simulated natural environments have a restorative effect on stress reduction. In contrast to the real environment, simulated natural environments, such as virtual reality and 2D video, provide safer and more controllable exposure. Several studies on the restorative effects of the natural environment in virtual reality and 2D video have been conducted. However, the difference between the two in reducing stress must be clarified. This study was conducted to determine the effect of the simulated natural environments in virtual reality and 2D video and their differences in reducing stress. This study hypothesizes that both simulated natural environments in virtual reality and 2D video can reduce stress, but there is a difference between them in reducing stress. Fifty-three subjects were divided into two experimental groups: 2D video (n=28) and virtual reality (n=25). The results indicated that simulated natural environments in virtual reality and 2D video reduced stress. However, there was no difference between the two groups regarding stress reduction.

KEYWORDS

virtual reality, 2D video, restorative, stress, simulated natural environments, physiological responses

1. Introduction

Stress is a common problem that has become an attribute of modern life (Kupriyanov and Zhdanov, 2014). Stress is associated with poor physical and psychological health (Toussaint et al., 2016). In the worst case, stress can cause various diseases, such as anxiety, insomnia, depression, heart disease, gastritis, and hypertension (Segerstrom and Miller, 2004).

Three theoretical models can explain the mechanism of stress. They are the stimulus model of stress, the response model of stress, and the transactional model of stress (Gaol, 2016). The stimulus model of stress explains stress as an environment that causes someone to feel depressed (Bartlett, 1998). According to Lazarus (1999), stress can be caused by the external environment and the individual's internal state. Conversely, the stress response model explains stress as the body's non-specific reactions to demands (Selye, 1976). Finally, the transactional stress model emphasizes the individual's subjective evaluation of the environment as a demand for or an inability to encounter a dangerous or threatening situation. In the American Psychological Association (2015), stress is a psychological or physiological response to internal or external stressors. This study defines stress as psychological and physiological responses when a person encounters a threatening or dangerous perceived stimulus.

Stress provokes psychological and physiological responses (Kozier et al., 2017). Psychologically, stress can trigger responses, such as anxiety, fear, anger, and depression.

Physiologically, stress can be explained through the general adaptation syndrome (GAS), which comprises three steps, i.e., alarm, resistance, and exhaustion (Selye, 1976). First, the body activates the physiological changes for fight-or-flight responses that increase sympathetic nervous and neuroendocrine system activity (Kozier et al., 2017) for fight-or-flight responses toward threatening stimuli. As a result, there is an increase in electrodermal activity, heart rate, respiratory rate, blood pressure, and cortisol. After the initial shock, the body attempts to overcome stressors in the resistance phase, noted by relaxation if it succeeds. Finally, exhaustion occurs when the emotional component cannot be addressed, and the body continuously generates physiological responses. In states of exhaustion, the body cannot overcome the stressor, resulting in illness.

Psychological scientists categorized stress into major life events and daily hassles (Gazzaniga et al., 2011). Major life events are any changes or strains that affect an individual's central life. Daily hassles are minor disturbances, such as driving in heavy traffic, dealing with a difficult person, or waiting in queues. Kozier et al. (2017) divided stressors based on their origin into four types: internal, external, developmental, and situational stressors. In addition, there are types of stressors based on duration, including acute time-limited stressors, brief naturalistic stressors, stressful event sequences, chronic stressors, and distant stressors (Segerstrom and Miller, 2004). Laboratory challenges are examples of acute time-limited stressors. A brief naturalistic stressor involves confronting short-term challenges. Stressful event sequences involve an important event, such as missing someone. Chronic stressors are stressors whose duration is unknown. Distant stressors are a past traumatic experience that affects the immune system's function continuously.

In an experimental setting, stress can be generated by manipulating stressful experiences, called acute time-limited stressors (Segerstrom and Miller, 2004). Stress can be manipulated in an experiment by giving the subjects specific tasks. For instance, the Setiatama and Kusrohmaniah (2019) employed the Sing-a-Song Stress Test (SSST), in which subjects were required to sing in front of strangers as a social-evaluative threat. SSST is a novel experimental approach that complies with ethical standards and can induce stress quickly and easily. In addition, it can control distractions resulting from sensory input and body movement (Brouwer and Hogervorst, 2014).

Many studies have been conducted about the restorative effect of a real and simulated natural environment. Previous studies have revealed a positive relationship between exposure to the real natural environment and individual health (Triguero-Mas et al., 2015; Ward Thompson et al., 2016). People who visited the forest reported feeling more comfortable, calm, and refreshed (Xiang et al., 2012; Tsunetsugu et al., 2013). Berto (2014) stated that exposure to the natural environment mediates the adverse effect of stress, reduces negative moods, and simultaneously increases positive emotions. Similarly, a forest simulated with virtual reality restored the physiological stress effect (Annerstedt et al., 2013) and improved psychological well-being (Yu et al., 2018). It was the same as the simulated natural environment in the photography slideshow (Kjellgren and Buhrkall, 2010). Video simulation of marine and forest environments also relaxed and induced changes in positive parasympathetic activities (Tsutsumi et al., 2017). In addition, the natural environmental film shown on a flat screen could have restorative effects, such as decreasing negative emotions and, vice versa, increasing positive emotions (de Kort et al., 2006). Thus, real and simulated natural environments can reduce stress (Kjellgren and Buhrkall, 2010; Hong et al., 2019).

Exposure to a simulated natural environment can be a choice to reduce stress because it is controllable and safer than the real natural environment. However, not everyone has access to the real natural environment. Because of urbanization, environmental damage, and lifestyle changes, human-nature interaction decreases quantitative and qualitative (Hartig et al., 2014). Also, not all natural environments, such as forests, are safe. A forest can pose risks to human safety. Many infectious diseases, such as the *Puumala virus (PUUV)*, *Lyme borreliosis*, *Hantavirus Cardiopulmonary Syndrome (HCPS)*, and malaria, are associated with forest, which is the preferred habitat for vectors (Aydin and Bakirci, 2007; Linard et al., 2007). Forest can also expose people to physical hazards such as forest fires, floods, droughts, landslides, and haze (Karjalainen et al., 2010).

The simulated environments commonly used are virtual reality and 2D media, for instance, 2D video. Several studies have compared the effect of virtual reality and 2D media. Compared to 2D video, virtual reality was more effective in inducing emotional and physiological responses (Ding et al., 2018), more capable of facilitating the presence effect and increasing pleasant and arousal experiences (Elsey et al., 2019), produced lower stress level (Liszio et al., 2018) and had more significant positive effects (Liszio et al., 2018; Yeo et al., 2020). Conversely, several studies found similar results between virtual reality and 2D media in reducing stress and psychological arousal (Mostajeran et al., 2021) and enhancing creativity (Palanica et al., 2019). Unfortunately, the studies comparing virtual reality and 2D media yielded inconsistent results. Therefore, this study was conducted to determine the differences between virtual reality and 2D media, i.e., 2D video, especially in reducing stress.

Unlike film or 2D video, virtual reality can provide a more immersive experience. According to Slater and Sanchez-Vives (2016), virtual reality users can experience "being there" in the virtual world through their immersive experience. The therapeutic potential is greater when the experience is more immersive (De Kort and Ijsselsteijn, 2006). Virtual reality users can also get clear, authentic experiences and a high sense of presence, which increases emotional responses and relaxation (Berto, 2014). Currently, virtual reality has been displayed through a fully immersive head-mounted display (HMD), making it possible to isolate the user's senses from the outside world (Witmer and Singer, 1998; Higuera-Trujillo et al., 2017).

Several studies discovered the role of different participants' geographical locations in response to environmental stimuli (Ji et al., 2000; Faggi et al., 2017). In addition, a restorative study found that the country difference significantly affected the participant's stress recovery (Suppakittpaisarn et al., 2023). It shows that the geographical factor impacts the individual response to environmental stimuli. However, there is no restorative study, especially using a simulated environment in the Indonesian context. To the best of the researchers' knowledge, research on the effects of the simulated environment in Indonesia has been conducted by Suyanto et al. (2017), Resibisma and Ramdhani (2020), Ramdhani et al. (2019), and Fatahillah and Hastjarjo (2021). Suyanto et al. (2017) focused on technology by developing the acrophobia application simulator to reduce acrophobia. Ramdhani et al. (2019) also Resibisma and Ramdhani (2020) focused on psychological and physiological reactions to altitude stimuli. Fatahillah and Hastjarjo (2021) focused on psychological and physiological responses to social stimuli. Regrettably, research on the

effects of a simulated environment on restorative stress has never been conducted in Indonesia. By doing this study, it will be possible to determine the calming benefits of virtual reality and 2D video on stress reduction. As an outcome, this study can guide professionals who want to use a virtual environment to help clients relax.

This study was conducted to determine the effect of simulated natural environments in virtual reality and 2D video and their differences in reducing stress. Hence, this study hypothesizes that (i) both simulated natural environments in virtual reality and 2D video can reduce stress and (ii) there is a difference between simulated natural environments in virtual reality and 2D video in reducing stress levels. A simulated natural environment in virtual reality can reduce stress more than a simulated natural environment in a 2D video.

2. Materials and methods

2.1. Participants

The participants were recruited using broadcast messages and posters on social media platforms. Candidates voluntarily filled out a Google form in which the link was included in the broadcast messages and posters for enrollment and screening. The participants must meet the inclusion criteria for this research. They must be enrolled as a full-time student at universities in the Special Region of Yogyakarta, not have psychological diseases now and in the past, and have moderate to high anxiety trait scores following the categories developed by Kayikcioglu et al. (2017). There were 85 registered candidates for the study. Based on the anxiety score from the State–Trait Anxiety Inventory (STAI) trait subscale, 62 participants comprising 33 men and 29 women met the inclusion criteria. They were randomly divided into two experimental groups by range matching. First, participants were paired based on their trait anxiety scores, i.e., high and moderate. Then, participants within the same range were paired and assigned to a different group. During the implementation, nine subjects withdrew because they had other activities they had to do: six from the virtual reality group and three from the 2D video. Thus, this research's participant was 53, comprising 25 people from the virtual reality group and 28 from the 2D video. Thirty-four participants took humanities and social science studies, 11 took engineering studies, 5 took mathematics and natural science studies, 2 took medical science studies, and 2 took agricultural studies. The virtual reality group comprised 13 men and 12 women, while the 2D video group had 16 men and 12 women. The average age of the virtual reality group was 20.7 ($SD = 1.72$), and the average of the 2D video group was 19.8 ($SD = 1.31$). There was no age difference between the virtual reality ($Mdn = 21$) and the 2D video ($Mdn = 20$) groups; $U = 245$, $p = 0.056$.

2.2. Stress induction

The SSST developed by Brouwer and Hogervorst (2014) induced stress in this study. It is a novel, ethically compliant experimental method to induce stress quickly and easily. It can also control distractions from sensory input and body movement (Brouwer and Hogervorst, 2014). SSST used in this study was based on Setiatama and Kusrohmaniah's (2019) study. The subjects from both groups were asked to sing any song in front of unknown people, i.e., the researcher, the assistant, and the operator, to provoke a social-evaluative threat. Social evaluative threats occur when essential aspects of oneself are, or could be, negatively judged by others (Brouwer and Hogervorst, 2014). Therefore, anticipating and watching oneself sing in front of an audience causes a solid neuroendocrine stress response (Dickerson and Kemeny, 2004) and elicits emotional stress (Harris, 2001). This study administered the SSST by instructing a task to participants in a sequence that could be seen on a flat screen (Figure 1). The first instruction, "Read it! Sing a song out loud when the counter shows zero and keep sitting still until the screen shows zero," for 10 min. Next, the screen would show a 60-s countdown. Then, the screen showed "start singing" instructions for 15 s. Simultaneously, the subject had to sing a song until the screen showed a "stop" instruction as a sign for the participants to cease singing.

2.3. Simulated natural environments

In this research, Nokia Bay was used as the simulated natural environment for both the virtual reality and the 2D video (Figure 2). The environment is commercially available in the Guided Meditation VR application. The application used had received permission from the developer. According to the assessment of 11 assessors who have researched the usage of virtual reality in psychology and/or been involved in the virtual reality research team of the Faculty of Psychology at UGM, the environment could generate a very high sense of presence. Witmer and Singer (1998) deemed that the effectiveness of a simulated environment is frequently linked to the sense of presence.

The virtual reality environment was shown on the HMD HTC VIVE Pro Eye, allowing subjects to explore the environment from a 3D, 360-degree point of view and equipped with a controller to move to other locations. Conversely, the 2D video environment was shown with a 22-inch flat-screen 1 m away that could only be seen from one angle. The 2D environment was produced by recording the Nokia Bay in motion mode. In both environments, the subjects could see waterfalls, trees, grass, foliage, rocks, and the sky and hear the water's voice and birds chirping.

2.4. Measurement

2.4.1. Stress

State–Trait Anxiety Inventory (STAI) is a scale developed by Spielberger et al. (1970) to measure an individual's level of anxiety, which is a psychological indicator of stress (Kozier et al., 2017). In the research on the relationship between virtual reality and stress, Annerstedt et al. (2013) also applied the STAI to measure individuals' stress levels. STAI comprised two subscales: the state and the trait subscales. Each subscale has 20 items with a choice of answers ranging from 1, "not very anxious" and "never," to 4, "very anxious" and "always." This research used the same scale as the research conducted by Ramdhani et al. (2019), with a coefficient alpha of 0.920 and a content validity of 0.921. The state subscale measured anxiety levels after the individual was given stress induction and environmental exposure. Meanwhile, the trait subscale was used as the participant's screening tool.

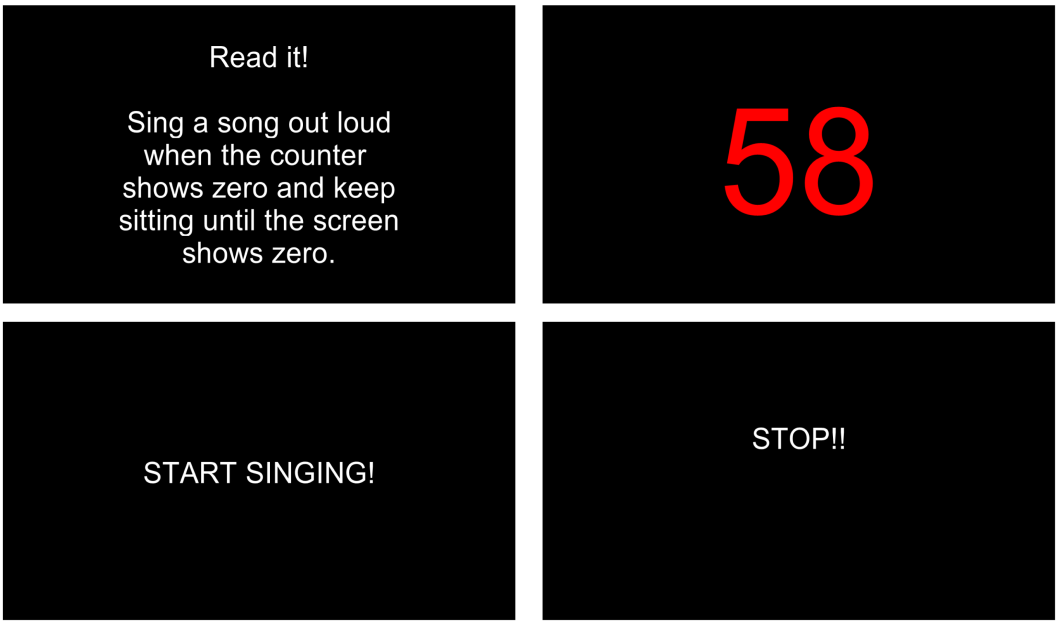

FIGURE 1
The sing-a-song stress test instructions.

FIGURE 2
Screen captures of Nokia Bay. Reproduced with permission from Guided Meditation VR®, available at https://guidedmeditationvr.com/.

2.4.2. Self-consciousness towards body sensations

The Autonomic Perception Questionnaire (APQ) scale was developed by Mandler et al. (1958) with 24 items. The APQ scale measures self-consciousness towards bodily sensations such as sweat, temperature change, heart rate, muscle tension, respiration, digestion, and blood pressure (Seinfeld et al., 2016). According to Mandler et al. (1958), people with high self-consciousness report high levels of autonomic feedback when anxious and very high levels in stressful situations. This study used the same scale as Resibisma and Ramdhani (2020), with a coefficient alpha of 0.960 and a response range of 1–7.

2.4.3. Physiological responses

The ProComp5 Infiniti biofeedback system developed by Thought Technology Ltd. was used to measure the physiological responses, i.e., the heart rate and skin conductance. The heart rate (HR) was obtained from the HR/BVP sensor on the middle finger. The electrodermal skin response was obtained from the skin conductance sensor on the index and ring fingers. All collecting

physiological data were processed with BioGraph Infiniti Software V6.0.

2.5. Procedure

The study implementation was divided into eight daily sessions, lasting about 35–45 min for each session. Each session comprised experimental processes and another procedure, including the tool installation, briefing, and break time to adjust the place and all the instruments used in this study. We defined the time based on experimental processes conducted for approximately 16 min, plus another procedure noted above took about 15–30 min. The data was retrieved in the virtual reality laboratory of the Faculty of Psychology at Gadjah Mada University. In the laboratory room, there were four people, i.e., the participant, the researcher, a computer operator, and a research assistant. The participants were asked to complete the attendance list and provide informed consent when they entered the laboratory room. Then, after agreeing to join the study, they performed a series of experimental processes (Figure 3).

First, the participants were invited to sit on the therapy chair to adjust to the laboratory for a minute. The physiological responses measurement using an HR/BVP sensor and skin conductance as a baseline was conducted for 85 s afterward. Second, the SSST as stress induction was administered to participants. Concurrently with the stress induction, physiological responses were measured for 85 s as a pre-test and manipulation check. The measurement comprised three stages, i.e., (i) 60 s during the countdown, (ii) 10 s when the instruction to sing a song out loud came up after the countdown, and (iii) 15 s when the participants were singing. Third, the participants completed the APQ scale and STAI as a psychological pre-test to determine the level of consciousness towards the body sensations and anxiety experienced during the stress induction period. Fourth, the research assistant explained to the participants what they had to do during environmental exposure. The explanation was followed by simulated environmental exposure to the participant. At the beginning of the environmental exposure, the physiological responses were measured for 85 s. After that, the participants were invited to continue exploring the simulated environment for 2 min. Fifth, the post-test measurements of physiological responses were conducted after giving environmental exposure, and post-test psychological responses were performed afterward. At the end of the session, a debriefing was given by the researcher to the participants. Participants who did not feel comfortable could see the psychologists provided by the researcher. Rewards were given to the participants as well.

2.5.1. Virtual reality

The research assistant helped participants in the virtual reality group attach the HMD. HMD was used to display the environment for 3 min and 25 s. Wind stimuli coming from a fan were given to the participant as well. During the first 85 s, physiological responses were measured, so the participants were asked to remain seated while looking at the environment. The participants were then permitted to look around and use the controller to move to other places for 2 min. The participants could only move to other places, which is the application's default, by pressing the right button. It was intended so participants could efficiently operate the controller and not move to places that blocked their view, for example, right in front of a rock. At the end of the environment displayed, the research assistant helped the participant detach the HMD.

2.5.2. 2D video

The participant in the 2D video group was only seated on the therapy chair and still looked at the screen, which would display the environment. Same as the virtual reality group, the environment was displayed on the screen for 3 min and 25 s in this group. The physiological responses were also measured during the first 85 s, so participants were asked to remain seated while looking at the environment. Then, the participants continued watching the environment on the screen for 2 min. The environment was displayed in "floating motion mode" in several places, allowing the participants to see the environment flow like a river.

2.6. Statistical analyses

The Friedman test was used to compare stress levels across time measurement periods (within the subject). The Kruskal–Wallis test was used to compare stress levels between groups in each time measurement (between the subject). In addition, the Wilcoxon signed-rank test was used as a *post hoc* test with Holm correction to find the physiological response differences between the measurement times in each group.

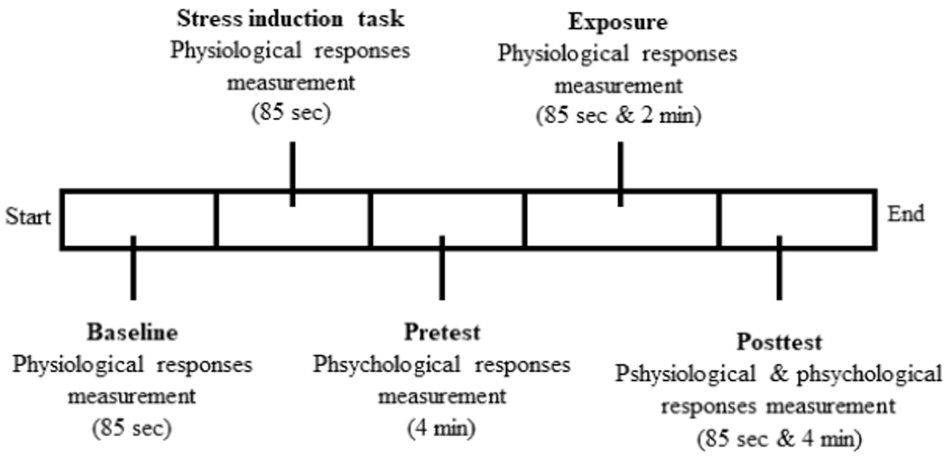

FIGURE 3
Experimental process.

3. Results

3.1. Psychological responses

3.1.1. Stress

Analysis of the stress score revealed a statistically significant difference between before and after the simulated natural environment was displayed $\chi^2_F(1) = 40.692$, $p < 0.001$, $W = 0.768$. Nevertheless, no statistically significant differences between the two groups before $H(1) = 1.035$, $p = 0.309$, $\varepsilon^2 = 0.0199$, and after $H(1) = 1.912$, $p = 0.167$, $\varepsilon^2 = 0.0368$, the simulated natural environments were displayed. Thus, both simulated natural environments in virtual reality and 2D video decreased stress levels, but there was no difference between virtual reality and 2D video in reducing stress levels (Tables 1–3).

TABLE 1 Descriptive statistics of psychological and physiological responses.

	Virtual reality			2D video		
	Mean	SD	Median	Mean	SD	Median
State STAI						
Pre-test	45.5	8.61	46.0	48.5	8.63	48.0
Post-test	31.5	5.82	32.0	35.3	8.71	33.0
APQ						
Pre-test	70.8	21.7	79.0	70.6	19.6	69.0
Post-test	55.0	17.6	52.0	58.3	19.4	52.5
Heart rate						
Baseline	87.48	12.25	87.4	90.58	90.58	90.6
Stress induction	105.70	13.16	110	108.63	17.09	110
Exposure	83.42	11.98	81.7	86.58	14.05	83.1
Post exposure	84.44	10.70	85.1	87.37	12.27	85.1
Skin conductance						
Baseline	1.29	1.18	0.870	1.44	1.49	1.07
Stress induction	2.07	2.04	1.43	2.16	2.62	1.29
Exposure	2.45	1.62	2.48	2.28	2.29	1.54
Post exposure	2.69	2.04	1.89	2.56	2.52	1.33

All the STAI and APQ data for each group could be analyzed ($n = 25$ for the virtual reality group, $n = 28$ for the 2D video group). However, one set of heart rate data in the 2D video group could not be analyzed ($n = 25$ for the virtual reality group and $n = 27$ for the 2D video group). In addition, one skin conductance data point in the virtual reality group and three in the 2D video group could not be analyzed ($n = 24$ for the virtual reality group and $n = 25$ for the 2D video group).

TABLE 2 Friedman rank test of psychological and physiological responses.

	n	χ^2	df	*p*	*W*
State STAI					
Total	53	40.692	1	0.000***	0.768
Virtual reality	25	21.160	1	0.000***	0.846
2D Video	28	19.593	1	0.000***	0.700
APQ					
Total	53	30.769	1	0.000***	0.581
Virtual reality	25	13.500	1	0.000***	0.540
2D Video	28	17.286	1	0.000***	0.617
Heart rate					
Total	52	102.9	3	0.000***	0.660
Virtual reality	25	46.921	3	0.000***	0.626
2D Video	27	56.111	3	0.000***	0.693
Skin conductance					
Total	49	61.482	3	0.000***	0.418
Virtual reality	24	36.200	3	0.000***	0.503
2D Video	25	26.904	3	0.000***	0.359

***$p < 0.001$.

3.1.2. Self-consciousness towards body sensations

Analysis of the self-consciousness toward body sensations score revealed a statistically significant difference between before and after the simulated natural environments were displayed $\chi^2_F(1) = 30.769$, $p < 0.001$, $W = 0.581$. On the other hand, no statistically significant differences between the two groups before $H(1) = 0.001$, $p = 0.979$, $\varepsilon^2 = 0.0000137$, and after $H(1) = 0.258$, $p = 0.611$, $\varepsilon^2 = 0.00496$ the simulated natural environments was displayed. Thus, both simulated natural environments in virtual reality and 2D video decreased self-consciousness toward body sensations. However, there was no difference between virtual reality and 2D video in reducing self-consciousness toward body sensations (Tables 1–3).

TABLE 3 Kruskal–Wallis of psychological and psychological responses.

	χ^2	df	p	ε^2
State STAI				
Pre-test	1.035	1	0.309	0.0199
Post-test	1.912	1	0.167	0.0368
APQ				
Pre-test	0.001	1	0.979	0.0000137
Postets	0.258	1	0.611	0.0049
Heart rate				
Baseline	0.128	1	0.721	0.0025
Stress induction	0.399	1	0.527	0.0078
Exposure	0.376	1	0.540	0.0073
After exposure	0.578	1	0.447	0.0113
Skin conductance				
Baseline	0.123	1	0.726	0.0025
Stress induction	0.014	1	0.904	0.0002
Exposure	0.828	1	0.363	0.0172
After exposure	0.449	1	0.503	0.0093

3.2. Physiological responses

3.2.1. Heart rate

The heart rate score analysis revealed a statistically significant main effect for time $\chi^2_F(3) = 102.9$, $p < 0.001$, $W = 0.660$. However, there were no statistically significant differences between virtual reality and 2D video for each time measurement. Baseline condition $H(1) = 0.128$, $p = 0.721$, $\varepsilon^2 = 0.0025$, stress condition $H(1) = 0.399$, $p = 0.527$, $\varepsilon^2 = 0.0078$, exposure condition $H(1) = 0.376$, $p = 0.540$, $\varepsilon^2 = 0.0073$, and after exposure $H(1) = 0.578$, $p = 0.447$, $\varepsilon^2 = 0.0113$ (Tables 1–3).

The results on heart rate in each time measurement (Table 4 and Figure 4) revealed that the two groups experienced significant increases from baseline to stress induction ($p < 0.001$). Conversely, the heart rate was significantly reduced while the simulated natural environments were provided ($p < 0.001$). While after the simulated natural environments had been given, there were neither significant differences in virtual reality ($p = 0.325$) nor 2D video ($p = 0.94$). Moreover, neither significant differences between exposure and after exposure in virtual reality ($p = 0.325$) nor 2D video ($p = 0.94$).

3.2.2. Skin conductance

The skin conductance score analysis revealed a statistically significant main effect for time $\chi^2_F(3) = 61.482$, $p < 0.001$, $W = 0.418$. Nevertheless, the two groups had no statistically significant differences for each time measurement. Baseline condition $H(1) = 0.123$, $p = 0.726$, $\varepsilon^2 = 0.0025$, stress condition $H(1) = 0.014$, $p = 0.904$, $\varepsilon^2 = 0.0172$, exposure condition $H(1) = 0.828$, $p = 0.363$, $\varepsilon^2 = 0.0172$, and after exposure $H(1) = 0.449$, $p = 0.503$, $\varepsilon^2 = 0.0093$ (Tables 1–3).

TABLE 4 *Post hoc* analysis of psychological responses using Wilcoxon signed rank test on paired sample.

	Group	Time		n	Statistic	p	p adj*
Heart rate	Virtual reality	1	2	25	0	0.000***	0.000***
		2	3	25	324	0.000***	0.000***
		2	4	25	324	0.000***	0.000***
		3	4	25	125	0.325	0.325
	2D video	1	2	27	0	0.000***	0.000***
		2	3	27	378	0.000***	0.000***
		2	4	27	378	0.000***	0.000***
		3	4	27	154	0.394	0.94
Skin conductance	Virtual reality	1	2	24	19.0	0.000***	0.001**
		2	3	24	89.0	0.084	0.168
		2	4	24	67.0	0.016*	0.048*
		3	4	24	98.0	0.141	0.168
	2D video	1	2	25	5.50	0.000***	0.000***
		2	3	25	109.00	0.156	0.381
		2	4	25	105.00	0.127	0.381
		3	4	25	124.00	0.312	0.381

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$. 1 = baseline, 2 = stress induction, 3 = exposure, 4 = after exposure.

Outcomes on skin conductance in each time measurement (Table 4 and Figure 5) revealed that there were significant increases from baseline to stress induction in the two groups ($p < 0.001$). When the simulated natural environments were performed, there were neither significant increments in virtual reality ($p = 0.168$) nor 2D video groups ($p = 0.381$). Interestingly, there was a significant increment in virtual reality ($p = 0.048$) but not in the 2D video group ($p = 0.381$) after the simulated natural environments had been given. Finally, there were no significant differences between exposure and after exposure in virtual reality ($p = 0.168$) or 2D video ($p = 0.381$).

4. Discussion

This research aims to determine the effects of simulated natural environments in virtual reality and 2D video and their differences in reducing stress. The first hypothesis is supported, as the results indicated that simulated natural environments in virtual reality and 2D video reduced emotional stress levels and self-consciousness toward body sensations. However, the result contradicts the second hypothesis about the difference between virtual reality and 2D video in reducing stress levels. No differences were obtained between virtual reality and 2D video in reducing stress and self-consciousness toward body sensations. Physiologically, both simulated natural environments in virtual reality and 2D video decreased heart rate levels that increased because of stress induction. Interestingly, skin conductance increased significantly more in the virtual reality group than in the 2D video group when the simulated natural environments were shown.

This research finding is consistent with other studies that have been conducted. Hong et al. (2019) found that, although the simulated forest in 2D video and virtual reality significantly reduced stress and heart rate, there was no difference between 2D video and virtual reality. Virtual reality aids relaxation and relieves stress, as evidenced by decreased heart rate and cortisol (Annerstedt et al., 2013). The nature of the film shown on a flat screen also increased the restorative effect of post-stress induction (De Kort and Ijsselsteijn, 2006). Nature, illustrated as a forest in the 2D video, could have a relaxing effect (Tsutsumi et al., 2017).

Possible reasons for the absence of differences can be categorized into environmental characteristics, display devices, and other factors. Environmental characteristics can be seen in the presence or absence of an avatar or virtual body and the level of interactivity in the virtual reality environment. The environmental display device included several aspects, i.e., luminance, brightness, and field of view (FoV). Other factors, such as the difference in stress levels between the virtual reality and 2D video groups, stress induction, and exposure time, could all contribute to the lack of differences.

First, there was no virtual body or avatar in the virtual reality environment used in this study. The virtual embodiment with a virtual body generates an illusion of body ownership that substitutes the user's body (Banakou et al., 2018). An avatar's embodiment in the virtual environment also produces a greater presence (Lugrin et al., 2015). Several studies found that a virtual body seen from the first-person perspective improved cognitive function (Osimo et al., 2015; Banakou et al., 2018) and directly affected physiological responses (Burin et al., 2020). The presence of a virtual body can also increase the effectiveness of psychotherapy applications (Gall et al., 2021). In the stress restoration context, a virtual body seen from the first-person perspective can reduce emotional and physiological stress levels (Burin et al., 2022).

Second, the interactivity of the virtual reality environment may also contribute to the absence of differences. Virtual reality is more interactive and promotes engagement in rehabilitation therapy (Choi and Paik, 2018). Participants in a virtual environment who did the activity showed a more significant overall gain in conceptual learning than those who did not (Roussou and Slater, 2020). Ferraz-Torres et al. (2022) found that interactive virtual reality produced more significant anxiety reduction and lower pain levels than passive ones in children who underwent venipuncture. The virtual reality environment in this study was used with a controller to move to other places. Still, the

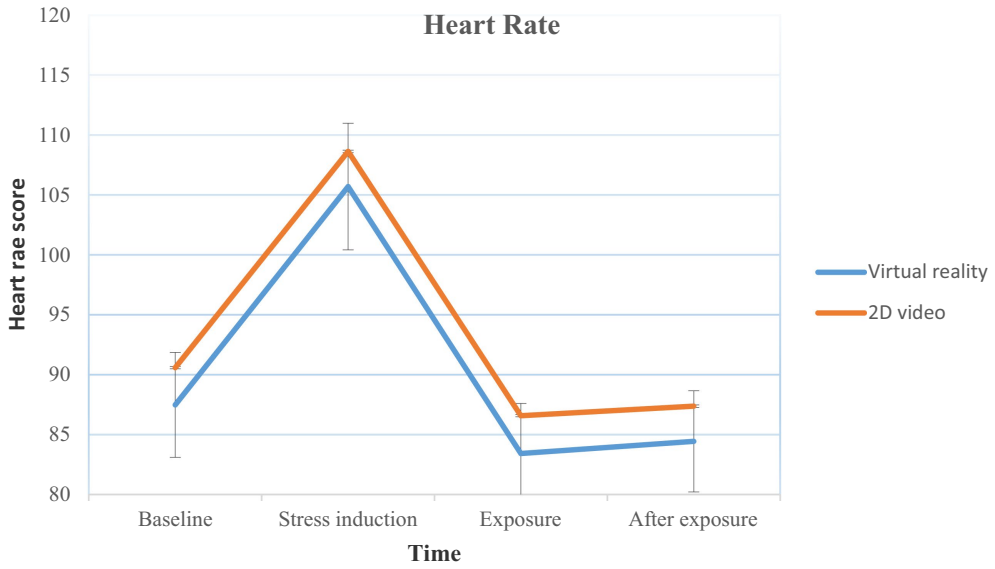

FIGURE 4
Changes in heart rate over time for the virtual reality and 2D video groups.

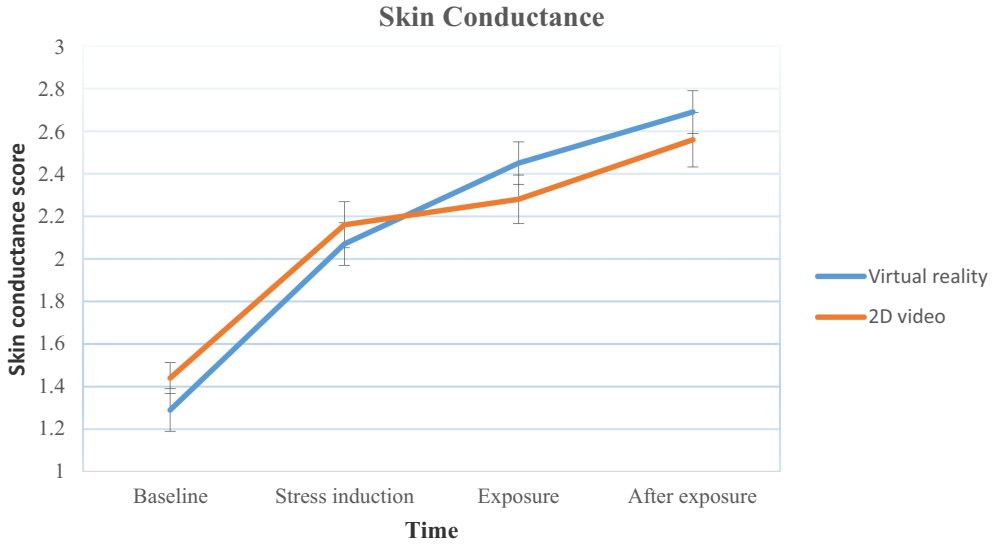

FIGURE 5
Changes in skin conductance over time for the virtual reality and 2D video groups.

participants could only click a specified button to move to other places, which is the application's default. It appeared as if the participants in the virtual reality group only explored the virtual environment by passively observing nature, similar to the 2D video group.

Third, luminance and brightness levels may produce different effects on stress reduction. Li et al. (2020) discovered that virtual reality's brightness affected different stress levels during an intervention. This study used the default brightness level in both environments for device displays. Unlike a flat screen, the HMD blocks light from the surrounding environment. It allows the virtual environment viewed with the HMD to appear brighter. When the HMD and LCD flat screens produced the same luminance, the HMD looked brighter than the LCD flat screens (Ha et al., 2021). Another study found that the 3D virtual reality scene with an HMD was perceived as brighter than the 2D scene with a luminance camera (Lin et al., 2020). Vasylevska et al. (2019) suggested that lower brightness, particularly when combined with low brightness compensating, can be employed well when using HMD. A study also found that an environment with medium brightness significantly reduced stress levels (Li et al., 2020). It implies that using HMDs to display virtual environments needs to be adjusted to achieve more optimal results. Because this study did not address the relationship between participants' perceptions of display brightness and stress levels, further research is needed.

Fourth, virtual reality and 2D video have a difference in FoV. The participant in the 2D video group watched the environment from one viewpoint displayed on a 22-inch flat-screen. The participant in the virtual reality group used the HTC Vive Pro HMD with a 110-degree field of view to watch the environment from a 360-degree point of view. A wide range of FoV generates a great sense of presence but contributes to higher cybersickness (Porcino et al., 2020). Conversely, reducing the FoV can reduce VR sickness (Fernandes and Feiner, 2016). A study showed that FoV restriction significantly reduced cybersickness (Teixeira and Palmisano, 2021). Cybersickness negatively impacts the user's well-being because of the discomfort it produces (Rebenitsch and Owen, 2016). Cybersickness accounted for 98% of the variance in anxiety on a virtual roller coaster, according to a study on the relationship between cybersickness and anxiety (Bruck and Watters, 2009). Although this study did not measure the discomfort or cybersickness level, using an HMD with a bigger field of view could affect the outcome.

Factors like the stress level between virtual reality and 2D video groups, stress induction, and exposure time can also contribute to the difference. First, despite no significant differences, the stress level of the virtual reality group was lower than the 2D video group. Van den Berg et al. (2003) stated that individuals with higher stress levels are more sensitive to restoration opportunities than individuals with lower stress levels. Second, the stress that comes from the *Sing-a-Song Stress Test* does not last long. Meanwhile, the time required for participants to complete the scale is long enough. When the participants fill out the scales, their stress levels may slowly return to their original state. As a result, exposure to a simulated environment may have no effect. However, it cannot be verified because there was no real-time measurement while the scale was filled in. Third, Suppakittpaisarn et al. (2023), who did the first study comparing virtual reality exposure duration in the restoration context, found that a 5 min dose of virtual nature produced more excellent stress recovery than 1 or 15 min. They explained that the intercorrelation between time and the outcome looked like a bell-shaped pattern, which was suggested by Shanahan et al. (2016). Brown et al. (2013) discovered a significant difference in the standard deviation of respiration rate (SDRR) between viewing a nature scene and a built scene during the first 5 min, but not the second. Compared with those studies, the exposure time in this study was relatively shorter. The shorter time may not produce the optimal recovery outcome.

In line with Brouwer and Hogervorst (2014), the *Sing-a-Song Stress Test* increased heart rate and skin conductance as an indicator of stress. Lin et al. (2011) stated that stress positively correlates with the sympathetic nervous system. The increased activity of the autonomic nervous system, which is part of the sympathetic nervous system, can increase an individual's heart rate, skin conductance, respiratory rate, and finger temperature when experiencing stress (Fink, 2016). Phelps

and LeDoux (2005) stated that heart rate is commonly used to indicate stress. A systematic review study revealed a direct association between stress exposure and physiological responses, including increased heart rate (Weber et al., 2021). It means the condition of a person experiencing stress can be seen from the increased heart rate (Lin et al., 2011; De Looff et al., 2018). Therefore, a significant reduction in heart rate indicates a significant reduction in physiological stress levels.

Environments that are simulated through virtual reality and 2D video can reduce skin conductance levels (Valtchanov et al., 2010). In this study, skin conductance increased after exposure was given. However, the increase in skin conductance may not be due to the increased stress levels of the participants. Lal and Narula (2019) state that emotions can be understood by looking at two dimensions: valence and arousal. Valence describes whether something is perceived positively or negatively. In contrast, arousal describes how our bodies respond to external stimuli. For example, the emotions of pleasure and anger have the same arousal but different valences. Likewise, joyful and calm emotions have the same valence but different arousals. It means someone who feels worried and excited can show different valences and the same arousal. Hong et al. (2019) stated that the increased sympathetic nervous system activity when viewing a virtual reality forest is a positive, sympathetic activity, such as novelty and curiosity, not a harmful sympathetic activity, such as stress and pressure. Browning et al. (2020) found that participants who showed continuously increasing skin conductance levels after virtual reality exposure reported higher levels of positive affect.

A significant increase in skin conductance is only found in the virtual reality group. Chirico et al. (2017) supported the significant increase in skin conductance. Virtual reality increases skin conductance more than 2D video on a flat screen. Because virtual reality offers a more immersive experience than 2D video, it represents a significant distinction. Virtual reality users can experience being in the virtual world through immersive experiences (Slater and Sanchez-Vives, 2016). Compared to 2D video, virtual reality is more effective in inducing emotional and physiological responses (Ding et al., 2018), is more capable of facilitating the presence effect, and increases pleasant and arousal experiences (Elsey et al., 2019). Therefore, skin conductance was significantly increased only in the virtual reality group. However, it is necessary to measure immersiveness in the two environments to determine the immersiveness level of the two environments.

5. Limitations

This study has several limitations. First, there was no control group, so the reduction in stress levels cannot be acknowledged if the treatment is not given. Second, the resignation of subjects in each treatment group causes the number of subjects to differ. Third, the stress induction method used in this study is a novel method for producing stress that does not last long. Fourth, the exposure time in this study was relatively short.

More research is needed to discover the virtual reality and 2D video differences in reducing subjective and physiological stress. Research examining the difference between the two in reducing stress is relatively limited. Further research can be conducted by considering several things based on this study, i.e., the presence of a control group, the selection of stress induction, real-time physiological measurement during the scale's completion, and the duration of giving environmental stimuli. Concerning the characteristics of the environment and device display, further research can add several components, such as virtual bodies or avatars, activities in the virtual environment, luminance or brightness level adjustment, and FoV restriction.

6. Conclusion

A natural simulated environment can be an alternative to give the restorative effect. This study showed that exposure to natural simulated environments in virtual reality and 2D video reduced emotional stress and self-consciousness toward body sensations. However, no difference was revealed between the two groups. Physiologically, both groups had a heart rate reduction, and skin conductance significantly increased only in the virtual reality group. Finally, no differences between virtual reality and 2D video were revealed regarding physiological responses in each time measurement.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by Ethics commission of Faculty of Psychology, Gadjah Mada University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

BS and TH contributed to conception and design of the study. BS organized the database, performed the statistical analysis, and wrote the first draft of the manuscript and sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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

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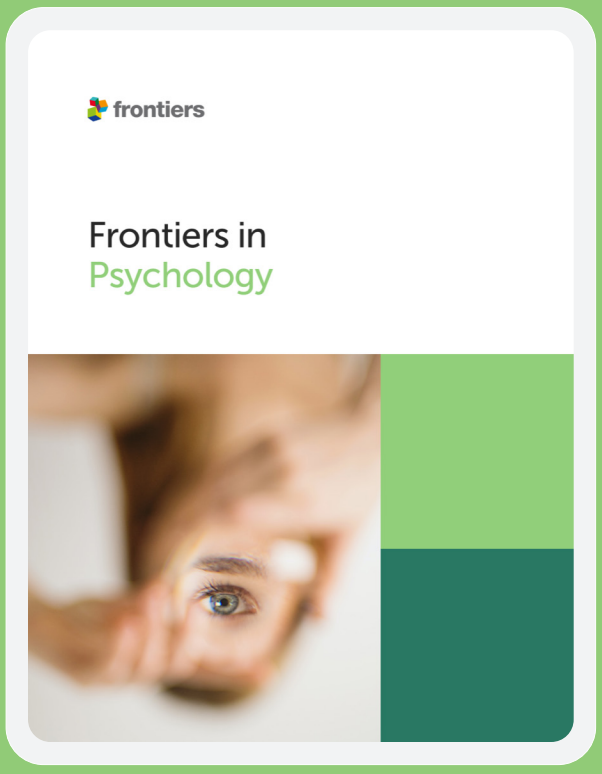

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