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RESEARCH

Unpacking engagement in EU climate policies: a socio-psychological approach

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Abstract
Climate adaptation is increasingly recognized as a global necessity. Top-down adaptation measures alone are unlikely to be effective unless complemented by bottom-up implementation and public compliance. To achieve this, individual engagement in the enactment of climate adaptation policies is essential. Motivating individuals requires a psychological understanding of the factors that drive support for policy operationalization. This study investigates these factors in European contexts by incorporating key concepts from the Extended Parallel Process Model, along with social norms and environmental awareness. The results of structural equation modeling reveal that perceived risk and efficacy significantly influence individuals' intentions to support climate adaptation policies. Additionally, social norms and environmental awareness significantly impact climate risk perception. Perceived risk emerged as the strongest determinant of engagement intention, while environmental awareness was the strongest predictor of perceived risk. From a policy perspective, efforts to increase individual engagement should consider these dimensions, particularly the crucial role of raising environmental awareness.

Keywords Climate change adaptation · Pro-environmental behavior · Environmental awareness · Social norms · Extended parallel process model · Policy engagement

1 Introduction

Climate change constitutes a profound global threat that immediately demands comprehensive and integrated policy interventions to curb its cascading impacts on ecosystems, economies, and human health (Adger et al. 2022). The urgency and imperative of climate

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adaptation have garnered significant international attention, prompting the development of context-specific frameworks aimed at enhancing resilience across diverse socio-ecological systems (Parmesan et al. 2022; Arjomandi et al. 2025a). This dimension remains a top policy priority within the European Union, where comprehensive and multi-level governance frameworks have been developed to mainstream climate adaptation across sectors and regions (Jordan et al. 2010; Soria et al. 2021; European Environment Agency, 2025).

Effective climate action depends on robust public policies that facilitate and promote adaptation throughout different domains (Puig et al. 2025). To this end, climate action is conceptualized as a multidimensional process that integrates institutional policy frameworks, governance mechanisms, and individual-level behavioral engagement, with particular emphasis on adaptation-oriented responses (Almeida et al. 2024; Sanz et al. 2025). Unlike mitigation, which typically entails long-term and system-level transformations, adaptation measures are often implemented at local and sectoral scales and require behavioral adjustments, acceptance, and sustained engagement from affected populations (Baack et al. 2024). Adaptation therefore constitutes the primary interface between climate policy and everyday decision-making, as it directly shapes how individuals and communities experience, respond to, and cope with climate risks (Hügel and Davies 2020). This development is conceived not merely as an infrastructural or institutional endeavor, but as a socio-behavioral process through which individuals actively engage in everyday practices that enhance resilience and reduce vulnerability (Mattera et al. 2025).

For climate adaptation policies to be successful and socially legitimate, governance structures must be aligned with bottom-up, community-driven visions and local knowledge systems (Crowley et al. 2017; Soria et al. 2021; Arjomandi Akram 2023). This alignment ensures that formulated strategies are contextually relevant, culturally appropriate, and capable of mobilizing grassroots engagement (Arjomandi et al. 2025b). Consequently, individual-level cognitive processes, perceptions, and behavioral responses play a pivotal role in shaping the effectiveness of climate adaptation policies. These psychological and social dimensions influence not only how individuals interpret climate risks but also their willingness to support, comply with, or resist policy interventions (van Valkengoed and Steg 2019; Orlove et al. 2020). Thus, it is essential to systematically explore individuals' perceptions, motivations, and adaptive behaviors, as these micro-level factors critically influence the broader societal capacity to respond to climate variability and long-term change (Whitmarsh 2009; Bechtoldt et al. 2021).

Scientific investigations into pro-environmental behavior within the context of climate adaptation have gained increasing prominence worldwide, as scholars and policymakers recognize the critical role of individual and collective actions in enhancing societal resilience to climate risks (Wamsler and Bristow 2022; Bullock et al. 2022). These studies examine how cognitive, social, and contextual factors shape adaptive behaviors—ranging from water conservation and energy use to sustainable land management and disaster preparedness (Arjomandi A. et al. 2023; Axon et al. 2023; Xianyu et al. 2024). In this context, although energy use is typically framed as a mitigation behavior, it is also conceptually relevant to climate adaptation, as energy conservation, efficiency, and demand reduction enhance system resilience, reduce exposure to energy insecurity during climate extremes, and strengthen households' adaptive capacity under climatic stress. Furthermore, such research highlights the importance of behavioral interventions, social norms, and environmental knowledge

in supporting effective climate adaptation across diverse geographic and cultural settings (Smith et al. 2021; Abousoliman et al. 2024; Maleknia et al. 2025).

In Europe, climate action research increasingly emphasizes behavioral change, reflecting the limitations of institutional measures alone (Hoffmann et al. 2022). Studies show that adaptive capacity is shaped by contextual and motivational factors across sectors and settings, including water conservation contexts (Rodriguez-Sanchez and Sarabia-Sanchez 2020), household resource use (Ambaum et al. 2024), crisis-driven behavioral shifts (Matiuk et al. 2023), and agricultural pro-environmental intentions (Giampietri and Trestini 2023), underscoring the role of residents' intentions and behaviors across diverse European contexts (Weckroth and Ala-Mantila 2022; Cantillo et al. 2025).

To address the determinants of pro-environmental behavior, researchers have employed a range of theoretical approaches and socio-psychological models. These frameworks have often been complemented by context-specific models tailored to environmental challenges. Within the European Union (EU), one particularly emphasized strategy for fostering public support for climate adaptation is strategic communication (Jensen et al. 2023). Communication is increasingly acknowledged as a critical lever for mobilizing individual and collective engagement in adaptation planning and policy implementation (Rayner 2023). Among the psychological models aligned with the goals of persuasive communication, the Extended Parallel Process Model (EPPM)–developed by Kim Witte (1992), has received particular attention. The EPPM emphasizes two central constructs: perceived threat and perceived efficacy, which together influence individuals' reactions to risk-oriented messages. These constructs are especially relevant for behavioral analyses in climate adaptation contexts, where the perceived risks of climate impacts and the perceived effectiveness of proposed solutions play pivotal roles.

The EPPM has been widely utilized in non-European contexts, including public health communication, disaster preparedness, and climate-related risk communication, in regions such as North America, East and Southeast Asia, and the Middle East and North Africa (e.g., Nguyen et al. 2020; Zobeidi et al. 2022; Armbruster et al. 2022; Ahn 2025; Xie and Chen 2025; Bousalah 2025). These applications demonstrate the model's versatility across cultural and institutional settings, providing a strong rationale for its use in the European climate adaptation context. However, despite this conceptual relevance, the application of EPPM in the EU context, particularly in research targeting behavior change and public engagement in support of climate adaptation policies, remains limited. Here, the "application" refers to the theoretical operationalization and empirical testing of the framework to analyze individual attitudes and behavioral intentions toward climate adaptation policies.

In addition to the core constructs of the EPPM, the roles of environmental awareness and social norms have also been frequently emphasized in the literature as influential drivers of climate adaptation behavior. Environmental awareness encompasses individuals' comprehension of climate-related risks, their familiarity with adaptation and mitigation strategies, and their recognition of the necessity for systemic solutions to address climate change effectively (Dabbous et al. 2023). In parallel, social norms—defined as perceived behavioral expectations within one's social group—have gained prominence as a predictor of pro-environmental behavior (Sherif 1936; Cialdini et al. 1990; Lo 2013). Normative beliefs can influence individual willingness to accept climate policies, particularly when policy compliance is visible and socially reinforced (Nilsson et al. 2004; Nolan 2021; Goerg et al. 2024).

Given these considerations, this study integrates principal constructs from the EPPM with contextual variables such as environmental awareness and social norms in a European setting to identify the factors shaping individuals' intentions to support climate adaptation policies. "Policy support" denotes individuals' acceptance of and endorsement for climate adaptation policies, including support for policy goals, approval of measures, and willingness to comply with or facilitate implementation (Kaiser et al. 2022). While extensive research has documented public support for climate policy, including socio-psychological approaches (e.g., Hammar and Jagers 2006; Heres et al. 2017; Bumann 2021; Bergquist et al. 2022; Betsch et al. 2025; Bretter and Schulz 2025), applications of the EPPM in this respect remain comparatively unexplored in European contexts. Accordingly, this research seeks to address this gap.

2 Theory, background and hypotheses

In the context of global climate governance, effective communication strategies are increasingly critical for building public engagement with climate policy (Nisbet 2009; Antwi-Agyei and Stringer 2021). Among the various theoretical frameworks developed to explain behavioral responses to risk messaging, the EPPM offers a practical tool for understanding how individuals process fear-based messages and decide whether to act on them (Sarrina Li and Huang, 2020).

The EPPM suggests that when people encounter risk messages, they assess two key factors: how threatening the risk appears (perceived risk) and how capable they feel in handling or avoiding the risk (perceived efficacy) (Barnett et al. 2014; Xue et al. 2016). Perceived threat refers to an individual's assessment of both the seriousness of a potential harm and the likelihood of experiencing it (Weinstein 1984; Taflinger and Sattler 2024). In contrast, perceived efficacy involves beliefs about how effectively one can respond to the threat, encompassing both confidence in the recommended action's effectiveness and in one's own ability to carry it out (Villamor et al. 2023; Van Valkengoed et al. 2024). The model asserts that when both threat and efficacy perceptions are high, individuals are motivated to engage in danger control, proactive behaviors aimed at reducing the threat. Conversely, when perceived threat is high but efficacy is low, fear control responses dominate, resulting in message avoidance, denial, or defensive reactions (Witte and Allen 2000).

Originally developed within the context of health communication, the EPPM has been increasingly applied to environmental risk communication, particularly in climate change contexts. This application is theoretically grounded in the growing recognition that climate change constitutes a profound risk to human health, involving threats to the environment, physiological integrity, livelihoods, and social systems—dimensions that align closely with the EPPM's emphasis on perceived threat and efficacy, as articulated within planetary health research and global assessments (Romanello et al. 2024, 2025). Empirical studies further illustrate this application. For example, Xue et al. (2016) demonstrated the model's utility in enhancing climate engagement among urban residents by integrating both threat and efficacy messaging. Similarly, Abbasi et al. (2020) applied the EPPM to promote sustainable behaviors such as solid waste separation, thereby highlighting its relevance in collective action contexts. More recently, Paek and Hove (2024) employed the framework to examine how exposure to media messages influences behavioral intentions regarding

environmental issues. Building on the model's theoretical foundations, Poortvliet et al. (2020) investigated the efficacy of climate change risk communication in stimulating public awareness and motivating behavioral change. Wang et al. (2024) further extended this application by exploring how objective and subjective knowledge, along with perceived government efficacy, influence hospitality consumers' acceptance of carbon offset initiatives. In a related study, Armbruster et al. (2022) utilized the EPPM to analyze the impact of different goal-framing strategies (i.e., gain, non-loss, and loss frames) on public support for climate change policies. Wenzel et al. (2023) incorporated the model to better understand drivers of biodiversity conservation behaviors. Additionally, Fleming et al. (2021) applied the EPPM to investigate the role of causal beliefs in shaping public support for climate change mitigation policies. Collectively, this literature suggests that framing climate change as a tangible threat to human environments, health, and livelihoods—while emphasizing the feasibility and effectiveness of individual and institutional responses—is key to mobilizing adaptive actions (DeBruin 2023; Kim and Chae 2025). These findings affirm the EPPM's utility as a theoretically coherent framework for climate risk communication.

Importantly, the EPPM framework aligns with emerging perspectives on the psychological underpinnings of climate policy support. Goldberg et al. (2020) argue that public acceptance of climate policies is contingent not only on information provision but also on community's perceived ability to act meaningfully. When individuals feel powerless or overwhelmed by the scale of the problem they may disengage, despite recognizing the threat (Spence and Walters 2012). The EPPM addresses this dynamic by highlighting the dual necessity of communicating both risk severity and actionable solutions.

Research indicates that higher environmental awareness often correlates with heightened risk perception regarding climate change. For instance, Diakakis et al. (2021) found that individuals with greater environmental sensitivity exhibited increased perceptions of climate change risks, particularly after experiencing extreme weather events. Additionally, Lorenzoni et al. (2007), argue that awareness facilitates both the cognitive and affective dimensions of public engagement. Moreover, EU environmental education initiatives have demonstrated that increasing public literacy on ecological matters can serve as a policy instrument in itself, raising long-term awareness and indirectly shaping the policy landscape (Sarti and St. John, 2019).

However, some research also reveals a paradox: high levels of awareness and concern do not always translate into policy support. Peñasco and Grossman (2025) demonstrate that in wealthier countries, environmental fatigue and perceptions of economic cost may dampen willingness to endorse further climate measures, even among populations with strong environmental consciousness. This suggests that environmental awareness must interact with other psychosocial factors to mobilize public support.

Environmental awareness—defined as individuals' knowledge of environmental issues, understanding of climate risks, and familiarity with adaptive and mitigative options—directly enhances risk perception by contextualizing abstract climate threats into personally relevant concerns (van der Linden 2015; Lee et al. 2015). While distinct from the salient EPPM construct of perceived threat, environmental awareness serves as a foundational cognitive resource that conditions how climate risks are recognized, interpreted, and evaluated for relevance. Rather than duplicating risk appraisal, it enables its activation by shaping whether climate threats come to be seen as credible, personally meaningful, and worthy of concern (Bostrom et al. 1994; Leiserowitz 2006; Lee et al. 2015; van der Linden 2015).

Studies have shown that individuals with higher environmental awareness are more likely to recognize climate change as a severe and immediate threat, thereby triggering the risk appraisal process central to EPPM (Wachinger et al. 2013; Wang et al. 2024; Hussain et al. 2025). As such, incorporating environmental awareness as a distinct construct thus extends the EPPM by accounting for upstream cognitive differences that determine when and how risk appraisal occurs, thereby adding theoretical depth rather than redundancy to the model. This enriches our understanding of how knowledge and perception coalesce to foster meaningful public engagement in climate policy.

In recent years, scholars have also begun to integrate social norms into EPPM-based approaches, recognizing their critical role in shaping efficacy perceptions and behavioral intention. Geiger et al. (2017) found that climate communication strategies incorporating normative cues (e.g., what others are doing) alongside threat and efficacy information can significantly increase public engagement. Similarly, Goldstein et al. (2008) demonstrated that normative appeals outperform purely informational campaigns, reinforcing the importance of collective behavior signals in driving individual compliance.

This intersection between persuasive knowledge, social norms, and policy support is particularly relevant for climate change, where the effectiveness of adaptation efforts often hinges on coordinated action. Constantino et al. (2022) emphasize that shifting social norms can accelerate climate action by amplifying public demand and reinforcing policy support, especially when political pathways are slow or blocked. Social norms shape both individual behavior and collective expectations, offering a complementary force to formal regulation. Goerg et al. (2024) further demonstrate that public support for climate policies often depends on how social norms are communicated. Their findings show that misperceptions of national support are common and correcting them can boost policy backing, particularly in regions with initially low engagement.

Norms not only guide what individuals believe is acceptable behavior but also inform how they interpret environmental threats. For example, Lo (2013) demonstrates that the voluntary uptake of flood insurance is significantly influenced by perceived risk, which itself is socially constructed through normative expectations within a community. Similarly, Yu et al. (2019) emphasize that social norms serve as a pivotal mediator between climate risk perception and pro-environmental behavior. Their findings suggest that strengthening normative influence can enhance individuals' intentions to adopt financial risk mitigation strategies, such as purchasing climate insurance. While norms reflect the social environment, awareness reflects a subjective cognitive and affective response. These two mechanisms, when combined, can produce a powerful motivational synergy (Alam et al. 2025).

Given these insights, combining the internalized cognitive processes emphasized in the EPPM with the external social validation offered by normative cues can yield an integrated framework that more accurately captures the multifaceted nature of public engagement in climate governance. Incorporating social norms into the EPPM thus can enable a more comprehensive framework for analyzing public intention to support climate policy, especially where success depends on shared action and perceived collective efficacy.

Hence, building on the conceptual foundation of the EPPM to examine the psychological determinants of European citizens' support for climate policies, this research integrates two additional, contextually pertinent constructs into its theoretical framework: environmental awareness and social norms. By incorporating these dimensions, the study proposes an elaborated analytical framework (Fig. 1) to more comprehensively assess individuals' inten-

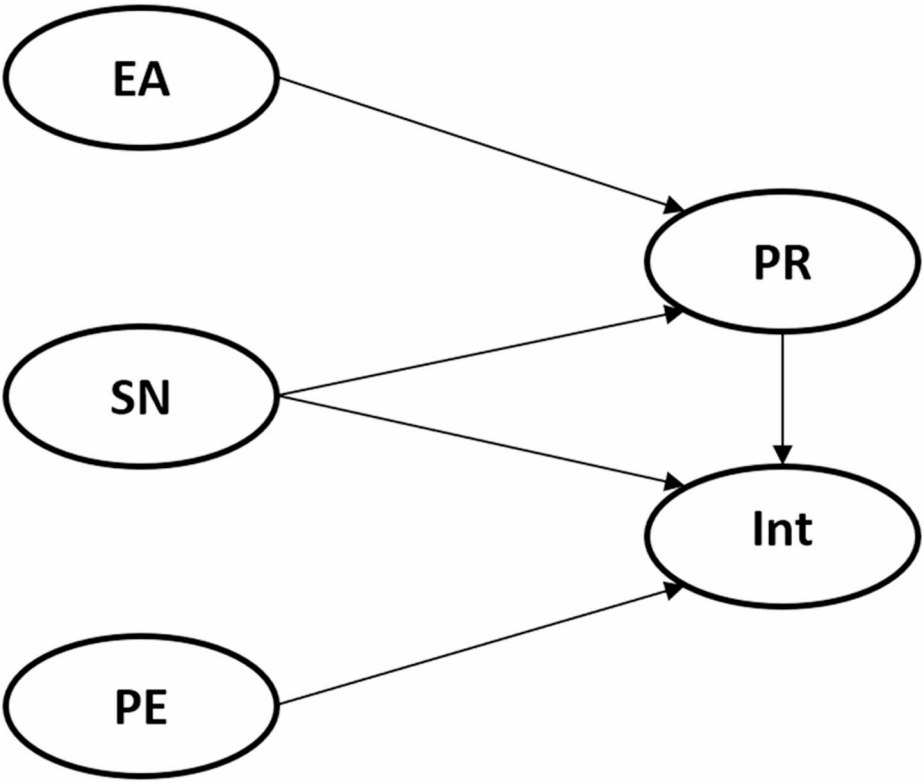

Fig. 1 Theoretical model of the analytical framework. Abbreviations: PE, perceived efficacy; PR, perceived risk; SN, social norms; EA, environmental awareness; Int, intention

tions to support climate adaptation policies. This integrative approach not only aligns with recent empirical insights but also acknowledges the socio-cognitive complexity underlying public engagement with climate action. The framework provides the basis for formulating and testing the following hypotheses (Hs):

H1: Perceived risks posed by climate change effects have a significant positive effect on the intention to support adaptation policies.
H2: Perceived efficacy in addressing climate change risks has a significant positive effect on the intention to support adaptation policies.
H3: Environmental awareness can significantly and positively affect perceptions of climate change risks.
H4: Social norms can significantly and positively affect the intention to support climate change adaptation policies.
H5: There is a positive relationship between social norms and the intention to support climate change adaptation policies, mediated by risk perception.

3 Methodology

3.1 Participant sample

In line with the study's focus, the empirical analysis targeted European Union citizens, specifically from Italy, Spain, Germany, and Sweden. The study sample comprised participants aged between 25 and 55 years, capturing a broad adult population relevant to engagement in climate adaptation policy. Educational attainment within the sample ranged from completion of a high school diploma to postgraduate qualifications, reflecting considerable diversity in educational backgrounds. Gender representation included both male and female participants in relatively comparable proportions, ensuring balanced gender coverage in the analysis.

3.2 Survey instrument

To ensure the accurate measurement of key psychological and socioeconomic parameters relevant to climate policy support, a structured questionnaire was developed as the primary data collection instrument. The survey design was informed by a multi-step process that integrated contextual understanding, an extensive review of relevant literature, and consultations with scientific experts and stakeholders affiliated with the project. This collaborative and interdisciplinary approach ensured that the instrument reflected both theoretical rigor and practical relevance within the European climate policy landscape.

The development of the questionnaire was guided by key concepts of the EPPM, particularly as applied to environmental and climate-related domains. Primary latent variables were identified through a thorough review of relevant research, with particular attention to empirical applications of the EPPM in the context of climate change and policy engagement (e.g., Poortvliet et al. 2020; Sarrina Li and Huang, 2020). In addition, other potential variables were selected based on contextual relevance and the functional scope of the framework. The full set of constructs measured in the survey includes: Perceived Risk, Perceived Efficacy, Perceived Social Norms, Environmental Awareness, and Intention to Support Climate Policy (i.e., pro-environmental behavioral intention).

Each construct was measured using multiple items formulated as manifest variables, with the aim of capturing the underlying psychological dimensions of the respondents. All measurement items were adapted from validated instruments in previous studies to ensure both content validity and comparability across research contexts (e.g., Abbasi et al. 2020; Tsoy et al. 2022; Ma et al. 2023; Wang et al. 2024). The selection of these scales was specifically guided by their established use in studies examining risk perception, efficacy beliefs, normative influences, and pro-environmental decision-making, which are conceptually aligned with the EPPM and the objectives of the present study. Potential construct overlap was addressed through subsequent validation procedures, ensuring adequate discriminant validity and the distinct contribution of each construct to the explanatory model.

To help limit potential skewness in response distributions, a five-point Likert scale was employed for all survey items, ranging from 1 ("Strongly disagree") to 5 ("Strongly agree"), allowing for subtle responses and supporting the reliability of subsequent statistical analyses. The questionnaire also incorporated introductory and demographic sections to contex-

tualize responses and capture participant characteristics, including age, gender, country of residence, and education level.

Support for climate adaptation policies was operationalized through behavioral intention rather than observed behavior, as direct engagement in adaptation policy processes is often contingent on institutional arrangements and not uniformly available to all respondents. Behavioral intention is therefore widely used as a valid and feasible proxy for policy support in climate adaptation and governance research (Bamberg et al. 2015; Drews and van den Bergh, 2015; Mitter et al. 2019; Choi and Hart 2021; Van Valkengoed et al. 2022; Ma et al. 2023). Furthermore, from a theoretical perspective, behavioral intention is a well-established proximal predictor of actual behavior within foundational models of planned action and risk communication, including EPPM–based frameworks (Ajzen 2020; Witte and Allen 2000).

3.3 Research design and empirical strategy

This study adopts an applied research design aimed at investigating public perceptions and support for climate adaptation policies across Europe. Employing a quantitative, cross-sectional approach, data were predominantly collected from Western European countries through an online survey administered during the summer of 2023. The survey instrument (Sect. 3.2), developed in English, was distributed via digital platforms to ensure broad accessibility and geographic reach.

The overarching objective of the study was to explore ways of engaging citizens in the co-design and co-creation of innovative, problem-oriented climate adaptation solutions, reflecting a participatory model consistent with contemporary EU policy frameworks. In this context, co-design and co-creation are conceptualized as inclusive mechanisms through which citizens contribute their perceptions, priorities, and experiential knowledge, ultimately informing the shaping of climate adaptation strategies. Rather than focusing on direct collaborative workshops or deliberative design sessions, this study operationalizes co-design and co-creation at the perceptual and motivational level by examining the psychological and social determinants of individuals' evaluative orientations toward climate adaptation policies and participation in related processes. Understanding these drivers is a necessary precursor for effective participatory policy design and implementation.

While the study does not incorporate experimental control variables, it captures citizens' perceptions, beliefs, and intentions as they exist within their everyday socio-political and environmental contexts at the time of data collection. In this sense, the findings reflect real-world conditions by drawing on respondents' lived experiences, subjective risk appraisals, and perceived efficacy in relation to climate adaptation, rather than reactions to hypothetical or artificially constructed scenarios. This methodological choice enhances contextual authenticity and aligns with the study's practical orientation toward informing policy implementation through grounded citizen engagement.

3.4 Analysis technique

To investigate the complex interplay between cognitive, affective, and normative factors influencing public support for climate adaptation policies, this study employs Structural Equation Modeling (SEM). SEM offers a robust analytical framework for evaluating the-

oretical models that involve latent constructs—such as perceived threat, efficacy beliefs, social norms, and behavioral intentions—commonly used in environmental psychology and climate policy research. SEM emerged from early 20th-century advances in factor analysis, path analysis, and multivariate statistics (Pearson 1901; Wright 1921; Spearman 1961; Fisher 1970), and was formalized in the 1960s–70s through the integration of confirmatory factor analysis (CFA) with structural modeling (Jöreskog 1970; Tarka 2018).

SEM is particularly well-suited to climate change communication due to its ability to capture latent psychological constructs that underlie policy acceptance (MacCallum and Austin 2000; Kline 2023). Unlike traditional regression, SEM simultaneously estimates multiple relationships while accounting for measurement error, thereby improving the validity of inferences (Bagozzi and Fornell 1982; Hair et al., 2021).

The SEM process consists of two components: the measurement model, assessed via CFA to validate the relationship between indicators and latent constructs (Bagozzi and Edwards 1998; Harrington 2009), and the structural model, which tests hypothesized causal pathways. Ensuring indicators load cleanly onto single constructs without cross-loadings is essential for construct validity (Lambert and Newman 2023).

Once validated, the structural model enables analysis of direct, indirect, and mediating effects—particularly useful in capturing the multi-layered drivers of environmental behavior (Menidjel and Bilgihan 2023). Model fit is evaluated using indices such as the Comparative Fit Index (CFI), Normed Fit Index (NFI), and Root Mean Square Error of Approximation (RMSEA), following recommended thresholds (Hu and Bentler 1999; Steiger 2007).

4 Results

To evaluate the developed questionnaire (Table 1) and implement necessary improvements to ensure its appropriateness for the main survey, a pilot survey was conducted with 30 European citizens. The pilot assessment tested the internal reliability of the questionnaire using Cronbach's alpha (Cronbach 1951) in JASP (Version 0.16; Love et al. 2019). This reliability measure is widely used and well established in behavioral and environmental policy research for assessing the internal consistency of theoretically grounded constructs measured with validated multi-item scales (Kellstedt et al. 2008; Peterson and Kim 2013; Steg et al. 2014; Bamberg et al. 2015; Chen 2020; Pakmehr et al. 2020; Savari and Zhoolideh 2021; Larionow et al. 2022; Ucar et al. 2023). Results indicated reliability scores ranging from acceptable to excellent, with values (α) spanning from 0.71 to 0.90 (Table 1). These findings confirmed the questionnaire's clarity, relevance, and credibility, supporting its suitability for the full survey.

The primary survey was administered to a sample of 161 EU citizens who participated in the study by completing the online questionnaire, distinct from those who participated in the pilot test interviews. The statistical sample included individuals ranging in age from 25 to 55, with a mean age of 37.77 years (SD = 8.49). Educational attainment among participants ranged from 16% holding a high school diploma, 17% holding a bachelor's degree, to 67% having earned postgraduate qualifications. Gender distribution was relatively balanced: 53.4% identified as male ($n = 86$) and 46.6% as female ($n = 75$). Due to data protection requirements under the General Data Protection Regulation (GDPR) and the conditions of participant consent, the raw survey data are not publicly archived but may be made avail-

Table 1 The psychometric properties (reliability and validity) of the latent constructs included in the developed model

	Statements	α	Mean	SD	AVE	CR
	Perceived Effectiveness	0.90	3.07	0.85	0.652	0.881
1	How confident are you that your community can work together to adapt to climate change?					
2	I am confident that our community can create adequate resources to develop adaptation policies.					
3	Our community can present itself in ways that solve the climate change problem.					
4	We (my neighbors and I) can work together to adapt to climate change.					
	Environmental Awareness	0.89	3.38	0.49	0.814	0.897
1	The balance of nature is strong enough to cope with the impacts of modern industrial nations. (reverse coded)					
2	The so-called ‘‘ecological crisis’’ facing humankind has been greatly exaggerated. (reverse coded)					
	Social Norm	0.82	3.15	0.95	0.732	0.845
1	A growing number of people in my reference group such as my family and colleague’s try to support climate change polices					
2	A growing number of people that are important to me try to support adaptation and mitigation policies.					
	Perceived Risk	0.78	4.07	0.49	0.608	0.752
1	How much do you think climate change will harm your local community?					
2	How much do you think climate change will harm the European commission as a whole?					
	Intention	0.71	3.66	0.56	0.616	0.753
1	I would like to engage in climate policies.					
2	I would try to participate in climate policies.					

Perceived effectiveness refers to beliefs about whether climate adaptation actions or policies are capable of producing meaningful outcomes, whereas collective efficacy reflects beliefs about a group’s capacity to act together successfully. Although related, these constructs capture distinct cognitive mechanisms. Given that the present study aims to examine how citizens perceive, accept, and support climate adaptation policies—rather than how they coordinate collective action—the analytical focus is appropriately placed on perceived effectiveness rather than collective efficacy (Bosone et al. 2024). Environmental awareness was operationalized as recognition of ecological limits and the seriousness of environmental problems, captured through reverse-coded items assessing rejection of minimization or denial narratives, and conceptually distinguished from perceived risk, which reflects subjective threat appraisal. The phrasing “a growing number of people” was intentionally used to capture dynamic descriptive social norms, reflecting perceived increases in support within respondents’ reference groups over time rather than static prevalence of support (Sparkman and Walton 2017). The dependent variable captures individuals’ intention to engage in climate policy processes, operationalized as self-reported willingness to act in the volitional phase, reflecting the translation of favorable perceptions into intentions to participate in and support climate policies

able upon reasonable request. Nevertheless, all measurement items and aggregated results are reported in full in this article to ensure transparency.

After conducting preliminary statistical analyses, including descriptive statistics on the demographic and socioeconomic characteristics of the participants and assessing the internal reliability of constructs using Cronbach’s Alpha, Pearson’s correlation test was employed to explore the correlations among the constructs. This analytical approach was used to examine bivariate associations among the study variables. The results presented in Table 2 reveal that all contributing variables were significantly correlated with the intention to support climate adaptation policies. Notably, perceived risk and social norms did not exhibit a significant correlation with one another, despite both showing strong associations with other variables in the model. Furthermore, while environmental awareness was not

Table 2 Pearson's Correlations

Variable	PR	PE	SN	EA	Int
1. PR	**0.780**				
2. PE	0.168*	**0.807**			
3. SN	0.117	0.283***	**0.856**		
4. EA	0.357***	−0.038	−0.460***	**0.902**	
5. Int	0.470***	0.442***	0.321***	0.250**	**0.785**

* $p < .05$, ** $p < .01$, *** $p < .001$

The **bolded** values denote the square root of the average variance extracted (AVE) of each latent variable (PE – perceived efficacy, PR – perceived risk, SN – social norms, EA – environmental awareness, Int – intention)

Table 3 Approximate Fit Indices (Confirmatory Factor Analysis)

Indexes	RMSEA	Cmin/df	CFI	NFI	IFI	GFI
Recommended value	≤0.08	≤3	0.9≤	0.9≤	0.9≤	0.9≤
The predictive model	0.077	1.94	0.965	0.931	0.965	0.968

significantly correlated with perceived effectiveness, it demonstrated a significant negative correlation with social norms.

To ensure the soundness of the measurement model, a Confirmatory Factor Analysis (CFA) was conducted. This statistical approach tests how well observed variables represent underlying latent constructs, allowing researchers to evaluate whether the data fit a hypothesized factor structure. The analysis confirmed that each set of indicators aligned with a single latent dimension, satisfying the requirement of unidimensionality, an essential condition for construct validity.

Construct validity was assessed through two lenses: convergent and discriminant validity. Convergent validity—measuring the extent to which related items converge on the same construct—was verified using Average Variance Extracted (AVE) and Composite Reliability (CR). All constructs met the thresholds of AVE > 0.5 and CR > 0.7 (Hair 2009), as shown in Table 1. Discriminant validity, which ensures constructs are distinct from one another, was evaluated using the Fornell–Larcker criterion (Fornell and Larcker 1981). Consistent with advised ranges (Hair et al. 2019), the model performed well, with each construct's AVE square root exceeding its correlations with other constructs (Table 2).

Model fit was examined using a suite of widely accepted indices, including χ^2/df, CFI, NFI, GFI, and RMSEA. The results adhered to established benchmarks—$\chi^2/df < 3$, CFI/NFI/GFI ≥ 0.90, and RMSEA ≤ 0.08—demonstrating that the overall model fit the empirical data well (Hu and Bentler 1999; Table 3). Collectively, these findings support the reliability, validity, and structural integrity of the proposed measurement model.

After confirming the validity of the measurement model, the analysis advanced to exploring how the independent variables affected the dependent factors (i.e. intention and perceived risk). To test the proposed hypotheses, SEM (Sect. 3.3 and Fig. 2) was employed as the primary analytical technique. This was conducted using JASP software (version 0.16).

The SEM results (Table 4; Fig. 2) indicated that social norms exerted a significant direct effect on perceived risk ($\beta = 0.654$, $p < .001$), as did environmental awareness, which also significantly influenced perceived risk ($\beta = 0.725$, $p < .001$). Together, these two predictors accounted for 62% of the variance in perceived risk. Additionally, perceived effectiveness

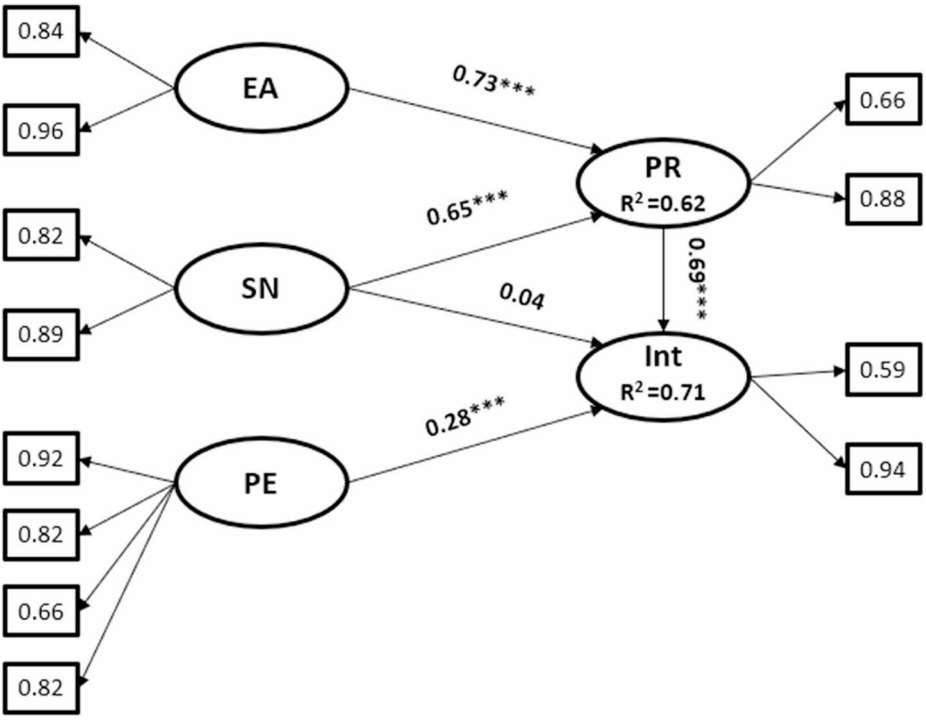

Fig. 2 SEM Results of the Analysis Model. Abbreviations: PE, perceived efficacy; PR, perceived risk; SN, social norms; EA, environmental awareness; Int, intention. The values in the rectangles (e.g., 0.84 and 0.96) represent the factor loadings of the observed indicators on latent constructs (e.g., EA), indicating strong associations between the indicators and their respective constructs

Table 4 The effects of the estimators on the dependent variables

Predictor	Outcome	*P*-Value	β
SN	PR	< 0.001	0.654
SN	Int	0.633	0.038
PE	Int	< 0.001	0.284
PR	Int	< 0.001	0.686
EA	PR	< 0.001	0.725

demonstrated a significant positive effect on intention (β = 0.284, $p < .001$), and perceived risk likewise had a strong, significant influence on intention (β = 0.686, $p < .001$). Although social norms did not directly predict intention, its influence was mediated through perceived risk, thereby indirectly shaping individuals' motivation to support climate adaptation policies. Overall, the model accounted for 71% of the variance in intention, highlighting the substantial explanatory power of the included predictors.

5 Discussion

Consistent with the formulated hypotheses, perceived risk, perceived efficacy, environmental awareness, and social norms demonstrated eventual strong relationship with climate adaptation policy support intention. Indeed, the results of the SEM analysis demonstrated that, in line with the hypotheses, perceived risk and perceived efficacy have significant positive direct effects on intention. Nevertheless, the relationship between perceived risk and intention was stronger than intention's relationship with perceived efficacy. Research has shown that pro-environmental behaviors differ significantly across regiones, with risk perception emerging as a key driver of individuals' behavioral intentions (Kikko and Ishigaki 2025). Furthermore, scholars have emphasized the link between exposure to climate change information and both the cognitive and emotional dimensions of climate risk perception (e.g.Saari et al. 2021; Arjomandi et al. 2025c). Given the context of this study within EU territories, the participants' considerable exposure to climate change information, and the predominance of highly educated respondents, the significance of perceived risk in shaping behavioral intention is clearly and reliably demonstrated. While response efficacy (RE) has been identified by researchers as a key determinant of pro-environmental behavior in the context of climate change adaptation (e.g., Arjomandi A. et al. 2023; Puig et al. 2025), the perceived effectiveness of adaptation efforts remains constrained, partly due to the prevailing emphasis on economic metrics and market-based mechanisms in adaptation practices (Lau et al. 2021). The influence of perceived efficacy is particularly pronounced when examined in conjunction with risk perception, as their interaction has been shown to significantly shape individuals' motivation to engage in climate adaptation actions. This combined effect reflects a dual-process mechanism, wherein risk perception generates concern or threat awareness, while perceived efficacy enables individuals to believe that effective and feasible responses are available and within their capability (Van Valkengoed et al., 2024). These initiatives strongly support the significance and contributory roles of perceived risk and perceived effectiveness within this model, highlighting their crucial role in fostering support for climate adaptation policies.

Additionally, social norms and environmental awareness strongly and directly affect perceived risk. Smith et al. (2021) reflected on the influence of social norms on risk perception, triggering collective actions for climate adaptation and eventually driving policy support. Similarly, the study by Saari et al. (2021) projected that environmental knowledge significantly influences risk perception.

Within the framework of the EPPM applied in this study, the central factors, alongside environmental awareness and social norms, collectively account for a substantial portion of the variance in individuals' intentions to engage with climate adaptation policies. In alignment with prior theoretical frameworks such as the research conducted by Lo (2013), our study similarly reveals that social norms do not exert a direct influence on individuals' intentions to support climate adaptation policies. Instead, we find that social norms significantly and positively influence risk perception, which in turn has a strong and direct effect on adaptive intention.

This mediating role of risk perception mirrors patterns described by Renn (2011) and others (e.g., Pidgeon et al. 2003; Grothmann and Patt 2005), who argue that social interactions and influences shape behavioral outcomes primarily by altering how individuals perceive risk. Notably, Grothmann and Patt (2005) emphasized that social discourse, including

social norms, has no direct linkage to adaptive intention, but rather functions through the intermediary of perceived risk. Synthesizing empirical and experimental evidence, Drews and van den Bergh (2015) similarly highlight that social norms shape public support for climate policies mainly by influencing perceptions of problem severity, social acceptability, and urgency, rather than exerting a direct effect on policy support. Together, these insights underscore the critical importance of incorporating perceived risk as a central explanatory mechanism in understanding public support for climate adaptation policies, and highlight the methodological consistency and relevance of this pathway within the present research context.

In this study, environmental awareness emerged as the strongest predictor of risk perception, underscoring its foundational role in shaping how individuals interpret and respond to climate-related information. This finding is consistent with prior research demonstrating that awareness operates upstream of formal risk appraisal processes by determining whether climate threats are recognized as salient and meaningful. For example, Pong and Fong (2024) demonstrated that environmental awareness is not only the most influential factor shaping operational risk perception but also plays a central role in influencing accountants' strategic risk perceptions related to Environmental, Social, and Governance (ESG) initiatives. Their results reinforce the argument that awareness structures how risks are cognitively framed before evaluative judgments are formed. Similarly, Ergun et al. (2024), in their EU-context study, found that individuals with higher levels of education exhibited greater climate change risk perception, offering valuable insights for EU policymakers seeking to enhance climate policy effectiveness and foster public engagement. This relationship highlights the close linkage between educational attainment, environmental awareness, and heightened sensitivity to climate risks. In addition, Yilmaz et al. (2023) emphasized that awareness about climate change strongly influences students' risk perception, reinforcing the broader proposition that knowledge-based engagement precedes and amplifies threat appraisal.

Taken together, these findings reinforce the conceptual rationale for treating environmental awareness as a distinct determinant within the model, rather than as an implicit component of risk appraisal. This framing underpins environmental awareness as a theoretically grounded antecedent that conditions the activation and intensity of EPPM processes, supporting the study's analytical approach.

Perceived risk emerged in this research as the most influential predictor of the intention to support climate adaptation policies. This finding aligns with prior research emphasizing risk perception as a critical determinant of adaptation policy support, particularly at the subnational level (Houser et al. 2022). Van Valkengoed et al. (2024) further demonstrated that heightened perceptions of climate change are positively associated with elevated climate-related risk perceptions, which subsequently strengthen intentions to implement adaptive actions at the national level. Similarly, Mase et al. (2017) underscored the pivotal role of risk perception in shaping adaptive attitudes, highlighting the importance of promoting strategies that are both economically viable and environmentally sustainable at the regional level. Consistent with these insights, the present study emphasizes the significance of risk perception as a key driver of public engagement in climate adaptation policy support across European regions.

Overall, the findings of this study align well with recent research indicating that both policy acceptance and public engagement are shaped by psychological factors such as perceived risk, social norms, perceived effectiveness of policy measures, and knowledge

(Betsch et al. 2025). The predictive strength of the proposed model lend strong support to the deliberate application of the EPPM, including the incorporation of social norms and environmental awareness variables, within the scope of this study.

6 Conclusion and policy remarks

This study contributes to the growing body of research on public engagement with climate adaptation policies by highlighting a critical gap: the underutilization of the EPPM within European policy research. While climate change is a central concern across EU policymaking, citizen participation and support for adaptation measures remain uneven and insufficiently understood.

By incorporating the EPPM into the analysis of pro-environmental behavioral intentions, this study demonstrates the model's relevance and utility in capturing the dynamic interplay between perceived threat, efficacy beliefs, and policy support. The findings underscore the importance of addressing both cognitive and perceptual dimensions of risk communication when designing interventions aimed at fostering climate-resilient behaviors.

The successful application of the EPPM offers a valuable framework for future research and policy design, particularly in enhancing persuasive communication strategies that resonate across diverse populations. It provides evidence that integrating theoretically grounded models into climate adaptation discourse can enhance the understanding of effectiveness of citizen engagement efforts within the European Union.

Perceived risk emerged as the most influential factor shaping individuals' intentions to engage with climate policy in this study. This finding underscores the critical role of the risk perception dimension as a central pillar in the design of behavioral change and public engagement programs. For such programs to be effective, however, they must be supported by broad-based efforts to elevate environmental awareness across all segments of society.

Raising awareness of the environmental consequences of climate change contributes not only to individual-level understanding but also fosters the emergence of collective social norms and heightened community consciousness. This process becomes particularly potent when supported by well-coordinated communication mechanisms capable of reaching across spatial and national boundaries—an essential consideration in the European context, where cross-border mobility and information exchange are highly facilitated.

Given the ease of travel and communication within the EU, there exists a unique opportunity to seed and cultivate transnational environmental norms. Diverse regional experiences with climate extremes—for example, drought-prone areas such as Spain and flood-prone regions like Germany—can serve as experiential anchors for shared learning. As citizens across these varied contexts engage with one another, either physically or digitally, a broader and more cohesive awareness of climate risks and adaptive needs may emerge.

Furthermore, this process can enhance public understanding of and trust in the effectiveness of policies and solutions disseminated by governmental authorities, academic institutions, research centers, EU-level organizations, and so on. Ultimately, fostering such an integrated, multilevel approach to awareness-building and norm development can strengthen the societal foundations for climate adaptation across the European Union.

7 limitations

While this study aims to contribute meaningfully to the existing body of literature by offering empirical insights through the application of the EPPM within European societies, some limitations must be acknowledged. First, although the sample size employed in the survey was adequate for the purposes of preliminary analysis, a larger and more diverse respondent pool would enhance the generalizability and statistical robustness of the findings. Future research would benefit from expanded sampling beyond the study contexts examined in this analysis (see Sect. 3.1), including a broader range of geographical regions and demographic groups to better capture cross-cultural variability in perceptions and behavioral intentions related to climate adaptation. Second, while this study incorporated additional constructs–such as social norms and environmental awareness–to enrich the explanatory power of the EPPM framework, other potentially influential variables remain unexamined. Prior research has highlighted the importance of factors such as trust in public institutions, perceived policy fairness, expected costs and benefits of climate measures, place attachment, and social capital in shaping public support for climate policies (e.g., Jones and Clark 2014; Drews and van den Bergh, 2015; Betsch et al. 2025; Hubner and Dirksmeier 2026). These factors capture broader institutional, relational, and socio-structural dimensions of climate action that extend beyond individual risk and efficacy appraisals. Integrating such variables in future research could further enhance understanding of how psychological, normative, and contextual drivers jointly shape citizens' acceptance of and engagement with climate adaptation policies. Finally, the majority of participants in this survey possessed higher levels of education, which is naturally reflected in the attributes of the factors incorporated in this study. Indeed, a broader and more educationally balanced sample, including proportionate numbers of both lower- and higher-educated participants, would contribute to a deeper understanding of climate policy support. Further empirical research is needed to explore the integration of these dimensions within the EPPM, thereby advancing the model's applicability and predictive capacity within complex, multi-actor governance environments.

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Data availability Data are available from the corresponding author upon reasonable request.

Declarations

Competing interests The authors declare no competing interests.

Ethical statement This study was conducted in accordance with the Declaration of Helsinki and relevant European Union ethical and data protection regulations (GDPR). Participation in the online survey was voluntary, informed consent was obtained electronically, and all responses were collected anonymously and processed confidentially for research purposes only.

Reference

Abbasi A, Araban M, Heidari Z, Alidosti M, Zamani-Alavijeh F (2020) Comparing the impact of educational messages based on an extended parallel process model on solid waste separation behaviors in female students: A four-group randomized trial. Waste Manag 117:1–8

Abousoliman AD, Ibrahim AM, Abualruz H, Magdi HM, Zaghamir DEF, Alhowimel A, Zoromba MA (2024) Exploring the relationship between nursing students' knowledge and attitudes towards climate change and their psychological distress: a cross-national investigation. BMC Nurs 23(1):294

Adger WN, Barnett J, Heath S, Jarillo S (2022) Climate change affects multiple dimensions of well-being through impacts, information and policy responses. Nat Hum Behav 6(11):1465–1473

Ahn C (2025) A Study of a Hypothetical Pandemic by Climate Change: Focusing on Construal Level Theory of Psychological Distance with Insights from EPPM and Moral Foundations. Asian Communication Res 22(1):94–118

Ajzen I (2020) The theory of planned behavior: Frequently asked questions. Hum Behav Emerg Technol 2(4):314–324

Alam SS, Haque IS, Kokash HA, Ahmed S, Ahsan MN (2025) Drivers of Waste Separation Behavior in Urban Bangladesh: Leveraging Social Norms and Environmental Awareness for Circular Economy Success. Circular Economy and Sustainability, pp 1–33

Almeida P, Gonzalez Marquez LR, Fonsah E (2024) The forms of climate action. Sociol Compass, 18(2), e13177

Ambaum M, Corten R, Lambooij M, van der Aa M, van Harreveld F, Buskens V (2024) Determinants of Long-Term Water and Energy Conservation Behavior. Integr Rev Sustain 16(11):4399

Antwi-Agyei P, Stringer LC (2021) Improving the effectiveness of agricultural extension services in supporting farmers to adapt to climate change: Insights from northeastern Ghana. Clim Risk Manage 32:100304

Arjomandi Akram P (2023) Governing the water conservation in the Urmia Lake Basin: addressing macro systems' fit and micro users' behavior

Arjomandi A, Yazdanpanah P, Shirzad M, Komendantova A, Kameli N, Hosseinzadeh E, M., Razavi E (2023) Institutional trust and cognitive motivation toward water conservation in the face of an environmental disaster. Sustainability 15(2):900

Arjomandi P, Seyedi S, Komendantova N (2025b) Dynamics of Expectations,(Dis) satisfaction, and Participation in Changing States of. Water Governance Systems

Arjomandi P, Seyedi S, Komendantova N, Yazdanpanah M, Mannocchi M (2025a) The institutional analysis and development framework: A mathematical representation in water arena. Curr Res Environ Sustain 10:100307

Arjomandi P, Yazdanpanah M, Zobeidi T, Komendantova N, Shirzad A (2025c) Place attachment, activation of personal norms, and the role of emotions to save water in scarcity. Environ Sustain Indic 25:100567

Armbruster ST, Manchanda RV, Vo N (2022) When are loss frames more effective in climate change communication? An application of fear appeal theory. Sustainability 14(12):7411

Axon S, Lent T, Njoku A (2023) Shifting sustainable lifestyle practices and behaviour during times of pandemic disruptive change: Implications for on-going socio-technical transitions. Energy Res Social Sci 102:103188

Baack F, Kuks SM, Özerol G, Vinke-de Kruijf J, Halman JI (2024) Deciding climate change adaptation implementation at the local level–a tale of two cities in the Netherlands. J Environ Planning Manage, 1–21

Bagozzi RP, Edwards JR (1998) A general approach for representing constructs in organizational research. Organizational Res methods 1(1):45–87

Bagozzi RP, Fornell C (1982) Theoretical concepts, measurements, and meaning. second generation Multivar Anal 2(2):5–23

Bamberg S, Rees J, Seebauer S (2015) Collective climate action: Determinants of participation intention in community-based pro-environmental initiatives. J Environ Psychol 43:155–165
Barnett DJ, Thompson CB, Semon NL, Errett NA, Harrison KL, Anderson MK, Ferrell JL, Freiheit JM, Hudson R, McKee M, Mejia-Echeverry A (2014) EPPM and willingness to respond: the role of risk and efficacy communication in strengthening public health emergency response systems. Health Commun 29(6):598–609
Bechtoldt MN, Götmann A, Moslener U, Pauw WP (2021) Addressing the climate change adaptation puzzle: A psychological science perspective. Clim Policy 21(2):186–202
Bergquist M, Nilsson A, Harring N, Jagers SC (2022) Meta-analyses of fifteen determinants of public opinion about climate change taxes and laws. Nat Clim Change 12(3):235–240
Betsch C, Geiger M, Lehrer L, Sprengholz P, Temme H, Tiede K, Jenny M (2025) Psychological foundations of climate action.
Bosone L, Thiriot S, Chevrier M, Rocci A, Zenasni F (2024) Visioning sustainable futures: Exposure to positive visions increases individual and collective intention to act for a decarbonated world. Global Environ Psychol 2:e11105
Bostrom A, Morgan M, Fischhoff B, Read D (1994) What do people know about global climate change 1. Mental models. Risk Analysis;(United States), 14(6)
Bousalah H (2025) Algerian public perception of wildfire risks amid climate change: a field study in affected regions (2021–2023). Environ Res Commun 7(11):115022
Bretter C, Schulz F (2025) Public support for climate policies and its ideological predictors across countries of the Global North and Global South. Ecol Econ 233:108603
Bullock RC, Diduck A, Luedee J, Zurba M (2022) Integrating social learning, adaptive capacity and climate adaptation for regional scale analysis: a conceptual framework. Environ Manage 69(6):1217–1230
Bumann S (2021) What are the determinants of public support for climate policies? A review of the empirical literature. Rev Econ 72(3):213–228
Cantillo J, Astorino L, Tsana A (2025) Determinants of pro-environmental attitude and behaviour among European Union (EU) residents: differences between older and younger generations. Quality & Quantity, pp 1–37
Chen MF (2020) The impacts of perceived moral obligation and sustainability self-identity on sustainability development: A theory of planned behavior purchase intention model of sustainability-labeled coffee and the moderating effect of climate change skepticism. Bus Strategy Environ 29(6):2404–2417
Choi S, Hart PS (2021) The influence of different efficacy constructs on energy conservation intentions and climate change policy support. J Environ Psychol 75:101618
Cialdini RB, Reno RR, Kallgren CA (1990) A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. J Personal Soc Psychol 58(6):1015
Constantino SM, Sparkman G, Kraft-Todd GT, Bicchieri C, Centola D, Shell-Duncan B, Vogt S, Weber EU (2022) Scaling up change: A critical review and practical guide to harnessing social norms for climate action. Psychol Sci public interest 23(2):50–97
Cronbach LJ (1951) Coefficient alpha and the internal structure of tests. Psychometrika 16(3):297–334
Crowley SL, Hinchliffe S, McDonald RA (2017) Invasive species management will benefit from social impact assessment. J Appl Ecol, 351–357
Dabbous A, Horn M, Croutzet A (2023) Measuring environmental awareness: An analysis using google search data. J Environ Manage 346:118984
DeBruin MR (2023) Applying the Extended Parallel Process Model to Climate Change Communication
Diakakis M, Skordoulis M, Savvidou E (2021) The relationships between public risk perceptions of climate change, environmental sensitivity and experience of extreme weather-related disasters: evidence from Greece. Water 13(20):2842
Drews S, Van den Bergh JC (2015) What explains public support for climate policies? A review of empirical and experimental studies. Clim Policy 16(7):855–876
Ergun SJ, Karadeniz ZD, Rivas MF (2024) Climate change risk perception in Europe: country-level factors and gender differences. Humanit Social Sci Commun 11(1):1–13
European Environment Agency (2025) Consolidated annual activity report 2024 (EEA Corporate Report No. 01/2025). Publications Office of the European Union. https://doi.org/10.2800/5106160
Fisher RA (1970) Statistical methods for research workers. Breakthroughs in statistics: Methodology and distribution. Springer New York, New York, NY, pp 66–70
Fleming W, Hayes AL, Crosman KM, Bostrom A (2021) Indiscriminate, irrelevant, and sometimes wrong: Causal misconceptions about climate change. Risk Anal 41(1):157–178
Fornell C, Larcker DF (1981) Evaluating structural equation models with unobservable variables and measurement error. J Mark Res 18(1):39–50
Geiger N, Swim JK, Fraser J (2017) Creating a climate for change: Interventions, efficacy and public discussion about climate change. J Environ Psychol 51:104–116

Giampietri E, Trestini S (2023) Pro-Environmental Viticulture: Status Quo and Perspectives from Prosecco Winegrowers in Italy. Sustainability 15(2):1073
Goerg SJ, Pondorfer A, Stöhr V (2024) Regional variation in social norm nudges. Sci Rep 14(1):16773
Goldberg MH, van der Linden S, Leiserowitz A, Maibach E (2020) Perceived social consensus can reduce ideological biases on climate change. Environ Behav 52(5):495–517
Goldstein NJ, Cialdini RB, Griskevicius V (2008) A room with a viewpoint: Using social norms to motivate environmental conservation in hotels. J Consum Res 35(3):472–482
Grothmann T, Patt A (2005) Adaptive capacity and human cognition: The process of individual adaptation to climate change. Glob Environ Change 15(3):199–213
Hair JF (2009) Multivariate data analysis
Hair JF, Babin BJ, Anderson RE, Black WC (2019) Multivariate Data Analysis, 8th edn. Pearson Prentice, England
Hair Jr JF, Hult GTM, Ringle CM, Sarstedt M, Danks NP, Ray S, Ray S (2021) An introduction to structural equation modeling. Partial least squares structural equation modeling (PLS-SEM) using R: a workbook, 1–29
Hammar H, Jagers SC (2006) Can trust in politicians explain individuals' support for climate policy? The case of CO. Clim Policy 5:613–625
Harrington D (2009) Confirmatory factor analysis. Oxford University Press
Heres DR, Kallbekken S, Galarraga I (2017) The role of budgetary information in the preference for externality-correcting subsidies over taxes: a lab experiment on public support. Environ Resource Econ 66:1–15
Hügel S, Davies AR (2020) Public participation, engagement, and climate change adaptation: A review of the research literature. Wiley Interdisciplinary Reviews: Clim Change, 11(4), e645
Hoffmann R, Muttarak R, Peisker J, Stanig P (2022) Climate change experiences raise environmental concerns and promote Green voting. Nat Clim Change 12(2):148–155
Houser M, Gazley B, Reynolds H, Browning EG, Sandweiss E, Shanahan J (2022) Public support for local adaptation policy: The role of social-psychological factors, perceived climatic stimuli, and social structural characteristics. Glob Environ Change 72:102424
Hubner E, Dirksmeier P (2026) Effects of climate policy attitudes and populism on the acceptance of renewable energy infrastructure in Germany. Energy Clim Change, 100232
Hu LT, Bentler PM (1999) Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Struct equation modeling: multidisciplinary J 6(1):1–55
Hussain A, Kanwel S, Erum N, Pasha U, Asad M, Khan SN, Sanusi ZM (2025) The role of environmental awareness, renewable energy, and green innovation in shaping climate change perceptions. Sci Rep 15(1):40933
Jensen A, Nielsen HØ, Russel D (2023) Diffusion of climate policy integration in adaptation strategies: translating the EU mandate into UK and Danish national contexts. Reg Envriron Chang 23(4):130
Jones N, Clark JR (2014) Social capital and the public acceptability of climate change adaptation policies: a case study in Romney Marsh. UK Clim change 123(2):133–145
Jordan A, Huitema D, Van Asselt H, Rayner T, Berkhout F (eds) (2010) Climate change policy in the European Union: Confronting the dilemmas of mitigation and adaptation? Cambridge University Press
Jöreskog KG (1970) A general method for estimating a linear structural equation system. ETS Research Bulletin Series, 1970(2), i-41
Kaiser FG, Gerdes R, König F (2022) Supporting and expressing support for environmental policies. J Environ Psychol 87:101997
Kellstedt PM, Zahran S, Vedlitz A (2008) Personal efficacy, the information environment, and attitudes toward global warming and climate change in the United States. Risk Analysis: Int J 28(1):113–126
Kikko Y, Ishigaki T (2025) Divergent effects of environmental concern and risk perception on pro-environmental intention: an international study across 17 countries. Sci Rep 15(1):7766
Kim H, Chae S (2025) Climate change health communication and its association with awareness and behaviors in South Korea. J Clim Change Health 26:100583
Kline RB (2023) Principles and practice of structural equation modeling. Guilford
Lambert LS, Newman DA (2023) Construct development and validation in three practical steps: Recommendations for reviewers, editors, and authors. Organizational Res Methods 26(4):574–607
Larionow P, Sołtys M, Izdebski P, Mudło-Głagolska K, Golonka J, Demski M, Rosińska M (2022) Climate change anxiety assessment: the psychometric properties of the polish version of the climate anxiety scale. Front Psychol 13:870392
Lau JD, Song AM, Morrison T, Fabinyi M, Brown K, Blythe J, Adger WN (2021) Morals and climate decision-making: insights from social and behavioural sciences. Curr Opin Environ Sustain 52:27–35
Lee TM, Markowitz EM, Howe PD, Ko CY, Leiserowitz AA (2015) Predictors of public climate change awareness and risk perception around the world. Nat Clim change 5(11):1014–1020

Leiserowitz A (2006) Climate change risk perception and policy preferences: The role of affect, imagery, and values. Clim Change 77(1):45–72
Lo AY (2013) The role of social norms in climate adaptation: Mediating risk perception and flood insurance purchase. Glob Environ Change 23(5):1249–1257
Lorenzoni I, Nicholson-Cole S, Whitmarsh L (2007) Barriers perceived to engaging with climate change among the UK public and their policy implications. Glob Environ Change 17(3–4):445–459
Love J, Selker R, Marsman M, Jamil T, Dropmann D, Verhagen J, Wagenmakers EJ (2019) JASP: Graphical statistical software for common statistical designs. J Stat Softw 88:1–17
MacCallum RC, Austin JT (2000) Applications of structural equation modeling in psychological research. Ann Rev Psychol 51(1):201–226
Maleknia R, Enescu E, R., Salehi T (2025) Climate change and urban forests: generational differences in women's perceptions and willingness to participate in conservation efforts. Front Forests Global Change 7:1450098
Mase AS, Gramig BM, Prokopy LS (2017) Climate change beliefs, risk perceptions, and adaptation behavior among Midwestern US crop farmers. Clim Risk Manage 15:8–17
Matiiuk Y, Krikštolaitis R, Liobikienė G (2023) The Covid-19 pandemic in context of climate change perception and resource-saving behavior in the European Union countries. J Clean Prod 395:136433
Mattera M, Erokhin D, Baldelli M, Komendantova N (2025) Climate experiences to adaptation participation: a survey study in Catalonia. Theoret Appl Climatol 156(11):568
Ma X, Yang Y, Chen L (2023) Promoting behaviors to mitigate the effects of climate change: Using the extended parallel process model at the personal and collective level in China. Environ Communication 17(4):353–369
Menidjel C, Bilgihan A (2023) How perceptions of relationship investment influence customer loyalty: the mediating role of perceived value and the moderating role of relationship proneness. J Strategic Mark 31(1):296–319
Mitter H, Larcher M, Schönhart M, Stöttinger M, Schmid E (2019) Exploring farmers' climate change perceptions and adaptation intentions: Empirical evidence from Austria. Environ Manage 63(6):804–821
Nguyen QA, Hens L, Nguyen N, MacAlister C, Lebel L (2020) Explaining intentions by vietnamese schoolchildren to adopt pro-environmental behaviors in response to climate change using theories of persuasive communication. Environ Manage 66(5):845–857
Nilsson A, von Borgstede C, Biel A (2004) Willingness to accept climate change strategies: The effect of values and norms. J Environ Psychol 24(3):267–277
Nisbet MC (2009) Communicating climate change: Why frames matter for public engagement. Environment: Sci policy sustainable Dev 51(2):12–23
Nolan JM (2021) Social norm interventions as a tool for pro-climate change. Curr Opin Psychol 42:120–125
Orlove B, Shwom R, Markowitz E, Cheong SM (2020) Climate decision-making. Annu Rev Environ Resour 45(1):271–303
Paek HJ, Hove T (2024) Mechanisms of climate change media effects: roles of risk perception, negative emotion, and efficacy beliefs. Health Commun 39(13):3426–3435
Pakmehr S, Yazdanpanah M, Baradaran M (2020) How collective efficacy makes a difference in responses to water shortage due to climate change in southwest Iran. Land Use Policy 99:104798
Parmesan C, Morecroft MD, Trisurat Y (2022) Climate change 2022: Impacts, adaptation and vulnerability (Doctoral dissertation, GIEC)
Pearson K (1901) LIII. On lines and planes of closest fit to systems of points in space. Lond Edinb Dublin philosophical magazine J Sci 2(11):559–572
Peñasco C, Grossman E (2025) The paradox of environmental consciousness: dissecting the gap between climate change awareness, environmental concern and policy support. Clim Policy, 1–18
Peterson RA, Kim Y (2013) On the relationship between coefficient alpha and composite reliability. J Appl Psychol 98(1):194
Pidgeon N, Kasperson RE, Slovic P (eds) (2003) The social amplification of risk. Cambridge University Press
Pong H-K, Fong C-C (2024) Environmental, Social and Governance Awareness and Organisational Risk Perception Amongst Accountants. J Risk Financial Manage 17(11):480. https://doi.org/10.3390/jrfm17110480
Poortvliet PM, Niles MT, Veraart JA, Werners SE, Korporaal FC, Mulder BC (2020) Communicating climate change risk: A content analysis of IPCC's summary for policymakers. Sustainability 12(12):4861
Puig D, Adger NW, Barnett J, Vanhala L, Boyd E (2025) Improving the effectiveness of climate change adaptation measures. Clim Change 178(1):1–15
Rayner T (2023) Adaptation to climate change: EU policy on a Mission towards transformation? NPJ Clim Action 2(1):36
Renn O (2011) The social amplification/attenuation of risk framework: application to climate change. Wiley Interdisciplinary Reviews: Clim Change 2(2):154–169

Rodriguez-Sanchez C, Sarabia-Sanchez FJ (2020) Does water context matter in water conservation decision behaviour? Sustainability 12(7):3026
Romanello M, Walawender M, Hsu SC, Moskeland A, Palmeiro-Silva Y, Scamman D, Costello A (2024) The 2024 report of the Lancet Countdown on health and climate change: facing record-breaking threats from delayed action. Lancet 404(10465):1847–1896
Romanello M, Walawender M, Hsu SC, Moskeland A, Palmeiro-Silva Y, Scamman D, Costello A (2025) The 2025 report of the Lancet Countdown on health and climate change: climate change action offers a lifeline. Lancet 406(10521):2804–2857
Saari UA, Damberg S, Frömbling L, Ringle CM (2021) Sustainable consumption behavior of Europeans: The influence of environmental knowledge and risk perception on environmental concern and behavioral intention. Ecol Econ 189:107155
Sanz E, Chelleri L, Chiabai A, Sanz MJ (2025) Enhancing Local Governance for Climate Action: A Guiding Conceptual Framework. Urban Governance
Sarrina Li SC, Huang LMS (2020) Fear appeals, information processing, and behavioral intentions toward climate change. Asian J Communication 30(3–4):242–260
Sarti M, St. John SK (2019) Raising long-term awareness: EU environmental policy and education. Education and Public Policy in the European Union: crossing boundaries. 165–181
Savari M, Zhoolideh M (2021) The role of climate change adaptation of small-scale farmers on the households food security level in the west of Iran. Dev Pract 31(5):650–664
Sherif M (1936) The psychology of social norms
Smith CJ, Dupré KE, McEvoy A, Kenny S (2021) Community perceptions and pro-environmental behavior: The mediating roles of social norms and climate change risk. Can J Behav Sci 53(2):200
Soria M, Bonada N, Ballester A, Verkaik I, Jordà-Capdevila D, Solà C, Munné A, Jiménez-Argudo SM, Fortuño P, Gallart F, Vinyoles D (2021) Adapting participatory processes in temporary rivers management, vol 120. Environmental Science & Policy, pp 145–156
Sparkman G, Walton GM (2017) Dynamic norms promote sustainable behavior, even if it is counternormative. Psychol Sci 28(11):1663–1674
Spearman C (1961) General Intelligence Objectively Determined and Measured
Spence N, Walters D (2012) Is it safe? Risk perception and drinking water in a vulnerable population. Int Indigenous Policy J 3(3):1–23
Steg L, Van der Perlaviciute G, Lurvink J (2014) The significance of hedonic values for environmentally relevant attitudes, preferences, and actions. Environ Behav 46(2):163–192
Steiger JH (2007) Understanding the limitations of global fit assessment in structural equation modeling. Pers Indiv Differ 42(5):893–898
Taflinger S, Sattler S (2024) A situational test of the health belief model: How perceived susceptibility mediates the effects of the environment on behavioral intentions. Soc Sci Med 346:116715
Tarka P (2018) An overview of structural equation modeling: its beginnings, historical development, usefulness and controversies in the social sciences. Qual Quant 52(1):313–354
Tsoy D, Godinic D, Tong Q, Obrenovic B, Khudaykulov A, Kurpayanidi K (2022) Impact of social media, Extended Parallel Process Model (EPPM) on the intention to stay at home during the COVID-19 pandemic. Sustainability 14(12):7192
Ucar GK, Yalcin MG, Planalı GÖ, Reese G (2023) Social identities, climate change denial, and efficacy beliefs as predictors of pro-environmental engagements. J Environ Psychol 91:102144
Van der Linden S (2015) The social-psychological determinants of climate change risk perceptions: Towards a comprehensive model. J Environ Psychol 41:112–124
Van Valkengoed AM, Perlaviciute G, Steg L (2022) Relationships between climate change perceptions and climate adaptation actions: policy support, information seeking, and behaviour. Clim Change 171(1):14
Van Valkengoed AM, Perlaviciute G, Steg L (2024) From believing in climate change to adapting to climate change: The role of risk perception and efficacy beliefs. Risk Anal 44(3):553–565
Van Valkengoed AM, Steg L (2019) Meta-analyses of factors motivating climate change adaptation behaviour. Nat Clim change 9(2):158–163
Villamor GB, Wakelin SJ, Dunningham A, Clinton PW (2023) Climate change adaptation behaviour of forest growers in New Zealand: an application of protection motivation theory. Clim Change 176(2):3
Wachinger G, Renn O, Begg C, Kuhlicke C (2013) The risk perception paradox—implications for governance and communication of natural hazards. Risk Anal 33(6):1049–1065
Wamsler C, Bristow J (2022) At the intersection of mind and climate change: integrating inner dimensions of climate change into policymaking and practice. Clim Change 173(1):1–22
Wang J, Wang S, Ru X, Chen J (2024) Understanding the acceptance of carbon offset programs among hospitality consumers: an application of the extended parallel process model. J Sustainable Tourism 32(5):943–960

Weckroth M, Ala-Mantila S (2022) Socioeconomic geography of climate change views in Europe. Glob Environ Change 72:102453
Weinstein ND (1984) Why it won't happen to me: perceptions of risk factors and susceptibility. Health Psychol 3(5):431
Wenzel M, Rowland Z, Nielsen KS, Lange F (2023) The impact of perceived threat and perceived coping efficacy on individual actions toward biodiversity conservation: a registered report. J Environ Psychol 88:102038
Whitmarsh L (2009) Behavioural responses to climate change: Asymmetry of intentions and impacts. J Environ Psychol 29(1):13–23
Witte K (1992) Putting the fear back into fear appeals: The extended parallel process model. Commun Monogr 59(4):329–349
Witte K, Allen M (2000) A meta-analysis of fear appeals: Implications for effective public health campaigns. Health Educ Behav 27(5):591–615. https://doi.org/10.1177/109019810002700506
Wright S (1921) Correlation and causation. J agricultural Res 20(7):557
Xianyu Y, Long H, Wang Z, Meng L, Duan F (2024) The Impact of Tea Farmers' Cognition on Green Production Behavior in Jingmai Mountain: Chain Mediation by Social and Personal Norms and the Moderating Role of Government Regulation. Sustainability 16(20):8885
Xie M, Chen L (2025) Refugees' health risks and resilience to environmental disasters in rural communities. Discover Public Health 22(1):204
Xue W, Hine DW, Marks AD, Phillips WJ, Nunn P, Zhao S (2016) Combining threat and efficacy messaging to increase public engagement with climate change in Beijing, China. Clim Change 137(1):43–55
Yilmaz V, Guleç P, Ari E (2023) Impact of climate change information of university students in Turkey on responsibility and environmental behavior through awareness and perceived risk. Environ Dev Sustain 25(7):7281–7297
Yu TK, Chang YJ, Chang IC, Yu TY (2019) A pro-environmental behavior model for investigating the roles of social norm, risk perception, and place attachment on adaptation strategies of climate change. Environ Sci Pollut Res 26:25178–25189
Zobeidi T, Komendantova N, Yazdanpanah M (2022) Social media as a driver of the use of renewable energy: The perceptions of Instagram users in Iran. Energy Policy 161:112721