2022

Social identity processes involved in the acceptance and collective actions regarding large-scale energy technologies: The case of deep geothermal energy in Cornwall, Wales and Scotland.

Tirotto, Francesca Ausilia

http://hdl.handle.net/10026.1/19315

http://dx.doi.org/10.24382/879
University of Plymouth

UNIVERSITY OF PLYMOUTH

Social identity processes involved in the acceptance and collective actions regarding large-scale energy technologies: The case of deep geothermal energy in Cornwall, Wales and Scotland.

by

FRANCESCA AUSILIA TIROTTO

A thesis submitted to the University of Plymouth in partial fulfilment for the degree of

DOCTOR OF PHILOSOPHY

School of Psychology

February 2022

Acknowledgements

I would like to thank the University of Plymouth, for this great opportunity to carry out my research project and develop essential skills for my future career as an independent researcher. I would especially like to thank my supervisors Prof. Sabine Pahl, Prof. Iain Stewart, and Dr Hazel Gibson for their guidance during my PhD.

Sabine, thank you for your valuable feedback, emotional support, patience, and for encouraging me to keep working on my project in challenging times.

I would like to thank Prof. Ferdinando Fornara, for his generous support since my university studies, for seeing potential in me and for inspiring me to do research in environmental psychology.

Studying for a PhD can be stressful and isolating. Amanda Elisabeth Lai, thank you for being the postgraduate buddy that every PhD student should have.

I would like to thank all the members of the lavaan group, for their invaluable help and commitment to open science.

I feel grateful for the support that my family has given me over the years. Mamma e papà, thank you for teaching me that I can do anything I set my mind to. Nonna, thank you for keeping me grounded. Roberta, Antonella, Salvatore e Rita, thank you for being the best siblings I could ask for.

Francesco, my love, thank you for deciding to start an adventure abroad with me. You deserve a PhD just for putting up with me! I cannot wait to see what the future holds for us.

Thank you to my dog friend Attila, your company kept me sane through lockdown and PhD.

Author's Declaration

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Doctoral College Quality Sub-Committee.

Work submitted for this research degree at the University of Plymouth has not formed part of any other degree either at the University of Plymouth or at another establishment.

Presentations at conferences:

International Conference on Environmental Psychology (ICEP, 2019), Plymouth (UK) (Chief Organizer: Prof. Sabine Pahl). 4 - 6 September. "Social acceptance of deep geothermal energy in the UK: a social-identity approach". Talk.

European Geoscience Union (EGU, 2019), Vienna (Austria) (Chief Organizer: Prof. Susanne Buiter). 7-12 April. "Exploring attitudes toward social acceptance of the first deep geothermal technology in the UK". Poster.

International association people-environment studies (IAPS, 2018) Rome (Italy) (Chief Organizer: Prof. Giuseppe Carrus). 8-13 July. "Psychosocial factors in the acceptance and support for deep geothermal energy in the UK". Poster.

Word count of main body of thesis: 64.659

Signed:

Date: 16/02/2022

Abstract

Francesca Ausilia Tirotto

Social identity processes involved in the acceptance and collective actions regarding large-scale energy technologies: The case of deep geothermal energy in Cornwall, Wales and Scotland.

Deep geothermal energy has been recognised as an important contributor to future energy demand. However, the development of renewable energy technologies has seen public disagreement hindering the implementation of such technologies. The present study investigated social dimensions underlying public acceptance of deep geothermal energy. Adopting a social identity approach, the present research consisted of four studies. The first was a qualitative study which aimed to understand which socio-psychological dimensions were relevant in the acceptance of the first deep geothermal energy plant in Cornwall, UK. Based on this study and existing theory, a theoretical framework was developed which identified two possible pathways. The first pathway highlighted the relevance of investigating normative and collective efficacy beliefs in the acceptance of large-scale energy technologies. The second pathway pointed out the relevance of investigating perceived identity support and threat from the technology, autonomy need, fairness perception, and risk perception. Based on these pathways, the other three studies tested a series of pre-registered hypotheses using correlational designs via structural equation modelling. Overall, results demonstrated the importance of considering the two pathways, specifically the role of normative and collective efficacy beliefs, procedural fairness, collective self-determined motivations, and perceived group-level identity support and threat associated with deep geothermal energy. Considering collective processes through a social identity lens contributed to a better understanding of the key drivers underlying both social acceptance and collective action intentions regarding sustainable energy technologies and might be a fruitful source of public engagement.

General introduction

Due to the intermittent nature of some renewable energies (e.g., wind), the UK government is exploring feasible complementary renewable sources such as geothermal energy to be transformed into electric power. Since 2009, the possibility of obtaining power and heat from deep geothermal resources has been explored in Cornwall. The technology used is known as “Enhanced Geothermal Systems”.

The government’s priority to transform the energy system into a sustainable and clean sector has to consider people’s perception of the new energy technologies. In fact, the successful implementation of energy projects will in part depend on local and regional social acceptance. It has been shown that lack of acceptance of and public resistance to the technology can hinder the implementation of renewable energy options (Kunze & Hertel, 2017). Moreover, understanding public response toward these technologies is also important to limit adverse effects on public mental well-being from energy project implementation. For example, feeling forced or pressured to accept or to do something has detrimental effects on well-being (Deci & Ryan, 2008; Ryan & Deci, 2000; Thomas et al., 2017) and affect (Contzen et al., 2021).

The literature on the social side of renewable energy projects indicates which psychosocial and contextual factors are implicated in the acceptance and response toward energy technologies (Steg et al., 2015). Research has mostly focused on risk perception, trust, distributive and procedural fairness, knowledge, past experiences, and emotions. Less attention has been given to the collective dimension toward environmental relevant behaviour and in the specific field of renewable energy technologies acceptance. In particular, acceptability of geothermal energy at a national and local level has mostly been studied through case studies and the literature is very limited (e.g., Dowd et al., 2011). No studies to date have focused on public understanding of deep geothermal energy in the UK.

The first chapter presents a brief review of the literature about socio-psychological dimensions considered in the acceptance of energy technologies. Further, in the first chapter I discuss the connection between the studies of the present thesis and their contribution to knowledge and originality. Chapters 2, 3, 4, and 5 consist of one qualitative study, and three correlational studies which are briefly summarised below. The four studies include their own introduction, method, results, and discussions sections.

The first study of the present thesis (Chapter 2) includes a qualitative exploratory analysis using focus groups. This study examined which relevant socio-psychological factors were particularly relevant in the acceptance of the geothermal energy technology in Cornwall. The approach undertaken in this study leveraged both deductive and inductive strategies, using an interplay between theory and data (Taylor, 2018). Results of this study were interpreted in light of social identity theories (Tajfel & Tuner, 1979). Two distinct, but theoretically inextricable, paths were identified. The first path showed that the geothermal energy was framed by participants as renewable and this emerged as an important attribute for their Cornish identity. Environmental concern, normative and collective efficacy beliefs in the acceptance of the geothermal technology played a key role. In contrast to earlier findings, the second path highlighted that generalizability of factors explaining public acceptance (e.g., risk perception, perceived fairness of the decision-making process) should be taken with caution and interpreted in light of identity meanings associated with the energy technology. This study set the final theoretical approach forming the basis of the pre-registered correlational studies 2-4.

The second study (Chapter 3) considered the relation between geothermal energy social acceptance and secondary processes of social identity: social norms, group-based emotions, and collective efficacy. In particular, using a simplified version of the SIMPEA model (Fritsche et al., 2018), I examined geothermal social acceptance in relation to: appraisal of environmental crisis from energy sources, Cornish social identity, descriptive norms, group-based emotions, collective efficacy. The adaptation of the SIMPEA model to the context of social acceptance of energy technologies required a careful analysis, and – to some extent – arbitrary choices among multiple ways in which the constructs of interest could be adapted. These choices were mainly based on the first qualitative study. Although the pre-registered model was not supported, an alternative model was investigated based on other relevant literature (e.g., Rees & Bamberg, 2014). The alternative model mostly reflected the pre-registered plan, only including few deviations which I explain in detail in this chapter.

The third study (Chapter 4) examined boundary conditions of procedural fairness perception when examining people's acceptance of large-scale energy technology. To this scope, the moderating effect of social identity violation was investigated (Mayer et al., 2009). I also examined relationships between group-level autonomy need and both procedural fairness and collective self-determined motivations (Thomas et al., 2017) in predicting geothermal energy social acceptance. The pre-registered model was supported and additional analyses were included to test its stability. In this chapter, I present a detailed discussion of the literature in the field of social justice, to better understand what it means for people to feel treated fairly in terms of identity outcomes.

Inspired by research on social identity theories (e.g., Tajfel & Turner, 1979) and identity processes and motives (Identity process Theory, Breakwell, 1986; Motivated Identity Construction Theory, Vignoles et al., 2006; Vignoles, 2011), the last study (Chapter 5) investigated the association between group-level identity motives and four outcome variables (e.g., intention to accept/collective actions toward geothermal technologies) in Scotland and Wales (UK). The role of risk perception, permeability of group boundaries, and perceived group relative deprivation were also investigated through mediation and moderation paths. This chapter presents a series of statistical analyses to validate the novel conceptualisations of support and threat toward group-level identity motives as well as to understand the contribution of each motive (i.e., self-esteem, distinctiveness, and continuity) in both weakening the relationships between risk perception and the four outcome variables and in directly predicting these variables.

In general, the quantitative studies confirmed the importance of taking into account intra and intergroup processes which emerged as key factors in the first qualitative study. These studies also present several limitations which are discussed in each chapter and in the general discussion.

In conclusion, this thesis highlights the importance of adopting a collective-level analysis that considers intra and intergroup dynamics in the acceptance of and collective action toward large-scale energy technologies such as deep geothermal energy.

Contents

List of Tables

List of Figures

Chapter 1 – Introduction

1.1 Introduction

The UK government has committed to the ambitious goal of achieving a net zero target by 2050 (HM Treasury, 2021). This means that greenhouse gas emitted should be close to the amount removed from the atmosphere. In April 2021, the government further announced a pathway to reduce emissions by 78% by 2035 (compared to 1990 levels) (Department for Business, Energy & Industrial Strategy, 2021a). This important goal needs to meet the energy security criteria, which could only be achieved by shifting away from fossil fuels to renewable power. The most recent UK government energy report, from the Department for Business, Energy & Industrial Strategy (2021b), shows that both in 2020 and 2021, oil and natural gas were the major energy sources in the UK, however the generation of energy from these non-renewable resources has seen a general decline in the last 30 years. The generation from renewable sources, such as wind and solar energy, has in turn increased. Energy produced by offshore and onshore wind has been, in particular, the most developed within the renewable energy sector.

Due to the intermittent nature of these types of renewable energy, the UK government is further exploring feasible complementary renewable sources such as geothermal energy to be transformed into electric power. In fact, exponential scientific and technological innovation has made it possible to exploit geothermal resources also in the UK. Since 2009, the possibility of power and heat from deep geothermal resources has been explored in Cornwall. The technology used is known as “Enhanced Geothermal Systems”. The United Down Deep Geothermal Project is examining if geothermal energy is a viable resource in the UK for producing renewable energy (Reinecker et al., 2021). Cornwall has been chosen as the project site because of the unique geological characteristics of its subsoil. Geothermal energy, the natural heat from the earth's interior, is a renewable energy that can ensure a reliable energy supply with a low environmental impact. This energy is independent of variations in weather and it is considered as an important resource for the future (Basosi et al., 2020). The extraction of geothermal energy to be used as power for electricity requires the implementation of a deep geothermal power plant which involves on average about 6 months of drilling to make two deep holes where the temperature of the earth is very high, approximately 190 ˚C. The drilling process produces noise pollution. However, subsequent installation phases are quiet. Once the power plant is installed, its visual impact is minimal and the gas emissions are very low (Paulillo et al., 2020). Main potential environmental risks may affect water quality and usage and induced-seismicity, but are deemed low (e.g., Rathnaweera et al., 2020; Zang et al., 2014).

Government priorities to transform the energy system into a sustainable and clean sector have to consider people's perception of the new energy technologies being implemented. In fact, the successful implementation of this project will in part depend on local and regional social acceptance. It has been shown that lack of acceptance of and public resistance to the technology can hinder the implementation of renewable energy options (e.g., Benighaus & Bleicher, 2019; Kunze & Hertel, 2017; Temper et al., 2020). The term social acceptance includes the acceptance by different actors involved. It requires the consideration of different drivers involved in the evaluation of the energy technology. Wüstenhagen and colleagues (2007) identified three dimensions of social acceptance named socio-political acceptance, market acceptance, and community acceptance. Socio-political acceptance could involve key stakeholders and policy actors while market acceptance refers to consumers and investors. The community acceptance includes local stakeholders, residents and local authorities. The present research work focused on the community acceptance level extended to the whole county residents (i.e., Cornwall). As better explained in the next Chapters, this level of acceptance will also be considered at national level, in Scotland and Wales.

1.2 Socio-psychological dimensions considered in the acceptance of energy technologies

People generally recognise the importance of using sustainable energy sources and that efforts to develop advanced and sustainable energy technologies should be made. However, these environmental and energy security concerns are embedded in a complex situation and consequences in which locals are involved when large-scale energy technology is installed. This problem has been recognised as the "social gap" (Bell et al., 2005; 2013) between people's general attitudes toward renewable projects and their responses when an energy technology is being implemented in their local environment. According to the authors, this gap implies the co-existence, within the same person, of support toward an energy technology and beliefs that some conditions have to be followed. The majority of people who support these technologies have thus reservations about some critical aspects of the technology, such as the impact on the landscape and the environment (e.g., Jones et al., 2010). The NIMBY (*not in my back yard*) motive has often been used as an explanation of such social gap. According to this view, public opposition occurs because individuals are selfish, primarily focused on their own interests and less concerned about the common good (see Burningham, 2000). Within this framework, which focuses on a cost-and-benefit rational analysis, individuals and the community involved suffer many more costs than non-locals (Wolsink & Devilee, 2009). However, the use of the NIMBY concept as a framework for the study of social acceptance of facilities (e.g., wind farms) has been described as non-explanatory and perilous (Devine-Wright, 2005; Wolsink, 2006).

Devine-Wright proposed an alternative partial explanation of the social acceptance of energy technologies, proposing a psychological framework of place change. The main point of his framework is that people will accept a new energy technology as long as they perceive that place changes are coherent with the characteristics of the place and their emotional bond with the place is not jeopardised (Devine-Wright, 2009). For example, the implementation of a wind farm may be interpreted as threatening the place-related positive distinctiveness. As a consequence, place-protective actions such as opposition to the development could occur as a public response. On the other end, energy technology could also enhance place-distinctiveness of local residents (Devine-Wright, 2010). Place attachment and place-identity are the two core constructs of this approach. Place attachment represents the emotional relation with a familiar environmental setting, a sense of safety and comfort derived from an affective and cognitive bond between the person and the setting (Altman & Low, 1992; Hidalgo & Hernandez, 2001). The concept of place identity has been described as a component of the individual's self-identity, which derives from the relationship with the physical environment (Proshansky 1978; Proshansky et al., 1983). The space contributes to explaining how people think, feel and respond to their everyday life experiences in a certain way. Accordingly, space is not conceptualised as a neutral background in which people build their own identity. Instead, the person's socialisation with the physical setting affects the development of a subjective sense of self along with the individual, interpersonal, and social group processes (Proshansky et al., 1983). An empirical study of public responses to an offshore wind farm in the UK showed that those with strong place attachment were inclined to negatively evaluate the wind project as a result of a perceived discrepancy between the natural environment of the proposed location and the industrial-scale technology (Devine-Wright et al., 2010). Finally, the authors emphasised how the symbolic meaning of place and the fit between place and technology are socially constructed and stress the importance of adopting an approach that implies the social, rather than individualistic, dimension of acceptance of energy technologies. Bell et al. (2013) qualified those opposing to an energy technology for motivations related to the "specialness of their local place" (p. 125) as place-protectors.

More generally, people tend to evaluate the implementation of energy technologies more favourably when the perceived benefits are greater than the perceived costs (e.g., Perlaviciute & Steg, 2014). The extent to which specific benefits and costs are being considered by individuals, and their perceived importance, depends on the specific social, cultural, and economic context. Benefits should not be intended as a mere practical advantage such as a reduction in energy bills or payment compensation from energy developers. People may simply prefer public good to money (e.g., Mansfield et al., 2002). Instead, payment compensation could actually be counterproductive, decreasing the support for the facility (Ter Mors et al., 2012; Jørgensen et al., 2020), undermining intrinsic motivation (e.g., Frey et al., 1997) and being ineffective in the long term (Kaiser et al., 2020). Therefore, while a one-size-fits-all solution is not appropriate, studies investigating public views on energy projects would benefit from a contextualised analysis and solution across different actors and groups.

The literature on the social side of renewable energy projects offers many suggestions on what psychosocial and contextual factors are mainly implicated in the acceptance and responses toward energy technology (e.g., Steg et al., 2021). Abstract goals or ideals that define what is generally important for people (i.e., values) act as a key principle that guide the evaluations and acceptability of renewable energies. In particular, stronger biospheric values (i.e., related to environmental concern) are associated with more importance ascribed to environmental consequences of energy technology implementation, and specifically with favourability toward renewable energy alternatives. In turn, egoistic values are strongly associated with the importance given to the individual consequences, compared to environmental, of energy technologies, and with more favourability toward nuclear energy (Perlaviciute & Steg, 2014; see also Sharpe et al., 2021). Research has extensively focused on public risk perception of energy technologies (see Siegrist & Árvai, 2020). In general, the higher the perceived environmental risks are, the less positively people evaluate an energy technology (e.g., de Groot et al., 2012). Studies on this topic varied according to the paradigms used such as the Psychometric Paradigm (Slovic 1987; Slovic et al., 2004) and the Cultural Theory of Risk (Douglas & Wildavsky, 1982). The ultimate common goal of these studies is to understand which factors determine the perceived risks of energy technologies. Studies have also emphasised the role of trust toward the parties involved in the technology implementation (e.g., Liu, 2020a; Whitfield et al., 2009) and of the distributive and procedural fairness of the decision-making processes (e.g., Devine-Wright & Sherry-Brennan, 2019; Gross, 2007; Liu et al., 2020b). Distributive fairness concerns the balance between the costs and benefits that people face. For example, they may perceive that the landscape of their place is ruined and that they are exposed to safety risks while other people in the country are only benefiting from the renewable energy without any annoyance. Procedural fairness implies the fairness of the decision-process which leads to the implementation of an energy project. That is, being involved in the process – having the opportunity to express opinions and be informed about the consequences and stage of the project.

Other main factors considered are knowledge (e.g., Stedman et al., 2016), past experience (e.g., Zanocco et al., 2021), and emotions (e.g., Ruiz et al., 2018). Other authors have also tested multi-factor behavioural models such as the theory of planned behaviour in the intention to use renewable energies (Liobikienė et al., 2021), the risk information seeking and processing model (Lu et al., 2021), and the technology acceptance framework (Huijts et al., 2012, 2014). These will be only briefly presented below since the present research work focus more on the social dimensions of technology acceptance, which is not the main focus of these multi-factor models. However, these models further help to understand the complexity around renewable technologies acceptance, especially the work carried out by Huijts and colleagues.

Liobikienė et al., (2021) examined their model including different types of renewable energy technology. The authors used as indicators of the perceived behavioural control (i.e., how easy/difficult is using renewable energies) the development level of renewable energy in participants' country and financial factors. They showed that these were the strongest predictors of the intention to use renewable energies among subjective norms (e.g., "My friends promote me to choose renewable energy") and general attitude (e.g., "Renewable energy enhances the energy independency").

Lu et al. (2021) built their model based on the RISP model (Griffin et al., 1999) and the theory of planned behaviour (Ajzen, 1991). The authors specifically examined their model considering deep geothermal energy in the USA. They tested a series of mediation paths on the outcome variable people's information seeking behaviours (i.e., number of articles about geothermal energy that was read and length of reading time). The predictors included in the model concerned perceived uncertainty, perceived fairness, positive and negative affect, knowledge, the extent to which people perceived to need more information about the geothermal technology, informational subjective norm, and information engagement intentions.

The model proposed by Huijts and colleagues (2012) was examined in the acceptance of hydrogen fuel stations (2014). The authors used as outcome variables the intention to act against and in favour the fuel station (e.g., sign a petition). The mediation paths of the model involving the intention to act in favour (the "supporters") considered trust toward the municipality and the authorities, distributive fairness, environmental problem perception, negative and positive affect, perceived effects, outcome efficacy, subjective norm, perceived behavioural control, attitude, personal and subjective norm. While the mediation paths that considered the intention to act against (the "opponents") included fewer variables consisting of trust in the industry and in municipality, distributive fairness, negative and positive affect, perceived effects, outcome efficacy, and personal norm. In both models, personal norm (e.g., "I would feel guilty if I did nothing to support/act against the hydrogen fuel station") was the strongest predictor.

1.3 Social processes in the environmental behaviours domain

Consistently with the more general literature on pro-environmental behaviours (e.g., Bamberg & Möser, 2007), public acceptance and responses toward energy technology have been analysed considering mainly personal and interpersonal factors with only few exceptions, such as the aforementioned psychological framework of place change proposed by Devine-Wright. Therefore, the collective dimension toward environmentally relevant behaviour (e.g., renewable energy technologies acceptance, recycling behaviour) has been less investigated.

The role of social processes in the broader area of sustainable behaviours has mostly been studied focusing on social influence in terms of social norms (Cialdini, Kallgren, & Reno, 1991) or subjective norms (Ajzen, 1991; see Thøgersen, 2006). Such norms have been considered as an external imposed regulation or as a social pressure to think and act consistently with the norms because of an expected real or symbolic sanction or reward (Ajzen, 1988). This view appears to be consistent with a perspective that sees individuals as cognitively separated from others' identities, meaning that when human motivation is influenced by social norms it tends to imply a shift from "what I think" to "what is right or wrong to think according to significant others". However, when adopting a social identity perspective, social norms are intrinsically part of people's identities, making groundless a view of the social norms as external, seeing people "depersonalised" (Turner, 1982; Turner et al., 1987). Through the process of depersonalisation, individuals behave in line with their group beliefs, goals, motives and norms (see Jans & Fielding, 2018). Furthermore, a social identity approach would allow to capture other group processes behind people's thoughts and behaviours, with no need to narrow the social dimensions down, focusing only on social norms. Individualistic models of pro-environmental behaviour have thus included social norms as one of the variables, among others, that influence environmental intentions and behaviours. For example, the Value Belief Norms Theory (VBN, Stern, 2000; Stern et al., 1999) included personal norms as internalised social norms consisting of a feeling of obligation to act in a certain way (Schwartz, 1977).

According to Ferguson and colleagues (2016), three core principles guide individualistic models: 1) motivations are driven generally by self-interest; 2) the internal motivations (e.g. values) which guide behaviours are relatively stable and fixed entities since people are resistant to behavioural changes; 3) social group processes are external, weak and unstable motivators in stimulating individual behaviour; this process is resistant to change since collective interests are overshadowed by self-interests. However, when considering social group processes, embracing a social identity approach (Tajfel & Turner, 1979; Turner, 1982, Turner et al., 1987; 1994) would enable to conceptualise reasons behind people's motivations in a way that sees self-interest as important but only to the extent to which the social and environmental context makes a personal identity more salient. It is wise to consider that self-interest could potentially fit with a sustainable behaviour as long as it is important for the individual (e.g. a person with strong egoistic values might be inclined to avoid harmful environmental behaviours for their own safety). Thus, when a social identity becomes salient, the shared collective interests give people direction and commitment that are as strong and internal as those guided by a personal identity (see Barth et al., 2021; Jans, 2021; Masson & Fritsche, 2021; Fritsche et al., 2018; van Zomeren, 2014).

In sum, although I recognise the importance of the valuable and fundamental individualistic perspective contribution, there is also a body of research that posits that shared collective perceptions provide people with direction and commitment (Fritsche et al., 2018).

1.4 Summary of the research work

Theoretical framework(s) inspired by Study 1

The first study comprised a qualitative exploratory analysis using focus groups. This study aimed to understand which relevant socio-psychological factors were involved in the acceptance of the EGS. Both open and topic-based questions were used. The latter were grounded on a series of constructs that appeared to be relevant in the context of energy technologies' acceptance and/or general pro-environmental behaviours. The group interviews were carried out among locals who were experiencing the implementation of the EGS near their villages (Cornwall, UK). Two distinct, but theoretically inextricable, paths were identified. The first path involved environmental concern, normative and collective efficacy beliefs in the acceptance of large-scale energy technologies. The second path concerned the relevance of social identity motives of distinctiveness, self-esteem, and continuity. The important roles of procedural fairness perception and risk perception in the acceptance of energy technologies, commonly highlighted by previous studies, were not confirmed in this study as key variables. More generally, this study indicated that the context of geothermal energy technology implementation made the Cornish identity salient. This study set the final approach undertaken in the next pre-registered correlational studies.

Summary of Study 2

In the second study, the first path found in the qualitative study was examined in Cornwall. Moreover, after a careful review of the literature, the secondary social identity processes related to energy technology implementation were considered underrepresented. Therefore, this second study aimed to overcome this limitation. The SIMPEA model (Fritsche et al., 2018), offers a meaningful and rich explanation on how these secondary processes can be associated in the general field of pro-environmental behaviours. Therefore, an adapted version of this model was investigated in the specific context of social acceptance of geothermal technology in Cornwall. In particular, the relationships between appraisal of the environmental crisis from energy sources, positive and negative group-based emotions, descriptive norms, regional collective efficacy, and Cornish social identity were examined through structural equation modelling. Main results indicated that the sequential path from appraisal of the environmental crisis from energy sources, group-based positive emotions, to descriptive norms on social acceptance was supported. Looking at the coefficient magnitude of the bivariate correlations, the role of collective efficacy seemed equally important as the role of descriptive norms. However, multivariate analyses showed that including both group-based emotions and descriptive norms rendered the association of collective efficacy and social acceptance non-significant. Results also confirmed previous studies addressing the different role of social identity for different type of pro-environmental behaviours (Masson & Fritsche, 2014): in the context of *low effort* environmental behaviours, such as passive acceptance, the role of social identity might work better as a predictor rather than as a moderator. Nonetheless, the mediation path from ingroup identification via descriptive norms and collective efficacy beliefs were also interpreted in light of Masson et al.'s (2016) study: accepting the geothermal energy technology might be seen as a positive attribute for the ingroup, which might have led to biased ingroup descriptive norms and efficacy beliefs.

Summary of Study 3

The third study was also based in Cornwall. I used a concise version of the motives of distinctiveness, self-esteem, and continuity represented by the construct of social identity violation (i.e., the perception that one's social identity is violated by a decision outcome, Mayer et al., 2009). This study questioned the importance of procedural fairness when taking into account the role identity implications from energy technology implementation. Procedural fairness was measured at a group level using the construct of procedural justice climate (i.e., a group-level cognition about how fairly a group is treated procedurally as a whole). Moreover, this study investigated the role of group-level autonomy (i.e., the perception that one's own group is free to act autonomously according to one's group values, Thomas et al., 2017) in predicting the social acceptance through procedural justice climate. This mediation was moderated by social identity violation. Results indicated that the more people perceived their social identity as violated, the stronger procedural justice climate positively predicted social acceptance, thus mitigating the negative effect of social identity violation on social acceptance. Follow-up analyses indicated that this result could be interpreted in light of the value-group model (Tyler et al., 1996): people's need for self-esteem could be either satisfied by fair procedures or by positive identity features associated with the outcome decision (i.e., the implementation of the technology). This study also examined to what extent the group-level autonomy was associated with social acceptance through group members' perceptions of the type of reasons that other members of their group may have for accepting the energy technology (i.e., collective self-determined motivation, Thomas et al., 2017). Results of this path showed that when Cornish people's acceptance was experienced as collectively self-determined, this fostered acceptance of geothermal energy.

Summary of Study 4

The fourth study was based on different country contexts. Rather than collecting responses from Cornwall (i.e., England, UK), where the geothermal technology was actually being implemented, this study focussed on Scotland and Wales. This was to overcome an important limitation found in the previous studies. The outcome variable social acceptance was negatively skewed as geothermal technology is strongly accepted in Cornwall. Note that data from previous studies were collected from different areas in Cornwall. Therefore, the high level of acceptance could not be explained with locals being particularly involved in the technology implementation. In fact, as reported in Study 2, there was no significant relationship between social acceptance and spatial proximity. This happened with both voluntary participants and paid participants. Consistently, the variable social identity violation was also positively skewed. Moreover, Scotland and Wales represent an ideal ground for understanding social identity dynamics based on country identity. Scottish and Welsh people have their own strong country identity, but they are part of a common superordinate category of "British citizen", similarly to Cornish and British identity.

The objective of this fourth study was twofold. The first objective was the validation of novel constructs of support and threat toward group-level identity motives by testing the invariance of these measures across two groups. In fact, rather than relying on the construct of identity violation, as in Study 3, ad-hoc measures of threat and support were developed and tested to understand the association between perceived threat and support of people's social identity from energy technology implementation. Three first-order factors accounting for threat toward group-level identity motives of continuity, self-esteem, and distinctiveness and three first-order factors accounting for support toward group-level identity motives of continuity, self-esteem, and distinctiveness were generated and tested. The measurement invariance of these novel constructs was supported across the two groups (i.e., Scottish people and Welsh people) and across gender. The model structure was also compared against four different alternative models.

The second aim was to (i) examine the relationship between risk perception and four outcome variables at low and high levels of support toward group-level identity motives and (ii) to explore the possible role of perceived permeability of group boundary in mediating or moderating the relationship between threat toward group-level identity motives and the four outcome variables. In summary, results from the structural models showed that each support toward group-level identity motives weakened the effect of risk perception on collective action intentions and on the specific intention to protest against the technology. The role of perceived permeability of group boundaries was not supported as a mediator, nor as a moderator in subsequent analyses. However, its role was evident in interaction with perceived group relative deprivation. Finally, results indicated that among group-level identity motives, self-esteem motives generally explained a larger amount of variance of the outcome variables.

1.5 Originality and contribution to knowledge

No study to date has examined people's opinion toward deep geothermal energy in the UK. The present research work fills this gap by examining relevant socio-psychological variables in a real-world context where the geothermal technology was being implemented (Cornwall) and in other two countries in the UK where the technology was not being implemented (Scotland and Wales). In both contexts, the geothermal technology was generally accepted.

In contrast to earlier findings, the first study highlighted that generalisability of the importance given to factors commonly used to explain public acceptance toward large-scale energy technologies with severe safety risks - such as risk perception and the perceived fairness of the decision-making processes - should be interpreted with caution in light of shared rules within each community and symbolic meanings associated with the technology.

Firstly, the belief that environmental problems are an urgent problem contributes to the formation of social norms about the extent to which communities should host a large-scale energy technology in their territory. In this sense, prior work on the role of community shared rules in the field of public acceptance of large-scale energy technologies was expanded (e.g., Wang et al., 2021). Moreover, previous experiences with energy projects could generate beliefs on the extent to which large-scale renewable energies could successfully be managed in people's environment. This level of collective efficacy belief had not been considered in previous studies.

Secondly, the symbolic meaning associated with the implementation of energy technologies could possibly determine the acceptability of this type of energy technology. Indeed, previous studies have shown that place-related meanings associated with implementation of new energy technologies play an important role in people's acceptance of these technologies. However, these studies analysed less risky environmental threats (Bonaiuto et al., 1996), with few studies examining identity dynamics and important environmental and safety risks (e.g., De Dominicis et al., 2015). Other studies have focused more on inconsistencies between energy projects and place features concerning low-risk types of energy technology (i.e., wind farms, power lines; e.g., Devine-Wright & Batel, 2017). Instead, the focus of this study was not on place-related aspects, and therefore on place identity or place attachment, but rather on county and national social identities. Either perspective has advantages. As Twigger-Ross et al. (2003) pointed out: "[...] the difference between social identity and identification with place is only a difference of emphasis [...]" (p. 227). As discussed in Study 1, the way in which participants discussed their experience with the implementation of the geothermal technology seemed more salient for *social* identity aspects than *place* identity. Therefore, this study, as well as the quantitative studies of the present research work, discussed the constructs of interest referring to the county and national level of social identity. Indeed, the present research context is a unique opportunity to analyse identity processes. EGS could eventually induce seismic events large in magnitude, although the probability is low. Furthermore, large-scale disasters from this technology (i.e., seismic events) happened in other countries (e.g., Häringa et al., 2018; Kim et al., 2018), and human-induced disasters are usually perceived more negatively than natural hazards (McComas et al., 2016).

The second study tested, for the first time, an adapted version of the SIMPEA model (Fritsche et al., 2018) in the context of energy technology acceptance. Other than expanding on prior limited work on social descriptive norms in the field of public acceptance of large-scale energy technologies (e.g., Wang et al., 2021), this study also expanded the limited evidence of the effect of group-level emotions (Harth et al., 2013). Furthermore, a novel concept of county-level collective efficacy beliefs was operationalised for the specific context of energy technology acceptance. This collective efficacy belief was defined as the belief in the ingroup ability to successfully manage and achieve its goals in renewables. Another novelty associated with this study concerned the covariate that took into account the extent to which one sees one's ingroup as a type of group which acts in an environmentally-friendly way. To date, this variable has only been analysed at an individual-level, as "the extent to which you see yourself as a type of person who acts environmentally-friendly" (Van der Werff et al., 2014, p. 56).

The third study examined, for the first time, a series of group-level cognitions in the context of energy technology acceptance: the perception that one's own group is free to act autonomously, the perception that one's own group is procedurally treated in a fair manner, the perception of the reasons why others in the ingroup may accept the energy technology, and the extent to which individuals perceive the energy technology as something that violates their county-level social identity. In particular, this study shed light on the boundary conditions of fairness perceptions showing that when the technology is not violating people's social identity, the role of fairness perception on individual acceptance is less important. This study also contributes to a recent theorisation that sees intrinsic motivations as something that could also be experienced at a collective level (Thomas et al., 2017).

The fourth study took a further step in understanding social identity primary processes in the acceptance and collective actions toward the EGS. Novel measures that account for support and threat toward group-level identity motives from energy technologies were developed and tested. These measures were then used to expand our knowledge on the interplay between risk perception and identity dynamics. This study has advanced our knowledge on how this interplay could be differently explained depending on (i) type of group-level identity motives considered and (ii) type of outcome variables, such as general collective action intentions to act against the technology, intention to protest against the technology, social acceptance, and collective action intentions to act in favour of the technology. Lastly, the fourth study examined, for the first time, the effect of threat toward group-level self-esteem motives on the intention to protest against the EGS depending on (i) level of perceived permeability of group boundaries and on (ii) the level of perceived group relative deprivation.

Chapter 2 – Study 1

Exploring attitudes toward social acceptance of the first deep geothermal technology in the UK: a qualitative study.

Abstract

The first deep geothermal power plant in the UK is being developed in Cornwall (UK). This study focuses on the social acceptance of this technology in Cornwall, recognising that a lack of acceptance of and public resistance to the technology has elsewhere hindered the implementation of renewable energy options such as geothermal energy. In order to understand why and how Cornish residents might accept this geothermal energy technology, the present study aims to consider psychosocial processes. Adopting a qualitative approach, four focus groups were carried out to elicit participants' opinions about the technology. Based on social identity theories, people's perceptions toward the technology in the present study were interpreted as the result of collectively shared interpretations within the community involved in the geothermal project. This approach provided a deep understanding of locals' feelings, opinions and concerns. Among other results, there was a general positive evaluation toward the technology. For example, the positive community interpretations were linked to their past long historical tradition of Cornish hard-rock miners. However, perceived unfairness of the decision-making procedures adopted by actors responsible for the project led to a general discontent among locals. As every social context in which a geothermal energy is installed is unique, a deep analysis of each case is required to understand the role of the social processes and how those processes could be used for the acceptance of geothermal energy.

2.1 Introduction

Acceptability of geothermal energy on national and local levels has mostly been studied through case studies and the literature is limited. Some studies have also focused on how geothermal energy is portrayed in the media (Romanach et al., 2015; Rochyadi-Reetz et al., 2019; Stauffacher et al., 2015) and on the acceptance of other stakeholders involved in a geothermal project such as developers, hot spring inn managers, tourism operators, and local government officials (Kubota et al., 2013; Sæþórsdóttir & Hall, 2019). No studies to date have focused on the general public's opinion toward geothermal energy in the UK. Therefore, the present study aimed at understanding public opinion toward the geothermal energy in general, and in the specific context of the United Down Deep Geothermal Project in Cornwall. The aim was to understand residents' thoughts and feelings toward the new geothermal energy technology to be implemented in people's villages or the villages near the technology site. In particular, I wanted to investigate which relevant factors were having an impact on these thoughts and were generally salient when expressing opinions toward the technology. Factors refer to socio-psychological constructs and any other relevant contextual element. These aims were accomplished by using a qualitative approach based on focus-group interviews. Prior to the group discussion interviews, a review of the literature about studies carried out elsewhere on people's view of geothermal energy was carried out. The goal of this review was to explore those studies examining any relevant aspects that would have helped answering my preliminary and general research question: what do people think about geothermal energy outside the UK?

2.2 Public view of geothermal energy: a review of the literature

Due to the limited literature on this subject, the review took into account any study investigating geothermal energy public views in general, not only those specifically referring to deep geothermal. The only exclusion criterion was year of publication (I included articles only from 2011 onwards).

The search terms were: “geothermal” AND “acceptance”; “geothermal” AND “public view”; “geothermal” AND “attitude”; “geothermal” AND “belief”; “geothermal” AND “perception”; “geothermal” AND “controversy”; “geothermal” AND “public engagement”; “geothermal” AND “communication”. The search term “geothermal” was also searched in specific journals relevant in the field of public understanding of renewable energies and environmental behaviours: Energy Policy; Energy Research & Social Science; Journal of Environmental Psychology. Google Scholar and Web of Science were used as search engines.

A total of 30 research articles which focused on the broad topic of what people think about geothermal energy technology were found, using different perspectives. Results are mainly presented according to the sample population’s country of origin to avoid generalisation due to the specific social contexts of the technology implementation site. This summary does not intend to be exhaustive, many studies reviewed also analysed other factors related to public views on geothermal energy that are not discussed in the present review. It aimed instead to offer insights on which main social and contextual factors studies on geothermal public views have focused on so far.

In Australia, Dowd and colleagues (2011) explored people’s perceptions of geothermal energy by conducting five workshops, in five different cities. Results showed that people’s support for geothermal energy was on average higher than for coal, oil, bio-fuels and nuclear but lower than other resources such as wave/tidal and solar. Participants reported a lower level of knowledge compared to other energy sources (biofuel, CCS, coal, hydro, natural gases, nuclear, oil, solar wave/tidal, wind). During the workshop people expressed their concerns about geothermal energy, where water usage and seismic activity were reported as the main perceived issues. Dowd et al.'s study is consistent with other studies comparing people's support of different energy technologies. For example, examining people's perceptions of nearby climate projects implementation in the US, Hart et al. (2015) found that support for geothermal energy was statistically lower compared to wind power. Interestingly, people's support did not change depending on physical proximity to the project site in any of the type of projects being considered in their study. However, Baek and colleagues (2021) showed that favourability toward energy sources for power generation, including geothermal, was significantly higher at the national level compared to local level in Korea. It is important to mention that locals had experienced an episode of "triggered earthquake", likely due to water injections from the geothermal technology. Therefore, this previous experience may have exacerbated the difference in preference for energy technologies between locals and non-locals. Consistently, mainly due to higher risk perception about induced seismicity, remote areas seem to be preferred over urban areas for potential geothermal technology sites in Switzerland and Germany (Knoblauch et al., 2019) as well as in Australia (Carr-Cornish & Romanach, 2014). Previous negative experience with a pilot geothermal power plant in Milos Island also negatively influenced the acceptance of geothermal power generation in Greece (Karytsas et al., 2019). This population also felt that their opinions did not matter and lack of trust in risk management was present. This lack of fair decision-making procedures perception might further have undermined the acceptability of the geothermal power station (McComas et al., 2016). It was also shown that perceived risks associated with deep geothermal energy could influence affective responses toward shallow geothermal projects (Cousse et al., 2021). Previous negative, direct or indirect, experiences with similar projects could therefore be negatively associated reactions toward new technologies, a process that has been recently named "controversy spillover" (Cuppen et al., 2020) or more commonly "spillover effect" in the general social science framework.

However, people's experience could also have a positive impact on their view of geothermal energy, for example, it was shown that past environmental behaviours were positively associated with level of knowledge of geothermal energy (Karytsas & Theodoropoulou, 2014). Analysing perceptions of locals that had direct experiences with geothermal power plant infrastructures in Philippines, Gabo-Ratio & Fujimitsu (2020) showed that the perceived environmental concerns mostly referred to air and noise pollution, while the most referred risks were earthquake and agricultural damages.

In Italy, Pellizzone and colleagues (2015) found a lack of knowledge toward geothermal energy and high levels of uncertainty. People were unable to identify pros and cons of geothermal energy, declaring a need for more information. The authors also found a lack of trust in politics, developers and transparency of public institutions related to the acceptability of geothermal (Pellizzone et al., 2017). In the same study, environmental concerns related to water contamination and earthquakes emerged, and 57% of the respondents ($N = 400$) thought that geothermal technology would be very hazardous.

In a Chilean study, geothermal energy was not well understood and there was a general negative attitude among locals. People expressed difficulty in understanding how geothermal technology works and claimed that only once an energy project is already approved, companies would start communicating with them about the project (Payera, 2018). The result from Payera's case study diverged from a more recent study (Balzan-Alzate et al., 2021) examining social acceptance from a well-educated sample in Chile, where the level of social acceptance was the highest compared to four other countries considered (Canada, Colombia, Belgium, and France). In the same study, Chile also had the highest level of knowledge about the geothermal energy compared to the other four countries, which is in contrast with the level of knowledge reported in Payera's study. This last difference might help to explain the differences in the level of acceptance. In fact, a negative correlation between level of knowledge and preferences for geothermal power plants was reported elsewhere (Baek et al., 2021). It has also been shown that the more people know about geothermal systems, the more they are willing to expand their knowledge (Lu et al., 2021).

A study carried out in in Çanakkale (Turkey), showed that most people associated geothermal with a renewable and natural type of energy source, however the majority of participants thought that geothermal resources were unnecessary (Çetiner et al., 2016). Investigating Istanbul residents' understanding of clean energy, Erbil (2011) found that participants erroneously ranked natural gas as cleaner than geothermal energy, showing lack of knowledge. In turn, wind and solar were ranked as the cleanest sources of energy among natural gas, hydraulic, geothermal, hydrogen, biomass/biogas, coal, and petroleum. Partially confirming Erbil's study, wind and solar energy were ranked as the most environmentally-friendly energy sources in Greece, but geothermal energy was ranked as more environmentally-friendly than natural gas (Tampakis et al., 2013). Another study carried out in Greece showed that locals of Skyros island had a more positive attitude toward solar, wind and geothermal energy, compared to coal and nuclear (Petrakopoulou, 2017).

There are mixed results for what concerns pro-environmental beliefs and orientation (measured using the NEP, New Ecological Paradigm; Dunlap et al., 2000) associated with geothermal energy. It has been shown that pro-environmental beliefs are positively associated with wind and solar but not with geothermal across Australians (Hobman & Ashworth, 2013). Differently, Steel at al.'s (2015) study results, based on samples in Oregon and Washington (US), indicated that those with higher scores on the NEP scale (i.e., more pro-environmental beliefs) were more supportive of government promotion of geothermal energy compared to those with lower scores.

Nowadays, geothermal energy is the less supported energy source among wind, hydropower, and solar energy in Switzerland (Stadelmann-Steffen & Dermont, 2021). Environmental aspects and community safety have been indicated as the most prominent issues to consider in the acceptance of geothermal energy in Canada, Colombia, Chile, Belgium, and France (Balzan-Alzate et al., 2021; see also Malo et al., 2019).

Earthquakes specifically attributed to underground energy extraction technology processes, compared to those linked with naturally occurring cases, are associated with more negative affective reactions (McComas et al., 2016). Experimentally manipulating risk communication of deep geothermal energy and shale gas Knoblauch et al. (2018) found, among other results, that people tended to evaluate identical risks differently depending on the technology type to which the risks were associated. In particular, risks associated with deep geothermal were evaluated as less concerning compared to the same risks linked to shale gas.

Some studies have also highlighted the importance of an efficient communication strategy from the actors responsible for a geothermal project, for a positive public view of geothermal energy to emerge (e.g., Gross, 2013; Meller et al., 2018; Yasukawaa et al., 2018; Knoblauch et al., 2018).

In summary, the literature on geothermal energy technologies acceptance is mostly descriptive, and a coherent theoretical framework is missing. People's risk perception has been the core topic overall, which has led to a "limited risk perception focus", as was pointed out by Chavot et al. (2018). People's knowledge of geothermal energy is generally low, unless a well-educated sample is considered, which is not surprising considering the complexity of such type of energy extraction procedures. Support toward the implementation of geothermal energy projects is usually lower than for other renewable projects such as for wind and solar, but higher than for non-renewable energy sources (e.g., coil and gas). Past negative experiences with similar projects seem to play a key role in people's level of acceptance, and for perceived risks, toward the geothermal energy. Finally, perception of fair decision-making procedures from the authorities responsible for the implementation of geothermal projects seems to also play a key role in public acceptance of geothermal energy and projects.

The present study aimed to describe people's real-word experience with deep geothermal energy in the UK by identifying positive and negative evaluations and feelings toward the technology. The ultimate goal was to identify relevant psychosocial dimensions to consider for community-based social acceptance of deep geothermal energy. Based on these aims, two main research questions were identified:

1) Which psychosocial dimensions and which contents of these dimensions should be considered in the specific context of deep geothermal energy in Cornwall?

2) Which public concerns and project-related dimensions about deep geothermal energy policymakers and developers should be considered for communication and public engagement in Cornwall?

2.3 Method

In order to understand what people think about geothermal energy technology in Cornwall a qualitative study was designed. The study was carried out in May 2018, a few months before the drilling start date of the geothermal technology. For participant recruitment, study flyers were posted around the main villages close to the technology site and advertised on social media. Sample size (i.e., sample adequacy, Bowen, 2008) was not determined a priori; a saturation method was used. This method consisted of collecting data until no further novel insights and issues emerged from the interviews (Bryant & Charmaz, 2007; Hennink et al., 2017). After the third focus group, a preliminary data analysis was conducted. Results revealed that participants' opinions started to be redundant, therefore it was decided that one more focus group would be sufficient for answering the research questions. Data gathered from the last, fourth, focus group confirmed that the data was sufficient to fully explore the research questions.

The study included four focus group discussions, lasting approximately 90 minutes. Two of them were pre-existing groups (participants already knew each other) and the other two were new groups. A total of 33 participants were recruited, with age ranging from 42 to 85 (M = 66.2; SD = 8.7, 17 were male). Nine participants had a university degree, three preferred to not disclosed this information, the others attended middle school. Discussions were conducted at facilities in Redruth, Gwennap and Chacewater (Cornwall, UK) by myself, assisted by the third PhD supervisor. Participants were offered a £10 Amazon voucher. All discussions were video recorded and transcribed verbatim. Within the R software environment, a qualitative data analysis library RQDA (Huang, 2016) was used to assist the coding and the thematic process.

2.3.1 Focus group discussions: epistemological approach and design

The semi-structured interview schedule for the focus groups was based on the study aims and existing literature. I did not include specific words (e.g., “risks” and “earthquake”) in either semi-structured interview or follow-up questions, to avoid triggering non-spontaneous reactions and responses.

The group interview comprised of two main parts. In the first part, I adopted a more inductive approach, and questions were deliberatively vague to allow content related to geothermal energy technology to emerge freely. Using open questions, I started to explore group views on global and national energy security issues (e.g., What do you think about UK’s future energy supply?) and on renewable energy sources (e.g., What can you tell me about renewable energies?). Then, participants were led to discuss geothermal energy (e.g., What comes to mind about geothermal energy and geothermal technologies?).

The second part of the semi-structured group interview was designed to shift the discussion into specific topics. The questions were grounded on a series of constructs that appeared to be relevant in the context of energy technologies' acceptance and/or general pro-environmental behaviours, as reviewed in Chapter 1 (see Table 1).

Table 1
Pre-structured topic-based group-interviews questions

Constructs	**Interview questions**
Emotional aspects Ruiz et al., 2018; Midden & Huijts, 2009.	1) How do you feel thinking about this project? 2) What are your general feelings? For example, some people feel scared or happy when they are involved in this type of project. 3) What do you think your feeling would be during the drilling process? And what about the heat extraction process? Why?
Symbolic aspects Steg, 2005; Dittmar, 1992; Noppers et al., 2015.	4) Having the geothermal technology in your county – is that something that can influence the image that you have of yourself, of your community and of Cornwall?
Norms and motivations Cialdini et al., 1991; Cialdini & Goldstein, 2004; Ryan & Deci, 2000	5) What do you think community opinions around you are about the geothermal project? 6) Is it something that is approved or disapproved? (and for the Cornwall? For the UK?) 7) Why others in Cornwall would approve or disapprove?
Procedural justice Schuitema et al., 2011; Lind & Tyler, 1988; Marques et al., 2015.	8) In which case do you perceive a project as fair? 9) What do you think about the fairness of the decision process that led to the implementation of the geothermal technology?
Cornish identity Tajfel & Turner, 1979; Turner et al., 1987.	10) How would you describe, briefly, Cornwall to a stranger? 11) What characteristics people from Cornwall and from other counties in UK have in common and what not? (some cultural aspect?)

I used these constructs as stimuli to facilitate the group discussions, and then extracted themes that could be related or not to the constructs themselves. In this sense, my approach took advantage of both deductive and inductive based strategies, using an interplay between theory and data (see Taylor, 2018). Thus, the present study aimed to go beyond the simple illustration of preselected social theories within a specific context (Blaikie, 2010), with the final goal to provide a deep meaningful interpretation of how people in Cornwall were experiencing the implementation of the geothermal energy and related motivations to accept or not accept such technology. This pragmatist approach, defined as abductive (Dubois & Gadde, 2002, 2014; Reichertz, 2019), is useful in those cases where the phenomena or objects of study have a background in the literature, but the researcher is prepared to acknowledge unexpected new perspectives (Timmermans & Tavory, 2012). "Abductive inferencing is, rather, an attitude towards data and towards one's own knowledge: data are to be taken seriously, and the validity of previously developed knowledge is to be questioned" (Reichertz, 2019, p. 9). The main steps of an abductive analysis consist of "Mnemonics", "Defamiliarisation", and "Revisiting Observations" (Timmermans & Tavory, 2014). The first regards the data familiarisation process. In order to avoid biased memories when interpreting the interviews, the researcher is invited to transcribe verbatim the interviews, whenever possible, to then proceed with the coding process. The second step, defamiliarisation, allows the researcher to not take the first interpretations for granted, based on pre-existing theories and ideas. In the third step, researchers should take some time to re-examine the data in different theoretical ways.

The context in which the data collection occurs is another critical aspect of the abductive approach, as researchers inevitably co-produce participants' ideas toward reality (Reichertz, 2019). Moreover, within qualitative research methods, the time frame in which the researcher analyses the data (i.e., shifts in the socio-historical context) can potentially affect how the researcher makes sense of the empirical data (e.g., Distinto &

Priola, 2021). The main results of the present study were, therefore, written not later than five months from the last focus group discussion for consistency purposes.

Throughout the coding process, I identified recurring themes across the four groups (Braun & Clarke, 2006). In the abductive approach, it is recognised that more than one interpretation of data is possible (see Lipscomb, 2012). Therefore, intercoder reliability (ICR) was not calculated for the initial coding frame. ICR is certainly a useful numerical measure of agreement, offering numerous advantages for the rigor and transparency of the study. However, the choice to use numerical computations in qualitative research has been subject of numerous controversies for the lack of fit with the interpretative nature of the qualitative research (e.g., Braun & Clarke, 2013; Madill et al., 2000). The ICR was substituted with interactive discussions between coders. After completing the three steps of the abductive approach, the results were shared with the colleague that assisted the group discussions. Through discussions and debate, an agreement on the final main themes was reached. Importantly, the first coder has a background in social psychology while the second coder has expertise in the field of geology and geology communication. The second coder's evaluation was less informed by socio-psychological theories and more pragmatic in investigating the contents of the group discussions. Following, two more colleagues, with expertise in social psychology and geology communication respectively, reviewed the identified themes agreeing with the interpretations.

2.4 Results

The initial coding scheme mainly differentiated between positive and negative features associated with geothermal energy. These were then divided into more specific codes such as "first geothermal impressions", "values", "past", "future" "identity aspects", "other renewable energies", "environmental concern", "living in Cornwall". From the coding scheme, six main themes were identified in the group discussions. Even if focus groups were used, the quotes did not include interactions between participants. Therefore, quotations from single individuals are reported instead because these were the most efficient and effectives ways to achieve the study's aims (see Morgan, 2010, for a discussion into the topic). Participant names are invented to protect their anonymity.

2.4.1 Theme 1: "Short term costs...have to be accepted"

In line with other studies (e.g., Pellizzone et al., 2017), most participants were confused about the technical features of the geothermal technology. However, they were aware of the magnitude of the geothermal project in general and of the advanced technology being used. Participants defined themselves as mainly supporters of the project, still maintaining some reservations, for example:

"I think it's going to be enormously, I mean, overall beneficial to the environment. Obviously, there will be a certain amount of energy used in drilling it, but that's peanuts compared to what can come out. Certain amount of traffic movements and things coming and going, but it's nothing compared to all the benefits, the net benefit to the environment" (Harry, FG 1).

The perceived disadvantages of the geothermal technology concerned noise from the drilling process, the disruption of the underground, high economic costs, and possible knock-on effects for the environment over the years. These concerns emerged only when the moderator specifically asked participants to indicate the perceived "costs and disadvantages" related to geothermal technology. In fact, during the first phase of the interview (i.e., when questions were very general) participants did not mention any of these possible disadvantages. In general, as the following extract shows, participants did not express a consistent concern:

"So the advantages from my perspective, the long term advantage is immense that the short term cost and infrastructure issues have to be accepted" (Anne, FG 4).

Referring to the general topic of "renewable energy", participants highlighted the importance of investing in such energies because environmental problems are urgent to solve. According to them, some discomforts have to be tolerated by those living near renewable energies projects. However, they also reported that some limits must be respected, as renewable energies should not harm both environment and humans' lives, for example:

"*Well, we all think we would all support renewable energy if it was viable and not damaging*" (Kevin, FG 3).

The above statement is in line with the 'Qualified Support' explanation offered by Bell and colleagues (2005): "[people] believe that wind energy is a good idea, but they also believe that there are general limits and controls that should be placed on its development" (p. 463). In fact, people generally recognise the importance of using sustainable energy sources and that efforts to develop advanced and sustainable energy technologies should be made. However, these environmental and energy security concerns are embedded in a complex situation and consequences in which locals are involved whenever a large-scale energy technology is installed.

2.4.2 Theme 2: "It's [...] exciting, but at some point [...] we are left with nothing again."

Negative emotions were frequently linked to past experiences with other energy projects which were perceived by participants as unsuccessful. A feeling of frustration was expressed in regards to the Wave Hub project, the St. Mary project and a "Solar project".

"It's all going to happen, exciting, but at some point are they going to say, "Well, we're not getting what we wanted." [...] we're left with nothing again; [referring to the Wave Hub project] *But if they do the same with the drilling, you think of all that disruption, the noise, the mess, you know, and expense, they don't actually see it through 'til the end, which, you know, it all is a possibility.* (Elsie, FG 3)

"And then we were all excited about the Wave Hub, weren't we? That's there but nobody's taken it up! [...] *It's like the same with the solar panels"* (Alice, FG 3).

Due to previous negative experiences with energy projects, Noah assumed a scenario where the geothermal project fails:

"Yeah, it just seems a shame just to, it's such a shame to chuck so much money at it in three years and then say: - Well, it isn't going to work, pack it up -" (Noah, FG 1).

"There's so much other forces out there, but it just doesn't seem to be working very well. You know, we've thrown millions of pounds into the Wave Hub project and we can't get the extension lead to stay on the floor" (Paul, FG 1).

"There's still no wave ... wave power is obviously a very difficult because no one seems to be able to manage it" (William, FG 4); "*It's such a lost opportunity!"* (Mia, FG 4);

"A couple of years ago there was, [energy supplier] were offering, and they have done it, to install solar panels on the roof of people's houses. But they spent literally months and months and months trying to get that through local government, central government. And at every stage up to a certain point they were dropped. Now, I don't understand that at all!" (Oliver, FG 2)

These discussion extracts seem to converge on the idea that renewable energy projects were perceived to be lacking successful management in their county. Thus, the negative past experiences associated with energy projects might have undermined the perceived efficacy toward the successful implementation of renewable energy projects in their own county, such as the new geothermal energy project. Feeling of efficacy on the acceptance of large-scale energy technology has received little attention in past studies. For example, Huijts et al. (2014) measured efficacy perception in the field of energy technology acceptance as the belief that the technology will reduce energy problems. In the present study, the efficacy perception seemed to be related to the belief that energy technologies are successful implemented in people's county. Trust toward external authorities such as the geothermal company seemed to not be compromised, these authorities actually seemed the most trusted among the different level of authorities involved (e.g., Parish Council, Cornwall Council, Environmental agency). The following extract explains why participants felt confident toward the energy company:

"[...] they've got to put their own money in so I always think it's like, you know, fly with the pilot, the pilot wants to go home that night so that's why I always trust a pilot because he's got to drive that plane as best as he possibly can because actually he's at the front, he'll probably die quicker than most of us. And on something like that, if they're putting their own company money in and they're willing to stand there and put their hand up and say, 'We're taking the hit if it goes wrong'" (Mike, FG 1).

At the same time, participants also declared to generally trust the other authorities involved, especially the local Parish Council, keeping some reservations for the Cornwall Council:

"I wouldn't say I don't trust them [the Cornwall Council], I don't trust their ability" (Alice, FG 3).

One interpretation could be that participants mainly felt a type of competence-based trust toward the energy company, and a type of integrity-based trust toward local and regional councils. The first focuses on trust in the performance and expertise, the second refers to trust in the honesty and reliability (van Prooijen, 2019).

2.4.3 Theme 3: "Our mining heritage to the next...generation"

The salience of Cornish identity played a key role in the evaluation of the deep geothermal energy in Cornwall. Spontaneous opinions regarding the connection between Cornish miners and geothermal energy emerged (no specific question about the mining history were asked that could have primed these answers). For example, some participants stated:

"*I think the interesting thing for me is that there is a huge history of innovation, and you know that encompasses from, you know, the industrial revolution in mining and all the rest of it which essentially started here. And it's been carried on ever since. And that's why I like the idea of creating this technology."* (Luke, FG 1);

"*[…] this* [the geothermal project] *takes our mining heritage to the next ...generation, doesn't it? This is where we come from and this is where we're going*" (Helen, FG 3);

"I see links […] with the, you know, the previous wealthy mining industry and then, you know, things going full cycle" (Carl, FG 2).

These participants interpreted the geothermal project as consistent with community members' identities, maintaining the historical continuity with the past. I interpreted this theme as connected with the concept of collective continuity relative to participants' regional identity (Sani et al., 2007; Smeekes & Verkuyten, 2015; Vignoles et al., 2006). Groups' historical and cultural past has, in fact, helped to give meaning to the undergoing lived experiences and changes, attributing a positive valence to these changes. The sense of continuity has been described as a psychological need, which motivates people's identification with groups and influences psychological well-being (Sani et al., 2008; Vignoles et al., 2011) providing existential security (Sani et al., 2009). Conversely, when people's sense of continuity is being threatened, in-group protectionism coping mechanisms and opposition (Smeekes & Verkuyten, 2013), as well as *group action* (Breakwell, 1986), are likely to emerge. Importantly, people's sense of continuity is reported as referring to a positive attribute of their ancestors. In fact, the Cornish were considered among the best miners in the whole world. During the eighteenth and early nineteenth century, Cornwall had the most important mining industry in the UK, supplying tin and copper all over the world (Nuvolari, 2004). The Cornish rocks, together with the high specialised Cornish miners, used to be a matter of pride in Cornwall. The geothermal energy extraction is, as well, made possible by a particular type of rock, granite. Considering the long historical tradition of Cornish hard-rock miners, the geothermal technology reminded people of typical Cornish prototypes, prompting positive attributes of the Cornish Identity. The supportive role of the geothermal technology on people's sense of collective continuity might be, in turn, related to people's need for meaning which reduces the sense of uncertain about who they are, how to feel and behave (Hogg, 2000).

2.4.4 Theme 4: "Cornwall pioneering the way again, showing the world how to do it"

Similar to previous finding for a tidal energy project (Devine-Wright, 2011), the geothermal project was described as a matter of pride for Cornwall, and a project with characteristics that allowed Cornwall to stand out from the rest of England. Talking about the geothermal project, Rose states:

"*There are other places in the country. So, you know, maybe it will be something that we can pioneer in Cornwall."* (Rose, FG 3).

Consistently, Alex expressed a community sense of proudness:

"And so I think we might be quite proud of geothermal" (Alex, FG 2).

In the same group discussion, Victoria pointed out:

"It would be lovely, wouldn't it? […] something unique to Cornwall." (Victoria, FG 2).

The concept of "uniqueness" and the sense of proudness applied to the context of the geothermal project was also pointed out in the other group discussions, for example:

"*It would be an example, wouldn't it, of Cornwall pioneering the way again, showing the world how to do it […] And having that pride in community as well, isn't it? Saying, "Look," you know, "this is a project that's working for us. [...] You know, "It started here. Look everybody, isn't this a great place?" […]*" (Jake, FG 4);

"*it's one more thing to put Cornwall on the map"* (Emely, FG 1);

“*I think it’s just proud again because, you know, you look back through time and Cornwall was always very innovative and leading, very good inventors, good mathematicians [...]* (Mike, FG 1).

Another example came from the second group discussion, Luis stressed the positive innovation feature associated with the geothermal project and the related sense of satisfaction:

“*I think in association with the other technological programmes, such as the, the space centre and the communications, you know telecoms, I think that can all add in together to a sense of satisfaction that we’re actually cutting edge and part of a technological advancement*” (Luis, FG 2).

The sense of distinctiveness and pride associated with the geothermal technology in the interviews above can be related to the identity motives of distinctiveness and self-esteem (Abrams & Hogg, 1988; Breakwell, 1986; Vignoles et al., 2006; Turner, 2010). In fact, people are motivated to maintain and achieve a sense of positive social identities (Tajfel & Turner, 1979; Hogg & Abrams, 1988). The desire to achieve a positive identity motivate ingroup favouritism and outgroup discrimination (Tajfel, 1982). Therefore, the perceived support toward people’s identity motives, given by the geothermal technology, might be one of the major drivers involved in the positive evaluation of the geothermal technology.

2.4.5 Theme 5: “We’re left in the dark by Cornwall Council”

A lack of perceived involvement in the geothermal project emerged from the statements of most of the participants. This was linked to a general discontent among locals and a negative perception regarding the fairness of the decision-making process for the geothermal project (see Gross, 2007). Since fairness perceptions are based on the fundamental psychological need for autonomy (i.e., the need of individual sense of volition and choice, Deci & Ryan, 2000), as shown by van Prooijen (2009), the way in which authorities responsible for the project communicate with the community involved is crucial (e.g., Lavergne et al., 2010).

Locals claimed that more information should have been provided by the energy developers and the local council through face-to-face interactions, for example:

"*I think for the local people there should be someone from the company should come and talk to them actually, because it's something so new"* (Anne, FG 3);

"But we're left in the dark by Cornwall Council, we don't know, do we?" (Lise, FG 3).

Further to the inadequacy of information, participants reported they could not express their opinions during the decision-making process, consistent with Payera's study in Chile (2018). For example:

"*But I think Cornwall council would have to do a proper consultation of it with, you know, lots, seriously with almost like a tick box. Are you for it? Do you want it?"* (Maggie, FG 4).

Participants felt that they could not made a significant difference by then, for example:

"They got, they got past that stage because it's gonna happen. It's happening, isn't it? So, I mean, they're gonna start drilling next week, this week, you know, in the very near future" (Luis, FG 2).

In the field of public perception of energy technologies, fairness of the planning decisions plays an important role in the acceptance of those technologies (e.g., Gross, 2007; Huijts, 2012; Simcock, 2016; Sovacool et al., 2016; Walker et al., 2017; Langer et al., 2018; Lienhoop, 2018). However, in the present study, the discontent about the fairness of the planning decisions was not translated into a feeling of anger in participants as in previous studies (e.g., Huijts, 2018) and into local opposition (so far). Indeed, when participants were specifically asked to indicate their emotions when thinking about the geothermal project, participants reported feeling of excitement in all four groups, for example:

"*Bubble, bubbling excitement, I like that!"* (Robert, FG 1).
"*I feel quite positive, quite excited, to be honest*" (George, FG 2)
"*It is exciting!"* (Valery, FG 3);
"*I think it's really exciting*"! (Mary, FG 4).

Therefore, it seems that participants recognised the problem of not been actively involved during the first stage of the project, and that they should have had the right to have voice. However, this appeared to not interfere with the general positive evaluation toward the geothermal technology.

2.4.6 Theme 6: "Cornwall, the forgotten county"

This theme reflects how participants in the present study might have seen the geothermal technology as an opportunity to improve the status of the Cornish people.

According to social identity theories, strategies used by groups to enhance their status position depend on socio structural variables such as the permeability of group boundaries, the stability of the group status, and the perceived legitimacy of the group status (Ellemers et al. 1993; Tajfel, 1974; 1975; Tajfel & Turner, 1979). Permeability indicates the extent to which it is feasible for an individual to move across groups, whereas stability concerns the possibility to change the current group status. Legitimacy of the group status concerns the extent to which people perceive the status of their group as reasonable and fair. Ingroup favouritism strategies are mainly evident when the group status is perceived to be illegitimate (Tajfel & Turner, 1979).

Compared to other counties, Cornwall is one of the most deprived areas in the United Kingdom (Noble et al., 2019). Cornish people might perceive themselves as a disadvantaged group and see the geothermal technology as an opportunity to enhance their group status. The perceived low group status was also confirmed during the group discussions, for example:

"*[...] we are seen as a backwards society now by a lot of people throughout the country. It would be nice to sort of step forward again really*" (Adam, FG 1)".

In this sense, Adam sees the implementation of geothermal technology as an opportunity to improve the negative stereotypes about Cornish people commonly held by the outgroups.

Feelings of anger toward the disadvantaged conditions of people living in Cornwall were also raised in FG 4:

"So there's a lot of ... as people have already said, it's a, it's a beautiful place to live [..] but it's also a very poor place in some respects" (Ryan, FG4).

"And actually the poverty can be very hidden to people outside of Cornwall. You know, people don't understand, really don't understand how difficult it is, you know ...for so many people. And, you know, people were think... it makes me laugh actually. It makes me ... not laugh, but it makes me quite angry the fact that they say: -Oh, unemployment in Cornwall, you know, is very, very low compared with the rest of the country -." Well, it's low because people are working two or three jobs a day if they can on zero hours' contracts and things like that. So, you know, and it's very, very hard I think" (Jane, FG 4).

Further to the perceived disadvantaged condition, contexts of high social identity identification represent the ideal ground on which ingroup favouritism strategies might develop (e.g., Bonaiuto et al., 1996). In the present study, a strong sense of belonging and "Cornishness" among these communities emerged, for example:

"[...]what I really love and what really strikes me is the fact that Cornish people are proud, proud of their identity and heritage in a way that I haven't seen in any other place" (Jake, FG 4);

"You're proud to be Cornish. It's not just, it's not English or British, it's Cornish" (Donna, FG 3).

Due the nature of the identity being considered (i.e., regional) and the fact that most participants were born and raised in Cornwall, I inferred that members might perceive low permeability of their group boundaries. Therefore, changing group affiliation might not be an available option to enhance their (individual) status (see Ellemers, 1993). For what concerns the socio structural variable of stability, participants of the group discussions reported feeling of hope for the future of people in Cornwall:

"*I'd just like to add, that Cornwall is the poorest county in the whole of the UK, we're almost the forgotten county. But I think we're on the change now. And I think this is one reason why people are actually now writing and wanting to use Cornwall a little bit more. There's more infrastructure now[...]"* (Mary, FG 2).

The sense of a better future for Cornwall might indicate that the status of Cornish group is unstable, therefore that opportunity to enhance the group position does exist (Owuamalam et al., 2018). It is conceivable that the positive, implicit, association between identity motives of continuity, self-esteem, and distinctiveness discussed in Theme 3 and 4 might be related to the disadvantaged social context in which Cornish people are embedded. The premises concerning the socio structural variables of the Cornish group (i.e., impermeable boundaries, illegitimacy of the group status, and unstable status), are consistent with the interpretation of the positive evaluation of the geothermal technology as a possibility for collective identity enhancement.

2.5 Discussion

The present study is the first investigation of people's perceptions of deep geothermal energy in the UK. This research is based on a "real-world" context, in which locals were interviewed around three months before the drilling phase of the project started. Previous studies that investigated what people think about geothermal energy technology have mostly focused on perceived risks, costs, and benefits, level of preferences among other renewable energy technologies (e.g., solar), general measures of acceptability, perceived trust toward the authorities involved in the geothermal project, fairness perception of the decision-making procedures, and knowledge of how the geothermal technology works. Adopting an abductive approach (e.g., Reichertz, 2019; Timmermans & Tavory, 2019; Dubois & Gadde, 2002, 2014), the present study aimed at identifying which relevant socio-psychological and contextual factors were shaping people's thoughts and were, more generally, salient when expressing opinions toward the technology in the specific social context of Cornwall. To accomplish this aim, four focus groups discussions were carried out.

A total of six themes were identified. The first theme concerns the relation between the geothermal energy and environmental issues. Participants explained that some discomforts have to be tolerated by those living near renewable energies projects in order to facilitate renewable energy implementation. In this sense, participants argued that environmental issues are urgent to solve and investment in new technology is therefore justified.

The second theme concerns the experience with past energy projects which were perceived as unsuccessful. In particular, it seemed that energy projects in their own county were perceived to be unsuccessfully managed, this could have possibly undermined thus the acceptability of the geothermal technology.

The third and fourth themes identified were interpreted through the lens of social identity motives of continuity, self-esteem, and distinctiveness. These motives seemed to function as drivers of the acceptance of the geothermal technology. In the present study, I interpreted these motives based on social identity theories (e.g., Abrams & Hogg 1988; Hogg, 2000; Tajfel & Turner, 1979) and research on identity processes and motives (Identity process Theory, Breakwell, 1986; Motivated Identity Construction Theory, Vignoles et al., 2006; Vignoles, 2011; Sani et al., 2007). The peculiar geological features that made Cornwall, during the 18th and 20th century, the most important metal mining county in the UK, nowadays make Cornwall the elite place in the UK to produce a large amount of renewable energy. The deep geothermal technology is the first one in the UK, providing a different and distinctive characteristic between those who are living in the county-implementation area (Cornish) and those who are not (other English/British) salient. This is in line with the *metacontrast* principle of the social-categorisation process, for which people categorised themselves as a member of a group when they perceive the intergroup differences to be greater than the intragroup differences (Turner et al., 1987). The geothermal technology could lead Cornish people to distinguish themselves from other relevant groups, attributing, for example, positive characteristics to them through stereotyping processes (e.g. "Our land will produce again, as in the past, something unique for all the UK"). As Tajfel and colleagues (1974) pointed out, "the characteristics of one's group as a whole [...] achieve most of their significance in relation to perceived differences from other groups and the value connotations of these differences" (p. 71).

Another theme was related to the fairness of the decision-making processes. During the group discussions, people claimed that those responsible for the technology implementation should have had involved citizens in the decision-making processes and that their opinion was not valued. The importance of the fairness perception appears to be linked to the important psychological experience of autonomy that people need to fulfil (Ryan & Deci, 2020; van Project, 2009). However, participants did not express strong negative feelings when discussing the procedure of the decision-making process, which might suggest that the fairness contents are not important for people when evaluating the geothermal technology as long as identity motives are supported by the technology.

In the sixth theme, I observed that this could be particularly true in disadvantaged social contexts and when the group boundaries are impermeable. In these circumstances, people might be more motivated to enhance their group position (e.g., Ellemers et al., 1993) and to give less importance to contextual factor such as perceived fairness. Supporting this reasoning, studies in the field of group disparity and intergroup attitudes have shown that disadvantaged group members present different group-specific needs compared to advantaged group members (Hässler et al., 2021; Shnabel & Ullrich, 2013; Siem et al., 2013). Disadvantaged group members need to perceive that intergroup contact is experienced as empowering, such that the advantaged group members perceive the disadvantaged group as competent and that they care about the disadvantaged group's opinion. In the present study, the way in which group members fulfilled their need to feel empowered might rely on the identity-related positive outcomes associated with the implementation of the geothermal technology.

In light of the present exploratory results, it is possible to identify two main motivational pathways by which social identity processes might guide people's evaluation of the geothermal energy technologies; these require further testing.

A first pathway might be rooted in the importance given to environmental issues and the subsequent environmental concern (Theme 1 and 2). People seemed in fact motivated to accept the geothermal technology because protecting the environment was relevant for their ingroup. Therefore, positive and negative emotions associated with the geothermal energy might have been, to a certain degree, related to their ingroup motivation to limit greenhouse gas emissions (e.g., Harth et al., 2013). This would imply the presence of pro-environmental ingroup norms which contain prescriptions on how to behave in regard to environmental problems (e.g. Gaede et al., 2020). However, this motivation might have been undermined by a perceived lack of ability to successfully manage large-scale renewable energies in their own county. This last aspect should be intended as different from the degree to which people trust the authorities involved in the project, which were, instead, generally trusted. In this sense, the efficacy perception is intended as a county-level shared perception of that specific social context. In summary, the first pathway suggests the investigation of normative and efficacy beliefs in the acceptance of large-scale energy technologies.

The second pathway refers more closely to the social psychology of intergroup behaviour presented by Tajfel and Turner, 1979 (Theme 4, 5, and 6). Briefly, people are motivated to maintain a positive and distinct social identity and are motivated to protect their ingroup. For example, media informing that Germany have produced more renewable energies than the UK could motivate British citizen to sign a petition in favour of a new renewable project in the UK, especially among those who see green and environmental aspects as important attributes for their national identity (e.g., Milfont et al., 2020). Group members could also be motivated to evaluate a specific energy technology more positively when the proposed technology has been framed as positively distinct compared to other technologies being used by a certain outgroup. In fact, people tend to support policies that maintain the ingroup's distinctiveness by separating it from a relevant outgroup (Wohl et al., 2011). The extent to which changes related to the implementation of energy technologies are positively or negatively seen by group members could also be affected by how much these changes are connected with the historical past of the group members (i.e., ingroup continuity). People tend to oppose to outgroups and social developments when their sense of collective continuity is undermined (Smeekes & Verkuyten, 2015). In summary, the second pathway suggests that the implementation of a large-scale energy technologies may support or undermined social identity motives of distinctiveness, self-esteem, and continuity in certain social structural contexts. However, fairness perception of the decision making-procedures calls into question the extent to which the technology is also supporting or undermining people's individual sense of volition and choice (Ryan & Deci, 2000).

Therefore, future studies should further explore if and how these factors are associated in the context of people's acceptance of large-scale energy technologies.

In terms of the limits of the present study, this study's findings are not generalizable to other energy technology implementation contexts (as with most qualitative research). Although, generalizability is a controversial topic in qualitative research since criteria from a positivist paradigm might not be appropriated within interpretivist approaches (Carminati, 2018).

My theoretical preconceptions might have coloured the interpretation of the group discussions (e.g., Suddaby, 2006). Nonetheless, the study was designed to leave ample room for people's spontaneous thoughts and discussions outside the given questions. Moreover, the data were linked to new theoretical insights into the field of people's acceptance of large-scale energy technologies. While previous studies have mainly focus on instrumental-based evaluation in terms of risks, costs, and benefits associates with the evaluation of energy technologies, often leading to a to a "limited risk perception focus" (Chavot et al., 2018), the group discussions in this study were interpreted through the lens of social identity processes, thus expanding the limited contributions of social identity processes applied into the energy technology acceptance field (e.g., Devine-Wright, 2011). Such social identity processes might represent the foundation by which people make meaning of and on which they base their evaluations toward these types of energy projects.

Furthermore, the particular context of this "real-world" research, in which the community involved is actually experiencing what it is like to live near the project site, is a precious opportunity to study the aforementioned processes. Indeed, a large part of studies on energy technology acceptance usually ask people to imagine a potential situation in which large-scale energy technologies have been implemented in their village/country. As this type of energy project requires a lot of time - from when it has been made public to the actual implementation- years of exchanges of opinions, impressions and concerns about the project, within the community, cannot be collected in the above mentioned type of scenario studies.

In conclusion, this present exploratory qualitative study has highlighted an important novel perspective in the field of energy technology acceptance. This will be extended in Study 2, 3, and 4 within a quantitative framework. Study 2 will consider normative and efficacy beliefs dimensions in the acceptance of the geothermal energy in Cornwall; Study 3 will use a concise version of threat toward social identity motives (i.e., social identity violation), to investigate its relationship with social acceptance in Cornwall and its potential moderating role when considering perceived autonomy and fairness perceptions; Study 4 will further examine the role of identity motives by developing ad-hoc measures of support and threat toward these motives, to then examining the relationship between these motives, social acceptance and collective action intentions in Scotland and Wales, controlling for risk perception.

Chapter 3 – Study 2

The SIMPEA model revised for social acceptance of renewable large-scale energy technologies: The case of the first deep geothermal energy technology in the UK.

Abstract

This study examined an adapted version of the SIMPEA model in the field of energy technology acceptance, focusing on the acceptance of geothermal energy in Cornwall (UK). Appraisal of environmental crisis from energy sources, group-based emotions, ingroup identification, descriptive norms, and regional collective efficacy were included in the model and tested using structural equation modelling. Main results indicated that the (i) majority of sequential paths proposed by the SIMPEA model was confirmed and that (ii) ingroup identification did not moderate the association of descriptive norms and regional collective efficacy on social acceptance, working instead as a predictor of them. This study confirmed the key role of positive group-based emotions and descriptive norms in the acceptance of energy technologies. The lack of interaction effects is discussed as well as practical implications.

3.1 Introduction

Transitioning toward renewable energies is one of the most important mitigation strategies for reducing emissions of greenhouse gases (IPCC, 2014). This transition involved a multitude of interconnected systems which must work together to reach the shared goal to mitigate the climate change. Other than cutting-edge renewable technology developments and economic investments, this transition cannot be successful if socio-cultural sides are not complementarily included. The deployment of renewable energy technologies involved different socially-relevant levels, from the creation of appropriated carbon mitigation policies to public awareness and acceptance of these technologies at different scales (e.g., national, regional, local) (Sathaye et al., 2011). The present work focused on the social acceptance of deep geothermal energy technology at regional level, in Cornwall (UK).

Geothermal energy, the natural heat from the earth's interior, is a renewable energy that can ensure reliable energy supply with low environmental impact (Paulillo et al., 2020). Alongside other renewable energy sources (e.g. solar, wind), geothermal energy used for power generation has been recognised as an important contributor to future energy demands (Li et al., 2015). However, the technology used to generate power from the underground has seen disagreements among residents hosting the technology in other countries such as Germany (e.g., Kunze, & Hertel, 2017).

Despite significant advance in understanding key psychosocial and contextual variables in the acceptance of energy technologies (e.g., Steg et al., 2015), a limited number of studies have considered how individual's social acceptance toward these technologies is also motivated by intragroup processes such as normative and efficacy beliefs (e.g., Huijts et al., 2014). More broadly, the literature of different type of pro-environmental behaviours, ranging from private to public sphere (Stern, 2000), has mostly undertook an individualistic approach (e.g. Bamberg & Möser, 2007). As Fritsche et al. (2018) pointed out, since environmental problems can only be limited through joint efforts, the explanation of environmental behaviours should take into account the role of collective self-definition on environmental appraisal and response.

Contesting the individualistic view commonly considered in study of environmental behaviours, Fritsche et al. (2018) proposed the *social identity model of pro-environmental action* (SIMPEA). The present study aimed to test an adaptation of this model as applied to social acceptance of renewable large-scale energy technologies.

In particular, the adapted model examined, via mediation and moderation paths, how social acceptance of geothermal energy technology was associated with appraisal of the environmental consequences from the energy system, group-based emotions, descriptive norms, collective efficacy, and ingroup identification.

Limits of individualistic approaches are evident within a social identity approach that explains people's perceptions, feelings, attitudes, and behaviours as intrinsically grounded in social identity and related processes (see Ferguson et al., 2016). Both implicit and explicit social rules guide how people see and evaluate external circumstances as well as consequences of how they behave in their daily life. People are able to discard their personal cognitive-based perception when confronted with the group opinion (Asch, 1961), yet still do not fully understand how much their social context influences their decisions (Nolan et al., 2008). The social context-dependency nature of human perception is what gives people directions and meaning in their lives (see Hogg, 2020, for a recent review). Therefore, it is not surprising that a simple information provision about a certain object - given to two different individuals - can potentially motivate very distinct perceptions, attitudes, and behaviours, depending on different ideologies and group prototypes (e.g., norms and/or efficacy beliefs) of an *accessible* and *salient* (Oakes, 1987) referent groups in which the individuals self-categorises themselves (e.g., Hogg & Smith, 2007). For example, people in left coalitions are more likely to believe in climate change than people who self-identify with right coalitions (McCright et al., 2016).

Following this line of research, the present study offers several contributions. To date, (i) this is the first study testing the paths suggested by the SIMPEA model; (ii) the study is based on a real-world setting, overcoming limitations due to poor ecological validity; (iii) the results provide insight into how to adapt the SIMPEA model in the context of social acceptance of large-scale technologies and (iv) for general low-effort environmental behaviour; (v) it also provides insight into the prominent role of descriptive social norms and group-based positive emotions in the field of social acceptance of large-scale energy technologies; (vi) a final contribution (beyond SIMPEA) gives insight into people's perceptions of deep geothermal technology in the UK, given lack of evidence in the literature.

Finally, this study offers a full transparent procedure, in line with an open science approach: hypotheses, statistical analyses and transformation procedures have been declared prior data collection.

3.1.1 Research context

This research was based in Cornwall (UK), where the first deep geothermal energy plant in the UK is being installed. The technology used is known as "Enhanced Geothermal Systems". Cornwall has been chosen to be the site of the project because of the unique geological characteristics of its subsoil. The implementation of the deep geothermal power plant requires approximately six months of drilling to make two deep holes to reach a ground level of high temperature (approximately 190 ˚C). Noise pollution is caused only in the first drilling phase. Once the power plant is installed, its visual impact is minimal. Main potential environmental risks include water quality and usage (Macknick et al., 2011) and induced-seismicity (Zang et al., 2014). Compared to other technologies that emit CO_2 geothermal energy produces very low gas emissions (DiPippo, 2012).

3.1.2 Sequential chains of group processes in social identity models

Thoughts, beliefs and behaviours arise from two main levels of identity: individual and social self. Contextual aspects affect the preponderance of a determined role within the social reality where individual traits may influence thoughts, beliefs and behaviours to a certain extent. When a certain social identity becomes salient for an individual, shared collective interests give direction and commitment as strong and internal as those guided by a personal identity (Tajfel & Fraser, 1978, Tajfel & Turner, 1979; Turner et al., 1987, 1994; Turner, 2010). Therefore, individual cost-benefit calculations are not as relevant as the group interests when the group identity is salient.

The relation between social identity/ingroup identification, collective or group efficacy, social norms, and collective or group-based emotions has been postulated in different directions and mostly studied in the field of collective action intention (e.g., Rees & Bamberg, 2014; Thomas et al., 2009; van Zomeren et al., 2008). Beyond the study of general collective action determinants, Fritsche et al. (2018) proposed that, in the context of environmental behaviours, social identity *secondary* processes (e.g., ingroup norms) guide group-based behaviours as the identification with the group makes those processes salient. A brief description of the SIMPEA model, alongside other relevant models of collective action, is presented below.

The *social identity model of pro-environmental action* (SIMPEA, Fritsche et al., 2018) proposes that both environmental appraisal and response are the result of collectively shared interpretation, which is driven by social identity processes. Environmental appraisal concerns large environmental crises such as information appraisal about climate change or appraisal toward a specific element of crisis (e.g. water shortage). The environmental response corresponds to both private (e.g. recycling behaviour) and public spheres (e.g. environmental policy acceptance). If the topic of the environmental crisis (e.g., energy pollution) is relevant for the ingroup, the appraisal and subsequent response toward the environmental crisis of energy pollution are supposed to be affected by four social identity processes: group-based emotions, social norms, collective efficacy and ingroup identification (such processes are defined from Section 3.1.4). Concerning the sequential chain, Fritsche et al. (2018) suggest that group-based emotions mediate the relationship between appraisal of the environmental crisis and social identity processes. In particular, group-based emotions (together with group comparison) should inform and activate the content of the ingroup norm. From there, the sequential chain is ambiguous as it might depend on how the model is contextualised regarding the specific study topic. It is very clear that ingroup norms, collective efficacy beliefs, and ingroup identification may interact in predicting pro-environmental behaviour and that ingroup norms and collective efficacy predict environmental response (and appraisal). The authors argued that there is a lack of evidence for what concerns the role of ingroup identification and ingroup norms in "catalysing the collective efficacy effect" (p. 10), which has not been addressed yet. Masson and Fritsche (2021) further clarified that sufficiently high scores in all of the core social identity variables might be needed for one of them to affect people's action.

The *social identity model of collective action* (SIMCA; van Zomeren et al., 2008) model proposes that social identification should increase perceived group efficacy as efficacy derives from a salient social identity. Both direct and indirect effects of social identity, through efficacy, are thought to influence collective actions. This relation between collective/group efficacy and ingroup identification has mostly been explored in the field of collective actions against collective disadvantage and recently also among advantaged groups (Thomas et al., 2019).

A third model, the *encapsulation model of social identity in collective action*, proposes the opposite direction, with group efficacy influencing ingroup identification (EMSICA; Thomas et al., 2009). In this sense, social identification mediates the effect of efficacy on collective action. Therefore, on the one hand, social identity *facilitates* the experience of efficacy (van Zomeren et al., 2008); on the other hand, social identity *encapsulates* the experience of efficacy (Thomas et al., 2009).

Experimentally manipulating group efficacy, Van Zomeren et al. (2010) showed that group efficacy provides the basis of social identification, and not vice versa, in line with the EMSICA model. Thomas et al. (2012) provided empirical tests of the two models, SIMCA and EMSICA, showing that social identity processes both facilitated and encapsulated relevant reactions such as group efficacy. Thus, the authors argued that the plausibility of the causal ordering might depend on the specific context.

More recent studies have further explained that the two models might coexist (Bamberg et al., 2018; Furlong & Vignoles, 2020). These authors argued that people identify with an opinion-based group motivated by collective efficacy (and injustice) beliefs (EMSICA model), whereas pre-existing identity groups might be more relevant for the SIMCA model (e.g., national identity), as these pre-existing categories make the experience of collective efficacy possible.

Consistently with the causal ordering of the SIMCA model, Rees and Bamberg (2014) found that social norms and collective efficacy mediated the relationship between social identification with the neighbourhood and intention to participate in collective climate action, while the direct relationship between the two was not significant. Similarly, Grant et al. (2015) showed that social (cultural and national) identification did not directly predict involvement in collective protests among immigrants, while collective efficacy was a significant direct predictor.

Finally, Masson et al. (2016) found that the need to see the ingroup in a positive light and as distinct from other groups could lead members to biased perceptions of ingroup norms. The premise is that acting pro-environmentally friendly is seen as a positive attribute. For this reason, members are motivated to evaluate other members' behaviours in a way that satisfy their need for self-esteem and distinctiveness. Specifically, their results showed that ingroup descriptive norms mediated the relationship between social identification and intention to act pro-environmentally.

3.1.3 Why "social acceptance" and not "individual/collective actions"?

The present study focused on social acceptance as the outcome variable in a real-world context. While I see social acceptance as an antecedent of action, I do not expect that the operationalisation of acceptance would translate into behaviour. I reasoned that accepting, being in favour, expressing agreement toward the development of other geothermal technologies in the UK, as well as perceiving the acceptance as a moral issue (i.e., this is how I measured the social acceptance) would be part of a single continuum attitude-behaviour (Andrich & Styles, 1998) where acceptance is located between the attitude and the behaviour. In the present study, I argue that the concept of social acceptance is particularly relevant to answer the main research question: to what extent are group processes associated with people's appraisal of the geothermal technology? Furthermore, people expressed the extent to which they accept/not accept the actual geothermal technology development, and not their *intention* to act in the future, thus making the measure of acceptance strong and realistic.

3.1.4 Group-based emotions

According to Fritsche and colleagues (2018), group-based emotions are expected to influence the formation of norms and goals and further guide group-based environmental action. However, research is needed to test this path. The authors suggest a mediation between emotions and motivations and the environmental crisis appraisal on group-level processes.

Emotions arising from group identification are distinct from individual-level emotions, are experienced to a greater extent when people strongly identify themselves with the group and motivate inter- and intra-group behaviours (Smith et al., 2007). As a consequence of the behaviour of other in-group members, people can experience positive and negative emotions regardless of their actual individual contribution to the decision (e.g., Doosje et al., 1998; Brown & Cehajic, 2008). The SIMPEA model assumes that when focusing on the collective consequences of the environmental crisis, group-based emotions and the resulting motivations emerge. For example, emotions and motivations could emerge when one's own group is evaluated as unsuccessful in acting toward an environmental crisis.

In the general environmental domain, the role of emotions (e.g., Bissing-Olson et al., 2016; Carrus et. al., 2008) and affect (e.g. Leiserowitz, 2006; Coelho et al., 2017) has mostly been studied at the individual level. At this level, a growing interest in the area of energy technologies is developing. Perlaviciute and colleagues (2018) provided a valued-based approach in which people's emotional responses to an energy project are the result of the extent to which people's values are violated or supported by the project. A recent correlational study showed that important factors involved in energy technology acceptance (such as perceived fairness, trust in industry, perceived risks, perceived environmental outcomes, perceived usefulness, and prior awareness) led to experience one or more of the emotions of anger, fear, joy, and pride (Huijts, 2018). Ruiz and colleagues (2018) found that negative emotions and low perceived benefits generated low acceptance of an oil drilling project. Studying the evaluation of a tidal energy project, Devine-Wright (2011) found a major positive emotional response (e.g. excitement, pride) across populations living nearby. Positive and negative emotions were also significant predictors of information engagement intention about enhanced geothermal technology in the United States (Lu et al., 2021).

However, there is a lack of research that focuses on group-based emotions in the context of energy technology acceptance. Only a handful of studies have considered group-level emotions in different environmental contexts. Ferguson and Branscombe (2010) found that feelings of collective guilt deriving from the awareness of ingroup responsibility for environmentally harmful behaviours led to the elicitation of mitigation behaviours. Harth and colleagues (2013) showed that ingroup responsibility for environmental damage and protection respectively predicted ingroup-levels of guilt and pride. Analysing people's intention to participate in collective climate action, Rees and Bamberg (2014) showed that group-based guilty conscience positively predicted participation intention. Onwezen (2015) examined perceived emotions of one's ingroup on sustainable food choices, showing that negative emotions are stronger for collective emotions while positive emotions are stronger for private emotions. Measuring group-based emotions as the extent to which people feel negative emotions when thinking about what their government and economy are doing to stop climate change, Bamberg et al. (2015) showed that such emotions have a direct effect on the intention to participate in community-based pro-environmental initiatives. More recently, it has been shown that the positive feeling of being moved and group-based anger enhanced collective action for forest protection (Landmann & Rohmann, 2020).

In the present study, group-based emotions were measured as the extent to which people feel positive and negative emotions when thinking about the decision made by their ingroup (local authorities and communities) to implement the geothermal technology in Cornwall. The goal was to capture the perceived group-based emotions related to the specific decision to install the geothermal energy in order to strengthen their correspondence with the outcome variable. In this sense, I expected positive emotions to arise from the awareness that the geothermal technology would be producing renewable and sustainable energy, which explains why the more people appraise the environmental crisis as urgent the more they experience positive emotions related to the decision to install the technology. Indeed, belonging to the group settled in the best place in the UK to produce clean and sustainable geothermal energy might lead to a positive sense of pride among the Cornish group as well as a sense of hope for future generations. At the same time, people might also experience negative emotions such as worry about the costs and risks associated with the decision to install the technology. Other types of negative emotions could also emerge from a more general appraisal of the decision as illegitimate (e.g., group-based guilt and anger). Negative emotions might occur especially at low levels of perceived environmental problems from energy sources (Fritsche et al., 2018). However, as Doosje et al. (1998) pointed out, "negative group-image-threatening emotions" (p. 879) might be subject to denial mechanisms as a defensive reaction.

3.1.5. Regional collective efficacy

Measures of collective efficacy vary in the literature, depending on the study context. For example, Thomas et al. (2020) measured efficacy as political efficacy (i.e., "The average citizen can have an influence on government decisions") whereas Thomas et al. (2012) measured efficacy as group efficacy (i.e., "I feel that together the 'Water for Life' program will be able to improve the water situation in developing nations"). In the context of the acceptance of energy technologies, Huijts et al. (2012) discussed two types of efficacy. The belief that the implementation of the technology might be susceptible to one' own individual will, and the belief that the technology will reduce energy problems. Recently, Gaede and colleagues (2020) described efficacy perception in terms of the ability to influence decisions regarding the use of energy storage technologies. Choi and Hart (2021) operationalised collective efficacy as the perceived likelihood that a large number of people would reduce their energy use for climate change mitigation.

The measure of collective efficacy of the present study is closely related to a more recent conceptualisation of collective efficacy in the context of the COVID-19 pandemic. Dryhurst et al. (2020) measured collective efficacy as the extent to which people feel that the actions that their countries are taking to limit the spread of coronavirus would make a difference. This belief was a positive predictor of risk perception of COVID-19. During lockdowns, people needed to believe that their effort to accept the pandemic guidelines would help to prevent the spread of COVID-19 in order to accept those measures (Tunçgenç et al., 2021). The measure of collective efficacy in the present study was adapted to the specific context of social acceptance of large-scale technology in terms of regional collective efficacy where the individual does not have a direct role in achieving goals such as the implementation of renewable energies. The feeling of regional collective efficacy was operationalised as the belief in one's own group ability to successfully manage and achieve its goals in renewables. Large-scale projects such as the geothermal energy technology required considerable economic investment (2.4 million from Cornwall Council for the geothermal project), environmental and human safety risk taking, noise pollution and landscape aesthetics considerations, and also consideration of associated issues such as tourism and property values. Although single citizens do not have an active role in the successful implementation of the geothermal technology (apart from passively accepting or actively protesting against the technology), they need to believe that the efforts made are worthwhile. They should believe that the ingroup effort to implement renewable technology in their hometown and/or country will effectively achieve its goals in order to accept the project. Similarly, it has been shown that teachers who believe that their school as a whole is capable of coping with tasks and problems in different settings are more attached to the school's goals (Caprara et al., 2003). Taking a problem such as earthquake exposure (Muldoon et al., 2017) as an example: when people expect their ingroup to cope well with earthquake exposure (i.e., national collective efficacy), but the ingroup does not actually cope well with such problem, this discrepancy between expectation and reality can increase people's level of post-traumatic stress following the event. These authors also found a positive effect of national collective efficacy on post-traumatic growth. These results show the relevance of national collective efficacy on people's beliefs and feelings.

It could be argued that if people perceive that large-scale projects are not successfully managed in their country, they will be less prone to accept such projects, and vice versa. The collective efficacy appeared particularly relevant to the present project because of the collective nature of both the environmental crisis and the implementation of the large-scale energy technology. Furthermore, citizens in the present research context have past experiences with similar projects based in Cornwall such as the Wave Hub project (see Study 1 of the present thesis). This project consists of a floating offshore wind and wave power research placed in the North coast of Cornwall. Local media reported news on how effective the project was in reaching its ultimate goals, e.g.: "Wave Hub off the coast of Cornwall has received up to £42m in public money but not produced a single KW of electricity in six years" (Whitehouse, 2018). Therefore, beliefs of regional collective efficacy regarding geothermal technology acceptance might be affected by such previous experiences.

3.1.6 Descriptive norms

A number of studies demonstrate the power of social norms in influencing pro-environmental behaviours (Cialdini, et al., 1990; Cialdini & Goldstein, 2004; Cialdini & Jacobson, 2021; Goldstein, et al., 2008; Nolan, 2021). As Fritsche and colleagues (2018) pointed out, norm conformity occurs from group-membership identification and people's willingness to adopt ingroup attributes. Intergroup comparison has been described by the authors as the main process that affects the appraisal of the environmental crisis and it provides information about ingroup norms. Normative influence has commonly been divided into two main forms (Cialdini et al., 1991). It consists of what others commonly approve or disapprove (injunctive norm) and what others typically do (descriptive norm). Thus, these salient rules in a given situation make people follow pro-environmental behaviours such as reusing towels in hotels (Schultz et al. 2008), saving energy (Dwyer et al., 2015; Wittenberg et al., 2018), recycling (White et al., 2009; Fornara et al., 2011), adopting photovoltaic systems (Korcaj et al., 2015; Curtius et al., 2018), purchasing meat (Lai et al., 2020), and setting home temperatures (Idahosa & Akotey, 2021). Liebe and Dobers (2019) found that the perception that other significant people would be in favour of the person's contribution to climate protection affected intentions regarding the construction of new power plants for renewable energy production. Another study showed that social norms influenced the willingness to participate in community energy projects (Kalkbrenner et al., 2016).

Few studies examined how social norms directly give direction toward the acceptance of an energy technology. In Huijts and colleagues' study (2014), social norms had a weak relation with the intention to act in favour of a hydrogen fuel station. According to the authors, the implementation of the hydrogen fuel station was at an early stage and citizens were probably not able to use other people's opinions as an information source as they had previously not thought about it or exchanged opinions with others. In the present study, social norms are expected to play a more relevant role. The geothermal project was made public in 2009 and the first phase of installation of the geothermal plant started almost 10 years later (2018). Participants' recruitment for the present study started in mid-2019, i.e. a few months before the drilling phase. Many visiting events for the general public as well as educational workshop for the youngest had been carried out by the project team during the implementation phases. Also, it was a popular subject reported in national and local newspapers. Therefore, the topic of the geothermal technology was very salient and it was expected people to have several opportunities to discuss and exchange opinions about the technology with other people in their city/village as well as on social media. It seemed reasonable that the majority of people would have had a clear idea about the extent to which other people in their region would accept the geothermal technology. Moreover, the majority of people would not possess the complex geological and engineering expertise necessary to deeply understand pro and cons of the geothermal technology (Pellizzone et al., 2015). Especially under uncertainty conditions, the information provided by the social context acts as a guidance for what to believe and how to behave (e.g., Deutsch & Gerard, 1955; Gelfand & Harrington, 2015).

Recently, Gaede et al. (2020) showed that the descriptive norms positively predicted support toward energy storage technologies. Among several psychological factors, social norms were the strongest predictors of acceptance of climate engineering technologies (Klaus et al., 2020). Experimentally manipulating descriptive-social norms, Wang et al. (2021) found that social descriptive norm information enhanced people's support for Carbon Capture and Storage (CCS) technology in China.

Based on this summary of relevant concepts and literature from a perspective of social identity, the present study investigated, via mediation and moderation paths, the association between social identity processes and social acceptance of the geothermal energy. The next section illustrates these paths.

3.1.7 Pre-registered hypotheses

The pre-registered model includes the following hypotheses[1] (see Figure 1):

H1: Appraisal of the environmental crisis from the energy system is positively associated with positive group-based emotions, and negatively with negative group-based emotions;

[1] Note that the pre-registered hypotheses were less specific than those presented here. I did not specify the positive or negative directions of the hypothesised paths in the pre-registration because these are implicitly included within the SIMPEA model. However, in order to improve clarity, I have been more explicit in the present hypotheses definitions.

H2: Positive and negative group-based emotions are respectively positively and negatively associated with descriptive norms and collective efficacy.

H3: Descriptive norms is positively associated with social acceptance of the geothermal energy;

H4: Collective efficacy is positively associated with social acceptance of the geothermal energy;

H5: Ingroup identification moderates the effect of descriptive norms and collective efficacy on social acceptance of the geothermal energy. It is expected that the association of descriptive norms and collective efficacy with social acceptance of the geothermal energy is stronger for high level of ingroup identification;

H6a, H6b, H6c, H6d: There is an indirect relationship between appraisal of the environmental crisis and social acceptance, mediated by: group-based positive emotions and descriptive norms (H6a); group-based positive emotions and collective efficacy (H6b); group-based negative emotions and descriptive norms (H6c); and by group-based negative emotions and collective efficacy (H6d).

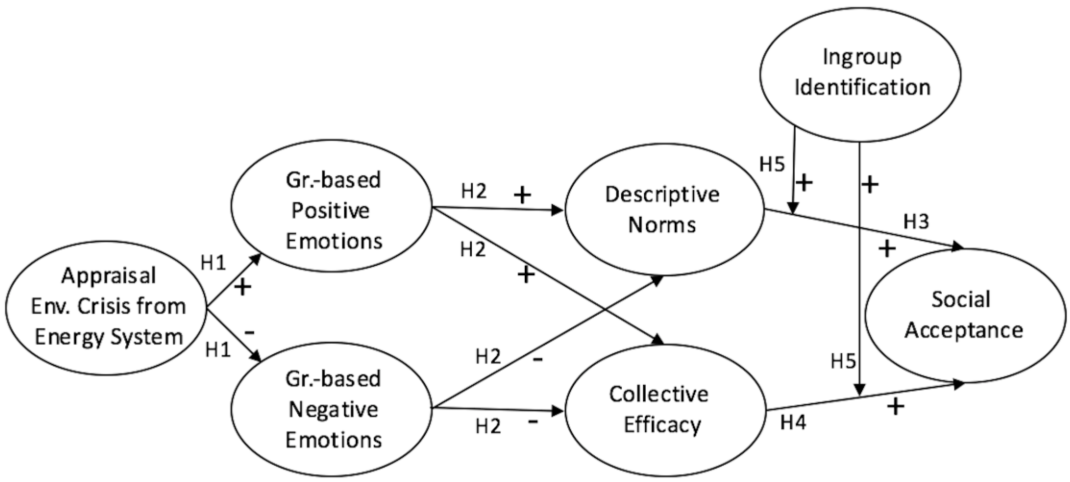

Figure 1. Conceptual model (Study 2).

3.2 Method

3.2.1 Participants

Both rule of thumbs and a post-hoc population of root mean square error of approximation (RMSEA) approach (MacCallum et al., 1996) were used to evaluate the required sample size. A minimum number of 400 – 500 participants has been suggested when running models with latent interaction effects computed using a product indicator approach (e.g., Kline, 2015). Therefore, I aimed to recruit at least 450 participants. Data were collected between the last months of 2019 (n = 513) and the first months of 2020 (n = 17). A total of 530 participants were recruited. Participants living in Cornwall were recruited via the online survey platform CINT (n = 186), from advertisements on social media (n = 230), and from Cornish students of the University of Plymouth (n = 115). Participants had to be resident in Cornwall, not be directly involved in politics, and be 18 years or older. CINT participants were compensated based on their agreement with CINT, and they also had the opportunity to participate in a lottery to win Amazon or Boots vouchers. Those recruited on social media were informed that they would have the opportunity to participate in the lottery, while students were given course credits and were allowed to participate in the lottery as well.

Thirty-four participants were excluded for not having explicitly declared Cornwall residence. Therefore, a total of 496 participants were included in the final dataset. The post-hoc power analysis based on population RMSEA (MacCallum et al., 1996) showed that 496 participants were sufficient to achieve power of 1. Null and alternative RMSEA were respectively fixed at .050 and .01 ($df = 334$; $\alpha = .01$).

3.2.2 Procedure

Participants were told that the purpose of the study was to explore people's opinions of geothermal energy in Cornwall. Prior to starting the online questionnaire and after giving consent to participate in the study, participants were offered a brief description of what geothermal technology is. The information included was based on information provided by the British Geological Survey website and reviewed by an expert geologist professor from the University of Plymouth. The order of questions in the online questionnaire represented the paths described by the SIMPEA model (from left to right in the current conceptual model), see 3.2.3 Measures section.

3.2.3 Measures

All items were rated on a 7-point scale. An agreement scale (from 1 [*strongly disagree*] to 7 [*strongly agree*]) was used for items measuring appraisal of the environmental crisis, ingroup identification, descriptive norms, regional collective efficacy, environmental group identity, and social acceptance.

Socio-demographic variables consisted of gender, age, place of residence, highest educational level, and political orientation. 225 participants were male (46.3%), 10 preferred to not answer. 29.2% were aged between 18-30, 41.1% between 31-60, and 29.6% between 61-80+ (M = 45.83; SD = 18.35). About half participants had a university degree (47.98%), 6% preferred to not disclose their education. Political orientation was measured via a 10-point scale, from 0 (left orientation) to 10 (right orientation). Those who answered $\leq$ 3 were the 44.76% (left orientation), those who answered $>$ 6 were the 13.10% (right orientation), the centre represented the 34.88% ($>$ 3 & $\leq$ 6). The 7.26% of participants did not answer this question. All participants declared to be resident in Cornwall.

Level of knowledge

Participants were asked to indicate how much they knew about the geothermal project in Cornwall (one item): "How much do you know about the geothermal project in

Cornwall?". Responses ranged from 1 (*you don't know anything about the geothermal project – nothing*) to 7 (*you are really well informed about the geothermal project – very informed*).

Appraisal of the environmental crisis from the energy system

Appraisal of the environmental crisis from the energy system was measured using the following four items: "I am worried about the environmental consequences of fossil fuels (coal, petroleum, etc.)"; "Fossil fuel energy use is linked to severe environmental problems"; "Reduction of greenhouse gas emissions from fossil fuels is urgent"; reverse scored "Claims that current levels of energy pollution from fossil fuels are changing the environment are exaggerated". The last item was adapted from Hansla et al. (2008), the rest are ex-novo.

Group-based emotions

Participants were asked to indicate the extent to which they felt a total of 12 emotions (six positive and six negative) when thinking about the decision made to implement the geothermal technology in Cornwall by local authorities and communities in Cornwall. Based on the highest mean values, only the three most relevant positive emotions (proud, hopeful, good) and the three most relevant negative emotions (worried, anxious, frustrated) were included in the model to reduce correlated residuals (Bandalos, 2021). Responses ranged from 1 (*not at all*) to 7 (*very strongly).*

Ingroup identification

The following items were used to measure social identification with the Cornish group (six items): "I see myself as Cornish"; "I am glad to be Cornish"; "I identify with other Cornish people"; "I feel connected with other Cornish people"; I see myself as more

Cornish than British"; reverse scored "To be identified as "Cornish" or "British" would be exactly the same for me". The first four items were adapted from Van Zomeren et al. (2010), last two were informed by Study 1 of the present thesis.

Descriptive norms

Descriptive norms[2] were operationalised as the extent to which people think that other Cornish people accept or reject the installation of the geothermal technology and think that it can provide sustainable energy (four items): "I think that most people in Cornwall agree that geothermal energy can provide a sustainable energy"; "I think that most people in Cornwall accept the installation of the geothermal technology"; reverse scored "I think that most people in Cornwall reject the installation of the geothermal technology"; reverse scored "I think that most people in Cornwall disapprove of the choice to install a geothermal technology".

Regional collective efficacy

Regional collective efficacy was operationalised as the belief in the ingroup ability to successfully manage and achieve its goals in renewables (four items): "I am confident that Cornish people can, together, boost the implementation of renewables"; "I am sure that, as Cornish people, we can achieve progress in renewables, because we are all pulling in the same direction"; Cornish people can come up with creative ideas to implement renewable energy use effectively, even if the external conditions are unfavourable"; reverse scored "Efforts to increase the use of renewable options are in vain, Cornish people will struggle to make it work". Items were adapted from Chen (2015).

[2] The pre-registration file erroneously names these norms as injunctive rather than descriptive.

Environmental group identity

Environmental group identity is an adaptation, for the group context, of the (personal) environmental identity described by Van der Werff and colleagues as "the extent to which you see yourself as a type of person who acts environmentally-friendly" (2014, p. 56). Therefore, environmental group identity was defined as the extent to which you see your ingroup as a type of group who acts environmentally-friendly. Three items were adapted as follows: "Acting environmentally friendly is an important part of being Cornish; "Cornish people are the type of people who act environmentally friendly"; "I see my Cornish community as composed of environmentally friendly people".

Social acceptance

Five items were used to assess social acceptance: "I am in favour of the geothermal project"; "I think that implementing geothermal technology in Cornwall is the right thing to do"; "I would vote for the implementation of geothermal technologies also in other parts of England"; "In general, I accept the geothermal technology"; reverse scored "All things considered, I am opposed to geothermal technology".

3.2.4 Analytic approach

A correlational design was adopted to test the relations between exogenous and endogenous variables via structural equation modelling. The analyses were carried out in R (version 4.0.3), mainly using the package *lavaan* 0.6-7 (Rosseel, 2012) and *semTools* 0.5-5.912 (Jorgensen et al., 2021).

Preliminary analyses were first carried out. These aimed at 1) verifying whether the association between physical proximity between people's village of residence and the geothermal technology location was relevant in the explanation of the geothermal technology social acceptance; 2) examining the measurement model of the constructs of interest and eventually improving the model until adequate model fit indices were obtained; 3) investigating the key hypotheses using aggregated measures via multiple regressions. Based on these results, the analytic strategy was further expanded including new exploratory structural paths that appeared as relevant to be tested. This is better explained in section 3.3.3.

3.3 Results

3.3.1 Physical proximity and social acceptance

The effect of physical proximity to the geothermal technology on attitude and acceptance of climate change related projects is still discussed in the NIMBY paradigm (e.g., Hart et al., 2015; Uji et al., 2021). Therefore, I first examined whether physical proximity to the geothermal energy was associated with the level of acceptance. The distance between participants' place of residence and the geothermal technology location was calculated in kilometres (straight line between the two points). Four participants did not indicate the specific city/village of residence while indicating only "Cornwall", therefore this analysis included four NAs. Regression analyses revealed no significant relationship between physical proximity and social acceptance (β = -.002; p = .278), in line with other studies examining the effect of the physical proximity of climate mitigation projects on public support (e.g., Hart et al., 2015). A visual inspection through boxplots of the aggregate mean of social acceptance grouped by three distance subcategories consisting in "small" (≤ 9.03 Km, n = 127, i.e., ≤ 25° percentile), "medium" (> 9.03 km & ≤ 21.74 km, n = 122, i.e., ≤ 50° percentile), and "large" (> 21.74 km, n = 243, i.e., > 50° percentile) distance, further confirmed no relationship between social acceptance and spatial proximity. This analysis excluded those who only indicated "Cornwall" as their place of residence, without specifying their village/city (n = 4).

For graphical purposes, participants' social acceptance scores were aggregated according to place of residence (e.g., Truro, Redruth, etc.) by taking an average. For example, if participant "A" from Truro had an average level of acceptance of 4.25 (aggregating the four items of acceptance) and participant "B" from Truro had an average level of acceptance of 5.25, the aggregate measure of acceptance for those living in Truro was 4.75. Therefore, data points in Figure 2 correspond to average social acceptance in each place of residence considered ($N = 90$). The result was then mapped according to the latitude and longitude coordinates of each city/village. As shown in Figure 2, participants largely accepted the geothermal technology.

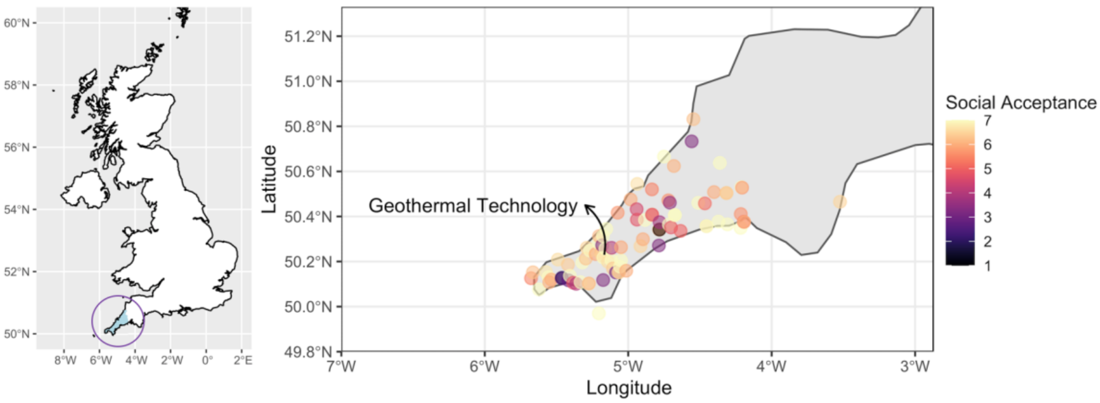

Figure 2. Data points by participants' city/village of residence representing average level of social acceptance of deep geothermal energy in Cornwall (UK).

3.3.2 Measurement model

A Confirmatory Factor Analysis was first run (CFA). The evaluation of the model fit was based on conventional criteria. For the Root Mean Square Error of Approximation (RMSEA) and the Standardized Root Mean Square Residual (SRMR) indices values ≤ .08 indicate a reasonable fit (Hu & Bentler, 1999). Regarding the Comparative Fit Index (CFI) and the Tucker–Lewis index (TLI), an acceptable fit is indicated by values > .90, values close to 1 indicate a better fit (Bentler, 1990). Examination of variables' distribution was carried out using density and Q-Q plots, which showed not normally distributed data. Therefore, a maximum likelihood estimator with robust standard errors

(MLR) was employed as it is robust against violations of normality. Accepted loadings were set to ≥.5.

Step 1

A confirmatory factor analysis including the original pre-registered items was tested. The model showed poor model fit (χ^2_{329} 1510.918, $p < .001$; SRMR =.087; RMSEA= .094, 90% confidence interval (CI) [.089, .099]); CFI= .856; TLI= .835). All the reverse coded items loaded weakly onto their corresponding factor (range between -.007 and .514). This was in line with previous literature showing that reverse code items can negatively affect the covariance structure of a scale (e.g., Zhang et al., 2016). Therefore, all reverse coded items were dropped. As the descriptive norms scale included two, out of four, reverse coded items, the two remaining loadings were constrained to be equal to avoid empirical under-identification (Kline, 2015). The result from the CFA showed that the model fit improved when dropping all the reverse coded items, showing acceptable fit to the data (χ^2_{210} 506.843, $p < .001$; SRMR =. 039; RMSEA= .059, 90% confidence interval (CI) [.053, .066]); CFI= .961; TLI= .954). Standardised factor loadings ranged between .651 and .965.

Step 2

In this step, the model residuals were extracted. The highest residual covariance was shared between two indicators of the Cornish identity scale (r = .203). In fact, the modification index suggested that including the residual correlation between the indicators “I identify with other Cornish people” and “I feel connected with other Cornish people” would have improved the χ^2 statistics by 231.821. The Spearman correlation between those items of the Cornish Identity was >.80 (r = 0.85, $p < .001$), indicating redundancy. This was consistent with van Zomeren at al.’s study (2010), from which I adapted the scale, as the Cronbach's alpha of the same scale in their study suggests high correlation between the scale items (*a* = .90). It has also been recently addressed that similar item meanings are likely to exhibit correlated residuals in confirmatory factor analysis (Bandalos, 2021). To account for the redundancy effects, a new model with the residuals correlation between the two indicators was tested. The fit of the model improved and fit well (χ^2_{209} 311.840, $p < .001$; SRMR = .041; RMSEA= .035, 90% confidence interval (CI) [.026, .043]); CFI= .987; TLI= .984).

Step 3

As a last step, the latent covariate "environmental group identity" was included in the model. The model showed good loadings and acceptable fit indices (χ^2_{271} 406.170, $p < .001$; SRMR = .043; RMSEA= .035, 90% confidence interval (CI) [.028, .042]); CFI= .985; TLI= .982).

The correlation matrix presented in Table 2 refers to the averaged indicators after the measurement model (CFA) test. Parameter estimates of the CFA model are presented in Table 3.

Table 2
Means, standard deviations, Cronbach's Alpha, and bivariate correlations.

	M (SD)	*α*	1	2	3	4	5	6	7	8
1. Social acceptance	5.92 (1.32)	.95	1.00							
2. Appraisal of environ. crisis	5.78 (1.42)	.91	.44 ***	1.00						
3. Group-based posit. emotions	5.14 (1.46)	.87	.66 ***	.41 ***	1.00					
4. Group-based negat. emotions	2.33 (1.42)	.86	-.50 ***	-.24 ***	-.46 ***	1.00				
5. Reg, collective efficacy	5.11 (1.32)	.89	.43 ***	.30 ***	.51 ***	-.19 ***	1.00			
6. Ingroup identification	4.45 (1.9)	.93	.07	.00	.18 ***	.00	.29 ***	1.00		
7. Descriptive norms	4.75 (1.38)	.86	.45 ***	.15 ***	.49 ***	-.25 ***	.54 ***	.27 ***	1.00	
8. Environment. group identity	5.07 (1.48)	.91	.31 ***	.30 ***	.38 ***	-.07	.61 ***	.22 ***	.40 ***	1.00
9. Knowledge	2.90 (1.89)	n.a.	.25 ***	.11 *	.25 ***	-.11 *	.12 **	.13 **	.22 ***	.05

p* < .05, ** *p* < .01, * *p* < .001
Note. Cronbach's Alpha is calculated using polychoric correlations via *semTools::reliability()*

Table 3
Parameter estimates of the confirmatory factor analysis (Study 2).

Latent Factor	Indicator	*B*	SE	Z	*p*-value	*β*
App. Env. Cri.	crisis_2	1.000	.000			.957
	crisis_1	.939	.043	21.684	< .001	.842
	crisis_3	.929	.046	20.058	< .001	.836
Soc. Accep.	accep_2	1.000	.000			.965
	accep_1	.984	.029	33.379	< .001	.946
	accep_3	.957	.035	27.233	< .001	.859
	accep_4	.907	.045	20.198	< .001	.893
Coll. Effic.	effic_1	1.000	.000			.904
	efficacy_2	.976	.031	31.318	< .001	.870
	efficacy_3	.943	.035	27.048	< .001	.805
Gr. Pos. Em.	hopeful	1.000	.000			.857
	proud	1.097	.050	22.049	< .001	.834
	good	1.042	.048	21.812	< .001	.824
Ingr. Ident.	soc_ide_2	1.000	.000			.952
	soc_ide_1	1.025	.021	49.054	< .001	.934
	soc_ide_3	.764	.030	25.485	< .001	.812
	soc_ide_4	.627	.034	18.687	< .001	.714
	soc_ide_5	.855	.035	24.729	< .001	.775
Gr. Neg. Em.	worried	1.000	.000			.914
	anxious	1.061	.067	15.921	< .001	.896
	frustrated	.727	.060	12.162	< .001	.651
Descr. Norms	norm_1	1.000	.000			.877
	norm_2	1.000	.000			.862
Env. Gr. Iden.	env_id_2	1.000	.000			.920
	env_id_1	.898	.040	22.567	< .001	.828
	env_id_3	.962	.039	24.746	< .001	.893

B = non-standardised estimate; *SE* = standard error; Z= test statistic; *p*-value = values of *p* corresponding to the z-statistic; *β* = standardised estimate. *Note.* The first indicator of each latent construct was used as a marker for scaling and identification purposes.

3.3.3 Testing direct and interaction effects with the aggregated measures

The effect of the two interactions on social acceptance was preliminarily tested using aggregate measures and a robust standard error estimator to account for heteroscedasticity ("HC3", see Long & Ervin, 2000). Both results and visual inspection showed no interaction effects, while the direct effect of the regional collective efficacy

(β = .45; p = < .001) and descriptive norms (β = .37; p = .001) on social acceptance was significant.

As Masson and Fritsche (2021) further clarified, sufficiently high scores on both social norms and collective efficacy might be needed for one of them to have an effect on people's intentions. Therefore, a three-way interaction using ingroup identification and social norms as moderators was also explored. The three-way interaction was not significant.

A model with all variables included was then fitted: appraisal of the environmental crisis, positive and negative emotion, ingroup identification, descriptive norms, and regional collective efficacy were regressed on social acceptance. All direct paths were significant except for ingroup identification.

Based on these preliminary results, further paths were added to be explored via structural equation modelling. The remaining results section is structured into three sub-sections:

1) Pre-registered model 1 – full model. The pre-registered structural equation model was tested;

2) Pre-registered model 2 – parsimonious model. Only the central variables (ingroup identification, social norms, collective efficacy) were tested, as described in the pre-registration as alternative to the full model.

3) Exploratory model. In this exploratory model, the ingroup identification is supposed to activate expectations about what the in-group actually does (descriptive norms) and what the in-group is able to achieve (collective efficacy). In this sense, perception of regional collective efficacy and descriptive norms stem from a salient social identity. No interaction effects were included: ingroup identification is conceptualised as a predictor of descriptive norms and regional collective efficacy. This exploratory model was based on previous literature highlighting the role of ingroup identification as a predictor of social norms norms and collective efficacy (Rees & Bamberg, 2014 for both norms and efficacy; van Zomeren et al., 2008 for the efficacy; Masson et al., 2016 for the norms).

All the pre-registered paths were included (crisis → emotions→ efficacy/norms → acceptance) and two direct effects between group-based emotions (positive and negative) and social acceptance were further included as these were recently found to be important drivers in the specific context of enhanced geothermal systems (Lu et al., 2021) and in close contexts such as perceived emotions from gas extraction procedures (Vrieling et al., 2021). The relationship between norms, efficacy and identity was conceptualised as follows: ingroup identification would be associated with both regional collective efficacy and descriptive norms, and these in turn would positively be associated with social acceptance. This exploratory model included the same correlated residuals as the confirmatory model (i.e., between two items of ingroup identification, and between positive and negative emotions). Also, the direct effect of ingroup identification on social acceptance was controlled. Figure 4 in the Results section further clarifies the paths of this exploratory model.

3.3.4 Results of the pre-registered model 1 – full model

3.3.4.1 Transformation of variables for the moderation analyses

The interactions in the structural model were computed using an unconstrained approach, via product indicators, which is robust against violation of multivariate normality (Marsh et al., 2004). This approach showed comparable results to other approaches used in structural equation models such as the 2-stage least square and the latent moderated structural equation estimators (Brandt et al., 2020; Wu et al., 2013). The new variables were created using a match-paired approach (see Marsh et al., 2012) and using a double-mean-centering strategy (the latter performs better than other strategies when the assumption of normality is violated, Lin et. al., 2010). Therefore, each mean of the indicators was centered, as well as the resulting product indicator. As the number of indicators was different across factors and a match-paired approach was adopted, some items were parcelled so that each factor would have the same number of indicators. This procedure has been suggested by Marsh and colleagues (2004; 2012). For the product indicators between the ingroup identification indicators and the collective efficacy indicators, two pairs of indicators of the ingroup identification variables were averaged, so that the ingroup identification variable had three indicators in total as well as the collective efficacy variable. Then, the three indicators of the ingroup identification variable were matched with indicators of the collective efficacy only once (the information from the same indicators were not repeated). The same procedure was adopted for the interaction with the descriptive norms. The choice of what indicator should match with what other indicator was based on indicator quality (i.e., loadings) as suggested by Marsh and colleagues (2004).

Step 1

The proposed structural model could not be accepted because the SRMR index did not achieve an acceptable value (χ^2_{335} 856.413, $p < .001$; SRMR = .119; RMSEA= .062, 90% confidence interval (CI) [.057, .068]); CFI= .940; TLI= .932). An inspection of the residual covariance matrix of the structural model showed correlated values between indicators of the positive and negative emotions (for example, between "anxious" and "good", res = .273, unstandardised). It seemed reasonable that the two collective emotions factors could share error variance. In fact, the perceived emotions were investigated by asking one question for both positive and negative emotions which probably contributed to shared error variance (Cole et al., 2007). Therefore, residuals of positive and negative emotions were allowed to correlate. This strategy to freely estimate the covariance between positive and negative affects was also adopted in previous studies examining similar topics (e.g., Huijts et al., 2014; Midden & Huijts, 2009; Onwezen et al., 2014). For example, Onwezen and colleagues allowed the two endogenous factors of anticipated pride and guilt to correlate in their structural equation model.

Then, the model was ran again including the correlated residuals between positive and negative emotions. The model showed an improvement but the SRMR index was still not acceptable (χ^2_{334} 803.096, $p < .001$; SRMR = .105; RMSEA= .059, 90% confidence interval (CI) [.054, .064]); CFI= .946; TLI= .939).

3.3.5 Results of the pre-registered model 2 – parsimonious model

In this parsimonious model, the SEM model only included the main variables of interest (i.e., ingroup identification, regional collective efficacy, descriptive norms, social acceptance). The model fit was acceptable (χ^2_{138} 433.280, $p < .001$; SRMR = .042; RMSEA= .075, 90% confidence interval (CI) [.067, .083]); CFI= .949; TLI= .936) and good when including the residuals correlations described in step 2 of the confirmatory factor analysis (i.e., between the two ingroup identification items) (χ^2_{137} 242.982, $p <$ .001; SRMR = .043; RMSEA= .045, 90% confidence interval (CI) [.035, .054]); CFI= .982; TLI= .977). Both models, with and without the residual correlations, had the same significant and non-significant regressions showing consistent and stable paths.

The model with included residual correlation is discussed here: there were significant relationships between social acceptance and group processes of descriptive norms (β = .44 [.318, .568]; p = < .001) and regional collective efficacy (β = .22 [.087, .358]; p = .001), confirming H3 and H4. The direct relationship between ingroup identification and social acceptance was not hypothesised, however I had to include this path in order to test the interactions. This direct relationship was not significant (β = -

0.07 [-.052, .007]; p = .074), nor were the interaction effects between ingroup identification and collective efficacy (β = -.13 [-.291, .031]; p = .11) and ingroup identification and descriptive norms (β = .049 [-.104, .203]; p = .528) significant (H5 could not be supported, see Figure 3).

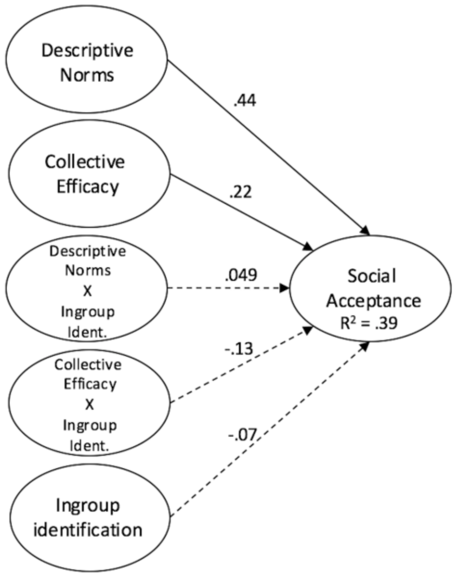

Figure 3. Graphical representation of the pre-registered model 2.
The dashed line indicates non-significant paths. *Note*. Indicators of the latent variables, variance between exogenous variables, and error variance are not reported in this figure to improve readability.

3.3.6 Results of the exploratory model

Having tested different versions of the preregistered models, here an additional exploratory model is tested. The role of ingroup identification is explored here as a predictor rather than as a moderator of descriptive norms and collective efficacy.

Path stability of the alternative-exploratory model was tested by separately introducing the main variables of interest, regional collective efficacy (Model A) and descriptive norms (Model B), to then test the model with both these variables at the same time (Model C) (see Tables 5, 6, and 7). The model with only the regional collective efficacy included showed acceptable model fit as did the models with only the descriptive norms included and with both variables, efficacy and norms, included (see fit indices in Table 4).

Table 4
Model fit indices of the SEM models (A, B, and C).

	df	χ^2	RMSEA CI L.	RMSEA	RMSEA CI U.	SRMR	CFI	TLI
Mod. A	177	292.523***	.032	.040	.048	.067	.984	.981
Mod. B	159	243.917***	.027	.036	.045	.064	.988	.985
Mod. C	215	397.300***	.039	.046	.053	.073	.976	.972

Note. Model A did not include the effect of descriptive norms, Model B did not include the effect of efficacy beliefs, Model C included the effect of both norms and efficacy. *** $p < .001$. RMSEA CI L. = 90% Lower confidence interval; RMSEA CI U. = 90% Upper confidence interval.

Results of the Model A are presented in Table 5. This model shown that appraisal of the environmental crisis from energy source predicted both positive and negative group-based emotions. Then, positive group-based emotions and ingroup identification predicted regional collective efficacy, while group-based negative emotions did not. Social acceptance was positively predicted by regional collective efficacy, group-based positive and negative emotions. Finally, ingroup identification did not directly predict social acceptance.

Indirect effects computed with Monte Carlo method (MacKinnon et al., 2004) showed that the path from appraisal of the environmental crisis, via positive emotions and collective efficacy, to social acceptance was significant, although weak (MC ind= .046, CI [.015 - .084], $p = .007$). The indirect effect from ingroup identification, via collective efficacy, on social acceptance was significant but weak as well (MC ind= .025, CI [.008 - .050], $p = .014$).

Table 5

Results of the Structural Model A.

Model A		
Paths	*B* [95% CI]	*p* value
cri → pos	.461 [.365, .557]	< .001
cri → neg	-.243 [-.341, -.146]	< .001
pos → eff	.560 [.455, .664]	< .001
neg → eff	.033 [-.078, .144]	.565
ide → eff	.228 [.139, .317]	< .001
pos → acc	.538 [.414, .663]	< .001
neg → acc	-.189 [-.288, -.089]	< .001
eff → acc	.180 [.059 , .300]	.004
ide → acc	-.018 [-.088, .053]	.626

cri = appraisal of environmental crisis; pos = group-based positive emotions; neg = group-based negative emotions; eff = regional collective efficacy; ide = ingroup identification; acc = social acceptance. Coefficients and confidence intervals are standardised.

In Model B, collective efficacy was substituted by descriptive norm. The pattern of results (Table 6) was the same of Model A. Indirect effects computed with Monte Carlo method (MacKinnon et al., 2004) showed that the path from appraisal of the environmental crisis, via positive emotions and descriptive norms, to social acceptance was significant and stronger in this Model (MC ind= .064, CI [.034 - .111], p = < .001) than the observed indirect effects of collective efficacy in Model A. The indirect effect from ingroup identification, via descriptive norms, on social acceptance was significant but weak (MC ind= .032, CI [.014 - .057], p = .003).

Table 6

Results of the Structural Model B.

Model B		
Paths	*B* [95% CI]	*p* value
cri → pos	.453 [.355, .550]	< .001
cri → neg	-.176 [-.270, -.083]	< .001
pos → des	.548 [.438, .658]	< .001
neg → des	-.023 [-.128, .081]	.664
ide → des	.203 [.108, .299]	< .001
pos → acc	.500 [.388, .611]	< .001
neg → acc	-.159 [-.259, -.058]	.002
des → acc	.261 [.152, .369]	< .001
ide → acc	-.021 [-.092, .050]	.563

cri = appraisal of environmental crisis; pos = group-based positive emotions; neg = group-based negative emotions; ide = ingroup identification; acc = social acceptance; desc = descriptive norms. Coefficients and confidence intervals are standardised.

As presented in Table 7, the effect of collective efficacy on social acceptance was no longer significant when including the effect of descriptive social norms (Model C). In particular, Model C showed that appraisal of the environmental crisis from energy sources predicted both positive and negative group-based emotions, then the positive group-based emotions predicted both descriptive norms and regional collective efficacy. Negative group-based emotions were not associated with regional collective efficacy and descriptive norms. In addition to the group-based positive emotions, descriptive norms and regional collective efficacy were predicted by ingroup identification. Further, descriptive norms predicted social acceptance while regional collective efficacy and ingroup identification did not predict social acceptance. Finally, both positive and negative emotions also directly predicted social acceptance. Figure 5 additionally presents the path described in Model C (Table 7).

In this model, only indirect paths that included descriptive norms were significant. The path from appraisal of the environmental crisis, via positive emotions and descriptive norms, to social acceptance was (MC ind= .050, CI [.019 - .082], *p* = .022). The indirect effect from ingroup identification, via descriptive norms, on social acceptance was (MC ind= .025, CI [.008 - .048], *p* = .009). Therefore, the association between ingroup identification and social acceptance was fully mediated by descriptive norms.

Model C with the covariates gender, political orientation, subjective knowledge, and environmental group identity included showed a good fit as well (χ^2_{340} 669.668, $p <$ .001; SRMR = .056; RMSEA= .048, 90% confidence interval (CI) [.043, .053]); CFI= .965; TLI= .958) and the significant and non-significant paths did not differ from Model C (apart from changes in coefficients' magnitude). Interestingly, environmental group identity was positively associated with group-based positive emotions (β = .28 [.176, .392]; *p* = < .001), descriptive norms (β = .24 [.115, .364]; *p* = < .001), regional collective efficacy (β = .54 [.445, .640]; *p* = < .001), but not with group-based negative emotions (β = .02 [-.089, .124]; *p* = .748) and social acceptance (β = .054 [-.065, .173]; *p* = .374).

Table 7

Results of the Structural Model C.

Model C		
Paths	*B* [95% CI]	*p* value
cri → pos	.458 [.362, .554]	< .001
cri → neg	-.244 [-.342, -.146]	< .001
pos → eff	.596 [.487, .705]	< .001
pos → des	.581 [.473, .690]	< .001
neg → eff	.047 [-.067, .162]	.418
neg → des	-.026 [-.138, .085]	.646
ide → des	.200 [.104, .296]	< .001
ide → eff	.227 [.137, .317]	< .001
pos → acc	.486 [.352, .620]	< .001
neg → acc	-.176 [-.271, -.080]	< .001
des → acc	.199 [.087, .312]	.001
eff → acc	.088 [-.035, 0.210]	.162
ide → acc	-.037 [-.109, .035]	.310

cri = appraisal of environmental crisis; pos = group-based positive emotions; neg = group-based negative emotions; eff = regional collective efficacy; ide = ingroup identification; acc = social acceptance; desc = descriptive norms. Coefficients and confidence intervals are standardised.

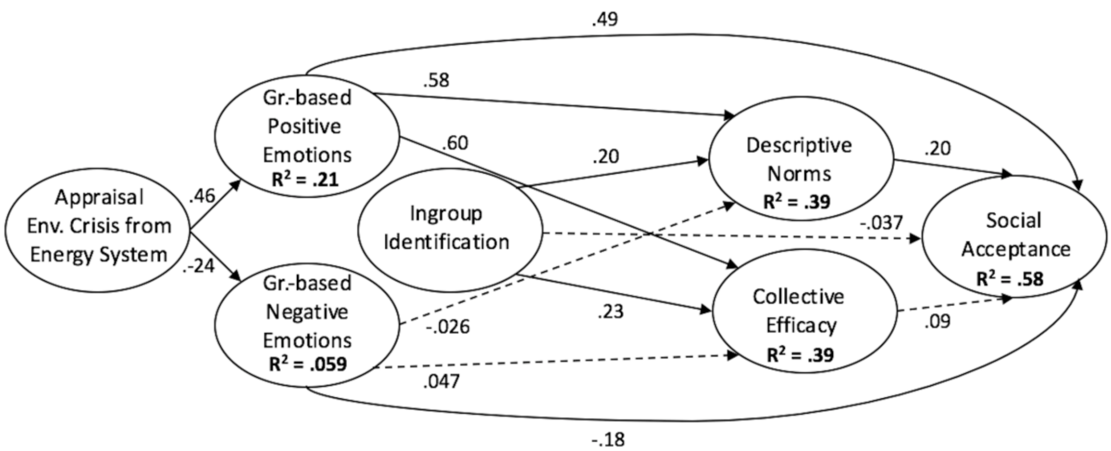

Figure 4. Graphical representation of the exploratory Model C.
The dashed line indicates non-significant paths. This model does not include the effect of covariates. *Note.* Loadings of the latent variable indicators, variance between exogenous variables, error variance, and the two correlated residuals are not reported in this figure to simplify presentation. Coefficients are standardised.

3.3.7 Summary of the results

Since the change in the exploratory model, respect to the full-preregistered model, only consisted of changing the role of ingroup identification (from moderator to predictor), the results are summarised as follows: hypotheses H1 and H2, based on Model C; H3 and H4 based on both the preregistered parsimonious model and on Model C; H5 based on the full preregistered model, the preregistered parsimonious model, and the regression model with aggregated measures; H6 based on Model C.

H1: this hypothesis was supported in Model C.

H2: this hypothesis was partially supported in Model C. Only positive group-based emotions were significantly associated with both descriptive norms and collective efficacy.

H3: this hypothesis was supported in the preregistered parsimonious model and in Model C.

H4: this hypothesis was supported in the preregistered parsimonious model, but not in Model C.

H5: this hypothesis could not be supported.

H6a, H6b, H6c, H6d: only H6a was supported.

The additional paths (i.e., not preregistered) tested in Model C showed that ingroup identification was associated with both descriptive norms and collective efficacy, and that ingroup identification was indirectly, and weakly, associated with social acceptance via descriptive norms (but not via collective efficacy).

3.4 Discussion

The present study aimed to test an adapted version of the SIMPEA model (Fritsche et al., 2018) into the context of social acceptance of renewable large-scale energy technologies. In particular, this study was based in Cornwall (UK), where a deep geothermal energy technology is currently being implemented. The model tested included a series of relevant variables taking into account the role of social dimensions in the acceptance of the geothermal energy technology.

The hypotheses of the full preregistered model considered the following paths: appraisal of environmental crisis from energy sources was expected to be predicted by positive and negative group-based emotions, both emotions were then expected to predict both descriptive norms and collective efficacy, the outcome variable social acceptance was, in turn, predicted by descriptive norms and collective efficacy. Finally, it was expected that the association of descriptive norms and collective efficacy with social acceptance of the geothermal energy was stronger for high level of ingroup identification. This model could not be accepted according to model fit indices.

An alternative exploratory model was tested based on other relevant studies showing that ingroup identification might better work as a predictor of collective efficacy and descriptive norms rather than as a moderator. This model showed adequate model fit indices.

A more detailed explanation and discussion of both the preregistered and the exploratory models is presented in the next sections.

3.4.1 Interactions and pre-registered models discussion

Starting with the pre-registered model, different methods of analysis found limited fit and lack of evidence supporting the hypothesised interactions. Therefore, the original model was simplified to one that only included the core variables, as also pre-registered.

When testing the pre-registered model with only the core variables (i.e., ingroup identification, descriptive norms, regional collective efficacy, and social acceptance) the model showed acceptable fit. However, the interaction effects were still not significant.

Reflecting back on the pre-registration regarding the full model, some aspects appear important that could explain why the data did not support the hypothesised model. One key aspect is the difference in the type of outcome behaviour. As long as individuals have to actively do something, such as general pro-environmental behaviours (e.g., participate in environmental initiatives), the moderating role of ingroup identification might occur; that is, the effect of the regional collective efficacy and descriptive norms on the outcome variable changes depending on high/low level of social identification (Masson & Fritsche, 2014). However, if the collective effort means passively accepting something despite some disadvantages (e.g., noise pollution) in order to achieve valuable goals (e.g., renewable energy production), the role of ingroup identification might be seen more as a prompt that makes the regional collective efficacy and social norms salient in a certain context.

Although I did not find the interaction effects expected, it is possible that the effects found in the present study would emerge differently in other contexts where the outcome variable represents a more active and costly pro-environmental behaviour (e.g., reduce meat intake or collective protests) and not a passive acceptance. As Masson and Fritsche (2014) found, the moderation effect was more pronounced for high-cost behaviour such as a boycott of companies harmful to the environment. This possible difference would need further examination in future studies.

It has also been shown that the type of social identity considered could lead to different responses in terms of pro-environmental behaviours. In particular, identification with a pro-environmental opinion-based group seems to be more strongly associated with pro-environmental behaviour compared to more general social categorisations types such as “nationality” (Schulte et al., 2020). Experimental evidence is needed to verify the moderation effect of general social identification with groups (e.g., gender, nationality) compared to identification with opinion-based groups. The difference between these two types of identification might be the salience and the importance given to certain contents, attributes, norms, and beliefs of a certain identity. On the one hand, pre-existing identity categories might or might not include specific directions and purposes toward environmental relevant behaviours (Milfont et al., 2020), and the salience of those attributes and purposes might differ according to the context and comparative outgroup (Rabinovich et al., 2012). On the other hand, pro-environmental opinion-base groups are more intrinsically and unequivocally associated with environmental behaviour. The main advantage of targeting group identity based on people’s regions and nations is that these groups already exist and are large in size. However, smaller groups representing the minority can actually trigger social changes in the environmental domain and have the power to influence the majority (Bolderdijk & Jans, 2021).

Lastly, Masson at al. (2016) explained that a mediation path from ingroup identification to pro-environmental intentions via ingroup descriptive norms can be the result of an identity enhancement strategy motivated by people’s tendency to see their group in a positive light. This interpretation fits well with the results of Study 1 (Chapter 2), where people clearly expressed a sense of proudness associated with the development of geothermal technology. Therefore, for the present study, it seems reasonable to conclude that the perceived ingroup norms, and also the perceived collective efficacy, could have been biased by ingroup identification: the latter favoured beliefs that people’s group were behaving according to ideal standards. It is important to take into account that Masson and colleagues (2016) did have tested a mediation path but the ingroup identification was manipulated (high vs. low) and not measured as in the present study. Therefore, the two studies cannot be directly comparable.

3.4.2 Exploratory model discussion

In this model, the role of ingroup identification was conceptualised as a predictor of descriptive norms and collective efficacy, and not as a moderator. The other expected paths were the same as preregistered. The reasoning was based on previous relevant literature showing these possible alternative paths (e.g., Rees & Bamberg, 2014; Masson et al., 2016).

The results showed that the appraisal of environmental crisis from energy sources was significantly associated with the extent to which individuals felt group-based emotions regarding the decision made by local authorities and communities to implement geothermal technology in Cornwall. That is, the more people felt that fossil fuel energy sources were linked to severe environmental problems and greenhouse gas emissions, the more people felt good, hopeful and proud about that decision, and, in parallel, felt less worried, anxious, and frustrated. As Fritsche and colleagues argued "Perceptions of high (vs. low) environmental risk may prevent the experience of collective guilt and thus reduce reparation intention." (2018, p. 13). Similarly, in the present study, the extent to which participants perceived that the environmental crisis from energy sources was important was associated with the experience of emotions toward the decision of the ingroup to implement a (renewable) large-scale technology in the region (i.e., the geothermal energy technology).

Group-based positive emotions, in turn, significantly predicted both regional collective efficacy and descriptive norms. This means that group-based positive emotions from the decision made by local authorities and communities to implement geothermal technology in Cornwall were positively associated with both the belief that the ingroup could achieved progress in renewables and the belief that other people in their region accepted the geothermal technology. However, the relationships between negative emotions and collective efficacy and descriptive norms were not significant: the extent to which people felt worried, frustrated and anxious about the decision made by local authorities and communities to implement the geothermal energy did not predict people's beliefs about the ability of their ingroup to progress in renewables (regional collective efficacy), nor about what they thought other people in their region did (descriptive norms).

Having said that, the zero-order correlation matrix showed a weak negative and significant correlation between these group-based negative emotions and regional collective efficacy and descriptive norms. This suggests that the weak effect of negative emotions was no longer relevant in predicting collective efficacy and descriptive norms after controlling for variance and covariance of the other variables included in the model. One explanation of this non-significant effect could be related to self-defence mechanisms where people are less prone to admit negative aspects of the ingroup's decisions and/or general negative group attributes (e.g., Doosje et al., 1998; Bonaiuto et al., 1996). Although the direct relationship between negative emotions and social acceptance was significant, the magnitude of this effect was weaker compared to the effect of positive emotions. This might be especially true among high identifiers (Doosje et al., 1998). Further studies are needed to better explain this effect on the group-level.

It is important to also take into account the way in which I have adapted the source of the positive and negative emotions in the present study. In fact, the SIMPEA model proposed different examples in which emotions can be contextualised in the model: anxiety from the global environmental crisis that affects the group (Jonas et al., 2014); collective guilt from learning that the ingroup creates more carbon emissions than the outgroup (Mallett et al., 2013); collective guilt (Mallet et al., 2012; Hart et al., 2013) and collective anger (e.g., Hart et al., 2013) from the perception that the ingroup contributes to global warming; collective guilt from the awareness that humans are responsible for the most part to the climate change (Ferguson & Branscombe, 2010); and collective pride from the ingroup's responsibility for environmental protection contributions (Hart et al., 2013). The conceptualisation of the group-based emotions in the present study was closed to Hart and colleagues' ones. In the present study, emotions were related to the ingroup decision and responsibility for (renewable) energy technology implementations. It might be possible that negative emotions based on the ingroup contribution to global warming could have, instead, presented a different and significant relationship with both regional collective efficacy and descriptive norms. Further studies are needed to compare the different effects of group-based emotions emerging from reparative ingroup decisions (e.g., renewable energy technology implementation decisions, environmental policy measure decisions) versus general harmful group behaviour for the environment (e.g., carbon emission production).

Descriptive norms showed a significant and positive association with social acceptance. Therefore, the more people thought that other people in their region accepted the geothermal technology, the more they accepted the geothermal technology. The path from the appraisal of environmental crisis from energy sources, positive group-based emotions, and descriptive norms to social acceptance was therefore supported.

Regional collective efficacy showed a significant association with social acceptance only when descriptive norms were not included in the model. Consistently, a recent study has showed unstable results for the effect of different types of perceived efficacy (e.g., self-efficacy, collective efficacy) on both policy support and behavioural intention (Choi & Hart, 2021). To my knowledge, no previous studies showed this type of dynamic between descriptive norms and collective efficacy. Looking at the coefficients' magnitude, it seemed that group-based positive emotions and descriptive norms might be sufficient alone to explain the effect of social identity secondary group-processes on low-effort environmental relevant behaviour such as social acceptance of large-scale energy technology. Importantly, while the correspondence between descriptive norms and social acceptance, and between group-based positive emotions and social acceptance, was strong (as they specifically refer to the geothermal technology), the correspondence between regional collective efficacy and social acceptance was weaker. In fact, regional collective efficacy was operationalised in the present study as a general belief regarding the ingroup ability to successfully manage and achieve its goals in renewables. This might be one of the reasons why regional collective efficacy was a weaker predictor compared to group-based positive emotions and descriptive norms. It also important to point out that zero-order correlations between descriptive norms and social acceptance, and between regional collective efficacy and social acceptance were almost equal (r = .45 for descriptive norms and r = .43 for regional collective efficacy). Therefore, similarity of content might be not sufficient to explain the lack of effect of regional collective efficacy on social acceptance when also including descriptive norms in the exploratory model. Further studies should better investigate this type of regional collective efficacy in the context of the public sphere of environmental behaviours such as acceptance of energy policies and of renewable technologies. As Bandura (2002) pointed out, people need to believe that their actions produce the desired outcome in order to persevere despite any difficulties. It could be argued that the same mechanism might occur when people are asked to passively accept/not accept something relevant. In this sense, in order to accept renewable-related projects and, indirectly, the associated costs and risks, people need to believe that progress in renewables implementation in their own region are achievable.

They need to believe that efforts to increase the use of renewable options are not in vain.

In the exploratory models, ingroup identification was a significant predictor of both descriptive norm and efficacy beliefs. These results corroborate with Rees and Bamberg (2014), and with Masson et al. (2016) for what concerns the path from ingroup identification via descriptive norms. Even if not directly comparable for the different outcome variable used as well as for the different conceptualisation of the collective efficacy beliefs, the present results are also in line with the sequential path proposed in the SIMCA model (van Zomeren et al., 2008) where collective efficacy is predicted by social identity. Although, in the present study and differently from the SIMCA model, ingroup identification did not directly predict the outcome variable, but only indirectly via efficacy beliefs (Model A).

Future studies might also verify to what extent social identity processes explain the social acceptance of large-scale technology beyond more individualistic variables such as perceived risks from energy technology. For example, does the content of a normative belief toward social acceptance emerge *because* of the perceived risks or it is the normative belief that guides risk perception? Especially when there is a high degree of uncertainty towards technology risks, is it the primary social identity processes such as desire for self-esteem (e.g., Tajfel & Turner, 1979) and/or uncertainty reduction (Hogg, 2007) that guide formation of normative beliefs, regardless of perceived risks? In this sense, is the extent to which people perceived risks only a mere, more tangible, outcome of these primary and secondary social identity processes?

Limitations

The results of this study present several limitations. A correlational design was used. Therefore, it is not possible to draw conclusions about causal relations between the model variables.

The questions order in the questionnaire was not randomised, which might have exacerbated correlated residuals (Bandalos, 2021). The intention was to allow participants to mentally follow the main steps proposed by the SIMPEA model. However, it is important to acknowledge that model sequential chains are a simplification of how and when humans perceive and feel certain aspects of the social context. Also, the SIMPEA model does propose a more interactive view of the variables involved. Future studies might test the variables of interest via a *nonrecursive* model (i.e., where causal effect are not unidirectional, see Kline, 2015) which allows for direct and indirect feedback loop (e.g., $X_1 \rightleftarrows X_2$).

Another limitation concerns the conceptualisation of regional collective efficacy. One could speculate that overlap between the conceptualisation of this measure in the present study and the concept of trust toward the authorities might exist. Future studies might test the discriminant validity between those measures.

Finally, it would had been good to include other outcome variables such as intention to participate in collective protest against the implementation of the technology since most of the social identity models are about collective actions. I carefully reviewed the possible consequences of this type of questions when participants involved in the study are actually embedded in a real-world context and I choose to avoid interference with the natural social dynamics happening in that specific time frame. Many studies show that the simply asking people how likely they would perform a certain behaviour increases the chance that people would actually perform that behaviour (Wilding et al., 2016). Examples of this *question-behaviour effect* (QBE, Sherman, 1980) are voting behaviour, purchase behaviour, and recycling behaviour.

Practical recommendations

The present work did not in any way aim to recommend to project developers to use social identity processes to persuade people into accepting large-scale technologies (e.g., using the power of social norms). As Aitken pointed out "Public attitudes and responses to wind power should not be examined in order to mitigate potential future opposition, but rather in order to understand the social context of renewable energy" (2010, p. 1). Instead, communication strategies should have a long-term purpose focused on intrinsic environmental motivations. If the ultimate goal of living in a more sustainable society is sustained by normative beliefs, people might be less likely to question the installation of renewable projects (e.g., wind farms, geothermal technologies) as these would be consistent with their social identity, which guide them in their everyday life. To develop more specific practical recommendations, further correlational and experimental studies are required to replicate the present results and sharpen the insights beginning to emerge.

3.5 Conclusion

This is the first study testing an adapted version of the SIMPEA model (Fritsche et al., 2018) applied to the context of acceptance of a large-scale energy technology in a real-world context in Cornwall (UK). The relationship between the appraisal of environmental crisis from energy sources, positive/negative group-based emotions, descriptive norms, regional collective efficacy, and ingroup identification was examined through structural equation modelling. The complete pre-registered model was inadequate to represent the relationship between the variables included. Only focusing on core variables, a pre-registered more parsimonious model showed acceptable model fit. However, the hypothesised interactions between ingroup identification and regional collective efficacy, and between ingroup identification and descriptive norms were not significant while the direct relationships of regional collective efficacy and descriptive norms with social acceptance were significant. The direction of the paths was then revised in light of others social identity-based models (e.g., Rees & Bamberg, 2014), still representing the main purpose of the SIMPEA model and including the same variables of the full pre-registered model. In this model, ingroup identification was treated as a predictor of both regional collective efficacy and descriptive norms. Looking at the explained variance, findings from this study suggest that descriptive and regional collective efficacy are similarly explained by the appraisal of environmental crisis, ingroup identification and group-based emotions. However, people' beliefs about the ingroup ability to successfully manage and achieve its goals in renewables were no longer relevant in explaining social acceptance when descriptive norms (together with appraisal of environmental crisis, group-based emotions and social identification) was included in the model. This last exploratory model explained the data better than the pre-registered models. A contribution to a new line of research in the context of social acceptance of renewable large-scale energy technologies, within the social identity framework, was given by testing an adapted version of the recent SIMPEA model in a real-world context.

The next Chapter will continue to this line of research. The model proposed will investigate the role of group-level autonomy, procedural justice climate, collective self-determined motivation, and social identity violation, in association with social acceptance of deep geothermal energy technology.

Chapter 4 – Study 3

The role of procedural fairness in the acceptance of deep geothermal technology when accounting for social identity violation, group-level autonomy, and collective self-determined motivations: a moderated mediation analysis.

Abstract

Previous research has highlighted the key role of procedural fairness perception in the acceptance of energy technologies. However, less attention has been given to how social dimensions might interact with procedural fairness perception. In this study, I investigated the association between the social acceptance of deep geothermal energy technology and procedural justice climate perception (i.e., group-level procedural fairness) while considering the social dimensions of group-level autonomy, collective self-determined motivation, and social identity violation. Results showed that (i) Cornish people's experience of autonomy and collective self-determination was positively associated with social acceptance of geothermal energy and that (ii) social identity violation had an important role in directly predicting the acceptance of geothermal technology and in moderating the effect of a mediation path from group-level autonomy to social acceptance via procedural fairness perception. I discuss how considering collective processes might lead to a better understanding of the key drivers underlying the social acceptance of sustainable energy technologies, and might inform public engagement.

4.1 Introduction

In the field of energy technology acceptance, special attention has been given to justice-related perceptions. This attention is largely driven by the recognition that feelings of injustice can hinder the implementation of renewable energy projects by motivating groups to engage in collective actions, such as protests, to restore justice (e.g., van Zomeren et al., 2008).

Within the justice framework, research on people's attitudes and responses toward large-scale energy technologies has particularly focused on two types of justice perceptions: distributive and procedural justice (van Bommel et al., 2021). The focus is respectively on *distributive fairness* and *procedural fairness*. Distributive fairness involves the perceived fairness of resource distributions. These comprise instrumental costs (e.g., local landscape impact and uneven distribution of safety risks) and benefits (e.g., valued renewable energy production and monetary compensation) of the outcome itself. Procedural fairness concerns the extent to which decision-making procedures leading to the implementation of the technology are considered fair by the general public and locals (i.e., procedural justice): for example, whether residents are given voice during the decision-making process.

While distributive fairness has received substantive attention from scholars since early work on the social acceptance of energy technologies, the emphasis on procedural fairness is more recent (Levenda et al., 2021). The emphasis on *procedures* in the study of public acceptance of energy technologies reflects a shift in emphasis in the general social psychology literature, from *outcome distribution* to *processes behind the distribution* (i.e., procedures). This shift is not new, as it can be traced back to the work of Thibaut and Walker in 1975 and it was expanded in 1988 by Lind and Tyler. Distributive fairness is certainly a key explanatory variable in many contexts of resource allocation (e.g., Vuichard et al., 2022). However, it is important to emphasise that people do not (only) evaluate their social experience based on the outcome received, rather people's evaluation also includes the processes used to reach the outcome (Lind & Tyler, 1988; Tyler, 2000).

The importance of fair decision-making procedures in the acceptance of energy technology has been confirmed in numerous studies (e.g. Gross, 2007; Huijts, 2012; Simcock, 2016; Sovacool et al., 2016; Walker et al., 2017; Langer et al., 2018; Lienhoop, 2018) and in general environment-related large-scale projects such as dam projects (Marques et al., 2015). For example, higher acceptance of a proposed wind farm was found when the involved German and Polish citizens had the opportunity to participate in the decision-making process (Liebe et al., 2017). Other relevant examples can be found in studies investigating fairness perception in relation to the similarly controversial carbon dioxide capture and storage (CCS) technology (Terwel et al., 2010) and, more recently, for the same energy technology investigated in the present study (i.e., deep geothermal technology; Lu et al., 2020).

Terwel et al. (2010) found that experimentally manipulated fair group-voice procedures (i.e., allowing relevant organisations such as environmental NGOs to voice their opinion in the decision-making process about the implementation of a carbon dioxide capture and storage, CCS, technology) affected the extent to which people accepted CCS policy decisions, with inferred trustworthiness of the decision maker mediating this effect. Specifically, group-voice procedures positively influenced people's acceptance toward the policy decision to implement the CCS both directly and mediated by the trustworthiness of the political decision maker.

It has been recently shown that manipulation of fairness perception (i.e., describing the energy developers as authorities open or not open to listening to locals' concerns) led to a positive attitude toward the enhanced geothermal systems (EGS) in the high-fairness condition, which in turn influenced the outcome variable of information seeking, related to the development of EGS (Lu et al., 2020).

Hence, a practically important and understudied question concerns the understanding of the boundary conditions of procedural fairness in the context of social acceptance of energy technologies. From a practical point of view, investigating this question would help project developers, local and national governments recognise in which cases they should prioritise communication campaign investments in fair procedures when a large-scale technology is in planning. Therefore, why and in which circumstances is procedural fairness important in the context of large-scale energy technology acceptance? Specifically, this question arose from the results of Study 1 (Chapter 2). Results of Study 1 highlighted that social identity processes were an important driver of people's view toward the geothermal energy technology. Moreover, participants in Study 1 expressed dissatisfaction on how the procedures of the decision-making processes (that led to the implementation of the technology) were managed. However, the positive identity-related features associated with geothermal technology seemed to override possible negative emotions associated with procedures perceived as unfair. Therefore, it is unclear how procedural fairness perceptions were related to the acceptance of large-scale technology when identity-related outcomes are taken into account.

In a different research area, Mayer et al. (2009) showed that identity-related outcomes (i.e., perceived social identity violation from an authority decision) were relevant in explaining the association between experimentally manipulated fair procedures and perceived distributive and procedural fairness perceptions. However, as better explained in Section 4.2.1, it is not clear if these results could be extended to different outcome variables - such as attitudes, behaviours or social acceptance toward decisions made by authorities - and when considering a different research field.

Since energy technology implementations are often embedded in contexts of limited choice opportunity offered to residents, the important role played by procedural fairness can be interpreted, among other factors such as social status implications, in light of the primary basic psychological needs of autonomy (Marshall et al., 2017; Ryan & Deci, 2000). Therefore, alongside the investigation of the boundary conditions of procedural fairness, the present study also aimed to examine the association between the perceived (group-level) autonomy (from authorities responsible of the development of the geothermal technology) and procedural fairness. In other research contexts, some evidence indicated that the extent to which people are given opportunities of choice (i.e., autonomy) is associated with fairness-based responses (Chou et al. 2021; van Prooijen, 2009). However, to date no research has tested this relationship – autonomy perceptions and procedural fairness perceptions – in the context of social acceptance of energy technologies.

Moreover, it was investigated how this perceived autonomy was associated with (collective) self-determined motivations. Self-determined motivations (i.e., motivation driven by intrinsic reasons), is a powerful explanatory variable in the general field of environmental behaviours, even when controlling for value orientations (Masson & Otto, 2021). While, the relationship between autonomy need and self-determined motivations is well-known (Ryan & Deci, 2000), there is (i) only limited evidence of this relationship in the general field of environmental behaviours (e.g., Aitken et al., 2016), and policy acceptance (Marshall et al., 2017), (ii) no evidence in the field of social acceptance of energy technologies, (iii) and there is only one study that has investigated collective levels of self-determined motivations and group levels of autonomy perception in another research field (Thomas et al., 2017), and none replicating or expanding Thomas et al.'s findings. This will be further explained in Section 4.3 of the present study.

In summary, based on the real-world context of the implementation of a new large-scale energy technology (i.e., geothermal power plant) in Cornwall (UK), the current work sheds light on (i) boundary conditions of procedural fairness when examining people's acceptance toward large-scale energy technology, by investigating the moderating effect of social identity violation, and (ii) the association between group-level autonomy need with both procedural fairness and collective self-determined motivations in predicting social acceptance of deep geothermal energy technology.

4.2 Why do people care about the fairness of the decision-making procedures?

There are some key aspects that people usually consider when evaluating procedural fairness. According to Tyler's review (2000), these aspects concern the opportunity to participate in the decision-making process with the chance to freely express opinions; the neutrality of the authorities, in terms of their honesty, impartiality, and objectivity; the trustworthiness of the authorities; the degree to which people feel they are treated with dignity and respect. In 2003, Blader and Tyler posited that beyond the quality of the decision-making process, interpersonal treatment provided by authorities is also another important factor shaping people's evaluations of procedure fairness. Being given the opportunity of voicing their opinions is still considered important to people even when they perceive that their contribution may not affect the authorities' final decision (Tyler et al., 1985), and even when their opinions are expressed after the decisions are made (Lind et al., 1990). In particular, early-stage public engagement in the decision-making process seems to be valued (e.g., Cotton et al., 2011). Furthermore, when people receive an unfavourable outcome but they feel that they could have had contributed to a more favourable outcome, if involved in the decision-making processes, they will feel the most resentment (Folger & Martin, 1986). Since values, moral standards, and general social practices guide attention, and shape the level of importance given to certain aspects of the decision-making procedures, there are no objectively “right” or “wrong” procedures. Therefore, people’s expectations of what “procedural justice” means, what is important for them and how they feel the process should be conducted in their specific context is what matters when they evaluate the fairness of the decision-making process (Simcock, 2016). These individual and group expectations are the results of historical, cultural and social processes (Debbané et al., 2004).

A social identity perspective offers novel and important avenues to the understanding of the processes underlying perceived fairness. By adopting such perspective, the perceived social structure of the society (e.g., status legitimacy) and group processes (e.g., group efficacy), explains the way in which people cope with injustice (e.g., Tajfel & Turner, 1979; Becker, 2012; van Zomeren et al., 2004, 2008). Indeed, individuals and groups respond to injustice in different ways: from inaction and redefinition of the situation to non-normative collective actions.

According to the group-value and relational models of procedural injustice (Lind & Tyler, 1988; Tyler & Lind, 1992; Tyler et al., 1996), people care about fair procedures because these inform group members about their value and status position within the ingroup, satisfying their need for self-esteem, and thus contributing to a positive identity. This model accounts for intragroup process, where individual group members infer information about their status, as members, within their group from a relevant ingroup authority. In this sense, group members should give less importance to whether outgroup authorities treat them fairly or unfairly compared to treatments received by ingroup authorities (e.g., Smith et al., 1998; Tyler et al., 1998). It has also been recognised that consequences of unfair decisions could be group-relevant rather than individual-relevant (Tyler et al., 1997) depending on whether the authority’s decision concerns collective rather than individual outcomes (e.g., Leung et al., 2007), in line with social identity theories (e.g., Hogg & Abrams, 1988; Tajfel & Turner, 1979). Later on, Tyler and Blader (2002) point out that feelings of pride could emerge from two types of evaluations, those based on internal standards related to group values and norms, and those based on external standards based on group comparison processes. Their results show that feelings of pride emerging from prototypical internal standards were more strongly affected by procedural fairness compared to those based on external standards.

Rather than justice-based, concerns have been found to be more instrumentally based (i.e., in terms of decision implications) when people are in a group context (Leung et al., 2007). In other words, the favourability of group-relevant outcome decisions (i.e., a decision that impacts the collective) is less influenced by a fair process than when the favourability is only relevant to the individual. Following this line, Urbanska et al., (2019) pointed out that fairness perceptions can be relevant to the *individual* in relation to other individuals within the group, but that these perceptions can also be relevant to *groups* in an intergroup context. In particular, the authors found that intergroup status informed expectations of authority fairness (i.e., how authority should behave) in terms of favourable *outcomes* distribution, but not expectations of fair *procedures* (i.e., voice opportunities).

Consistently, when the outcome decision is group-relevant as in the field of acceptance of large-scale energy technologies such as nuclear power plants, Visschers and Siegrist (2012) showed that outcome fairness explained a larger amount of variance in the acceptance of the power plant compared to procedural fairness. It is important to specify that indicators used by the authors to measure outcome fairness refer to both the specific distribution of benefits and costs but also a broad evaluation of the decision as fair/no fair and an item that overlapped with the concept of procedural fairness (i.e., “The wishes of the population at the sites are sufficiently considered at the site selection of the to-be-replaced nuclear power plants”).

4.2.1 Boundary conditions of the procedural fairness effect

The importance of self-esteem

The relevance of self-esteem to understanding procedural fairness effects has also been pointed out in other contexts, from a different perspective. While the group-value and relational models of procedural injustice previously discussed interpreted the relevance of self-esteem as the *reason why* procedural fairness is important to people, other research literature pointed out that reactions toward procedural fairness varies depending on the individual’s self-conception and status within a group (Diekmann et al., 2007; see also van Prooijen et al., 2002). That is, individual status position within an organisation influenced individual’s expectations of procedural fairness deservingness and moderated the relation between procedural fairness and job satisfaction so that the higher the status position, the more procedural fairness perception influenced job satisfaction. Similarly, the effect of procedural fairness has also been shown to be moderated by levels of personal and organisation-based self-esteem. In particular, in their study 3 Wiesenfeld et al. (2007) showed that people’s absenteeism frequency in organisations was negatively predicted by procedural fairness only at high levels of organisation-based self-esteem. That is, the more people felt valued in their organisation (example item: “I am important around here”), the stronger was the association between procedural fairness (example item: “Management treated employees with dignity and respect during the changes”) and absenteeism. This association was negative so that the more people felt valued, the less was the absenteeism frequency, and it was not significant when people had low levels of organisation-based self-esteem (the inverse relationship was not found).

In sum, Wiesenfeld et al.'s study highlighted the important role of *external* self-esteem (i.e., not informed by procedures as in the value-group model) in shaping the reactions to procedural fairness. However, no studies to date have investigated what happens to procedural fairness when the outcome of a decision is itself positively supporting the individual or the ingroup status. Studies have shown that people evaluate their identity and status from resources that they received from their groups, and that this lead individual to a stronger engagement in group behaviours such as cooperation (Tyler & Blader, 2003). Also, some studies have also showed that implementation of energy technologies may enhance place-related pride and self-esteem in residents (e.g., Devine-Wright, 2011), but it is unclear how this could interact with perceived procedural fairness in predicting social acceptance of energy technologies.

This literature is relevant to the present study for two reasons: 1) the idea of investigating the role of social identity violation in the acceptance of geothermal energy was inspired by results of study 1 in which rather than a perceived violation, the geothermal technology implementation positively supported Cornish identity by eliciting feelings of pride. However, there was not an established and reliable measure of support toward social identity motives, therefore it was decided to use a general measure of social identity violation which could still capture the identity-related features associated with the social acceptance of the geothermal technology; 2) the results of the present pre-registered study were followed by additional analyses which considered the role of group-level emotion of pride emerging from the decision outcome itself (i.e., the decision to implement the geothermal technology). This was used to indirectly and preliminarily support the interpretation given to the pre-registered results.

The importance of trust, leader ingroup prototypicality, and knowledge

Whether authorities' decisions are made by means of fair or unfair procedures influences people's favourability toward an outcome under certain conditions. It has been shown that information related to the trustworthiness of authorities impacts the effect of procedural fairness on people's evaluation of an outcome decision. That is, procedural fairness is particularly important at low-trust levels toward the authorities (van Dijke & Verboon, 2010) and it is even more important when either no information about the trustworthiness of authorities is available or when there is uncertainty about trustworthiness (van de Bos et al., 1998; van de Bos & Miedema, 2000; van de Bos et al., 2002). Similarly, the extent to which leaders are perceived as prototypical for the group mitigated the effect of procedural fairness on support of a political party (Ullrich et al., 2009; see also De Cremer et al., 2010). In general, it also seems that the more people feel that they are knowledgeable about a specific domain, the less they rely on procedural fairness to make decisions about that domain (See, 2009). These studies indicate that trust toward authorities (or close proxies of trust such as leader ingroup prototypicality) should be considered when examining the effect of procedural fairness in various domains. Moreover, another important aspect that needs to be considered is the level of knowledge that people have regarding the outcome decision.

In the present study, leader ingroup prototypicality and level of knowledge of the geothermal project in Cornwall were included as covariates.

The importance of morality and identity negative implications

The most influential theory of the boundary conditions of the procedural fairness effect concerns the moral mandate effect. As postulated by the value protection model (Skitka 2002; Skitka & Mullen, 2002; see also Skitka et al., 2021), when the decision outcome is high on moral conviction (i.e., it has important morally-relevant implications) the perceived procedural fairness of the decision has little or no effect on the overall perceived fairness of the outcome decision. A moral conviction is linked to but different from values, as it represents a strong non-negotiable belief about what is right and wrong toward a specific issue (e.g., rape is wrong). According to this model, procedures of the decision-making process and the outcome itself are perceived as fair when they are consistent with people's moral mandates, and vice versa. To explain the moral mandate effect, Mullen and Skitka (2006) presented an emotional pathway where people react to a violation of a moral mandate with anger and outrage which, in turn, colours both outcome and procedure as unfair. Contrary to this view, Napier & Tyler (2008) argue that the research design used by Skitka and colleagues led to ambiguous conclusions about the strength of their findings on the interactive effect between moral mandates and procedural fairness. By reanalysing Skitka (2002) and Skitka & Mullen (2002) data, Napier and Tyler proposed, instead, that "[...] overall perceptions of fairness are lower when morally divisive issues are involved, but that the use of fair procedures will still have a significant impact on final evaluations of authorities' decisions" (p. 512); to then conclude that "[...] the data show that decision acceptance is indeed shaped by procedural justice" (p. 525). In response to this issue, Skitka and Mullen (2008) further argued that their original conclusion about moral mandates were, instead, justified.

Siegrist et al. (2012) showed that procedural fairness predicted decision acceptance (i.e., in the acceptance of genetically modified [GM] field experiments) and that this relationship was even stronger for those who thought that GM field experiments were a threating morally relevant issue. This was only partially in line with the explanation provided by Napier and Tyler (2008) because Siegrist and colleagues (2012) not only measured whether the issue was morally *relevant* but also the extent to which the issue was perceived as a moral *threat* for people's values.

More recently, it has been shown that perceiving authorities as legitimate (i.e., entitled to use their power) mitigated the intention to engage in collective action against decisions that produced low disadvantages, but not high disadvantages (Blondé et al., 2021). Therefore, it might be that procedural fairness could still mitigate the effect of mild moral or identity threat, but not highly relevant threat, which is more consistent with Skitka's model.

Building on Skitka's model, Mayer and colleagues (2009) demonstrated that objectively fair procedures do not always positively affect procedural justice perceptions thus describing specific boundary conditions of the fair process effect. In particular, they showed that when the decision outcome violated an individual's social identity, having the opportunity to express opinions had a weak effect on fairness perception. This effect was evident for the social identity violation but not for the personal identity violation. According to the authors, this is probably due, in that specific research context, to the fact that a strong social identity identification occurred. Indeed, outcomes of authorities' decisions could be perceived as primarily concerning a group-level rather than an individual-level. As Leung and colleagues pointed out (2007), the dynamics involved in social issues and policy decisions are more likely to make people concerned about the collective outcome of the decisions and, thus, the individual outcome becomes less salient. The "identity violation effect" proposed by Mayer and colleagues (2009) demonstrated that fair procedures did not always lead to perceptions of fair procedures as social identity violation moderated this effect.

It appears that previous studies on the effect of procedural justice on decision acceptance do not clearly converge to a dominant interpretation. One explanation is that these studies used different methodologies and research design (e.g., correlational – experimental – field-based – scenarios) along with different topics of interest (e.g., emerging technologies – varies policy issues) as well as different outcomes (e.g., acceptance – intentions – outcome fairness) and operationalisations of procedural justice. A useful take-home message from these studies is that the issue of importance and valence of the decision, along with the extent to which the outcome decision is morally and identity relevant, needs to be considered when studying the effect of procedural fairness on the outcome variables such as the acceptance of authorities' decisions (Brockner & Wiesenfeld, 1996, 2005).

In light of the importance of considering moral and identity implications when studying the role of procedural fairness in the context of public acceptance of authorities' decisions, the present study took into account the conditional effect of these implications to study the relationship between procedural fairness and social acceptance of geothermal energy technology in Cornwall. In particular, the present study focused on identity-related implications. This choice was also motivated by the results of Study 1 (Chapter 2) in which positive identity-related features associated with geothermal technology seemed to override the negative consequences of the perceived lack of procedural fairness in the acceptance of the geothermal technology. Therefore, in the present study the results of the qualitative study (Study 1) were corroborated using quantitative methods. The identity-related implications were considered using the construct of social identity violation from Mayer et al. (2009).

Having discussed the first main path of interest, the next section will present the relevant literature and research rationale of the second path which focuses on group-level autonomy and collective self-determined motivations and their connection to procedural fairness.

4.3 The role of group-based autonomy need and collective self-determined motivations

In the context of the acceptance of deep geothermal energy technology, locals face a situation in which private and/or public authorities (e.g., the technology developers and local and national politicians) have decided to implement the technology on the locals' land, based on complex technical, economic, political and environmental evaluations. While the adoption of residential technologies (e.g. photovoltaics or geothermal heat pumps for the home) is an independent, personal consumer choice, living in a place that has been selected as the site of a large-scale energy technology leaves citizens, to some extent, without opportunity of choice. The opportunity of choice represents the important psychological need for autonomy (Deci & Ryan, 2000; Ryan & Deci, 2000; Ryan & Deci, 2017). According to Deci and Ryan, having a sense of autonomy satisfies the need to self-regulate one's experiences and actions. When a behaviour is autonomous (self-determined), it involves a sense of voluntariness and reflects one's interests or values. When it is controlled (not self-determined), an internal or external pressure is experienced (e.g. to avoid feelings of guilt, to receive monetary reward or when no choices have been offered). The need for this individual sense of volition and choice is supported or undermined by the social context. If the social context is supportive of an individual's autonomy, motivations are more likely to be experienced as intrinsic. Intrinsic motivation is a "spontaneous activity that is sustained by the satisfactions inherent in the activity itself" (Ryan & Deci, 2017, p. 99).

In the field of pro-environmental behaviours, the role of autonomous motivations has been examined in some contexts (e.g., transportation behaviour, Aitken et al., 2016; household energy-consumption, Webb et al., 2013; environmental activism, Masson & Otto, 2021). Of particular interest for the present research, Lavergne and colleagues (2010) examined the role of perception of government autonomy-support and control on motivation toward the implementation of environmental regulations (e.g., recycling, saving energy). Results showed that autonomous motivation was positively affected by government autonomy-support style and controlled motivation was positively affected by government control style. Moreover, autonomous motivations predicted a higher frequency of pro-environmental behaviours. Similarly, Marshall and colleagues (2017) found that community-based governance that provides communities with a high level of autonomy in deciding the design and the allocation of funding related to climate change adaptation increased behavioural donations (i.e., financial payment to donate for the climate change issues). The governance communication style positively influenced perceived autonomous support and autonomous motivations. However, both studies presented modest effects of these relationships. Considering the citizens' little power, in the present study, over the possible implementation of the geothermal energy, government communication style and energy developers' communication style could play a more important role in the degree to which acceptance of the technology is driven by autonomous motivations compared to the other pro-environmental behaviours. In fact, it has recently been shown that the perceived threat to freedom in the context of mandatory and voluntary policy adoption of heat pumps strongly influences positive and negative emotions toward the policy (Contzen et al., 2021).

It is also important to carefully consider the level of analysis and a social identity perspective which could be extremely valuable for understanding the full potential and functioning of autonomous and controlled motivations.

Only recently studies have started to examine collective levels of self-determined motivations and autonomy perceptions. In the context of intergroup helping, Thomas and colleagues (2017) adapted the principles of self-determination theory to the intergroup level, considering a social identity approach. They affirmed that self-determined motivation and autonomy perception could also stem from group memberships rather than only from individual identity per se. These group-level variants of self-determined motivations and autonomy perceptions were respectively named *collective self-determination* and *perceived autonomy of membership helping*. Collective self-determination can be defined as the perception that members of the ingroup act in a certain way *because* they value doing so. Group-level autonomy, which the authors called "Perceived autonomy of membership helping" in the specific context of their study, can be defined as the perception that group members act out of obligation. These definitions were extrapolated from the items used to measure these constructs. Consistently with the SDT, group-level autonomy is supposed to fuel collective self-determined motivations.

The important implication of this research is that some issues are particularly relevant for a group level of identity rather than for the personal identity. Consequently, in these contexts, the feeling that the ingroup is autonomous in performing a behaviour is what matters when evaluating behavioural options. In particular, Thomas et al. (2017) used an articulated research design showing that collective self-determined motivations predicted support for a series of outcome variables above the individual-level of self-determined motivations. Participants were invited to think about their individual and collective motivations to engage in supportive actions to tackle global poverty. These participants were actual supporters of global poverty reduction. An example item for the individual motivation was "[I did these items] because I valued doing so", an example item for the collective motivations was "Because they [ingroup members] valued doing so". By analysing the relationship between type of motivations (individual and collective) and financial donations to global humanitarian causes, the authors showed that donations were only predicted by collective self-determined motivations, while individual motivation was not a significant predictor. It is also relevant to clarify that the reference group in their study was the general category of Australian people, and that participants were Australians. This type of social identity category is similar to the social category of the present study, which focused on regional identity (i.e., Cornish identity).

In the field of pro-environmental behaviours and acceptance of climate policy, no study to date has considered the role of collective self-determined motivations. In fact, even if Marshall et al.'s (2017) study considered a community-level response for what concerns the perceived autonomy support (e.g. "This initiative provides my community with the freedom to make our own decision about the best way to adapt to climate change"), autonomous and controlled motivation reasons behind the donations (e.g. "For the pleasure I experience when I find new ways to help my community adapt to climate change; Because responding to climate change is an integral part of my life") remain properties of the individual and not the group. This is coherent with the classic Self-determination Theory (Ryan & Deci, 2000) according to which the group, as part of the social context, can be perceived as supportive or controlling of an individual's autonomous and intrinsic motivation. The group is not considered as an identity-level on which self-determined motivations could emerge. According to classic self-determination theory, the social context is only an external, fundamental, aspect that could more or less be supportive of personal motivation to act. I argue that political regulations such as the acceptance of an energy technology call into question a collective, rather than individual, level of self-determined motivation.

Which antecedent conditions promote the feeling that their own Cornish-group is accepting the geothermal energy because "they value doing so", because "it is important to them"? Once the collective level of self-determined motivations and the importance to verify this level are considered, this important question needs to be addressed. Behaviours undertaken autonomously usually reflect core personal values

(Ryan & Deci, 2000). Group values and norms and the positive feeling to do something for the public good could be a driver for accepting the geothermal technology. However, the way in which actors responsible for the deployment of the geothermal technology communicate with locals could undermine the basic psychological need of autonomy of the Cornish-group (e.g., see Lavergne et a., 2010) which, in turn, may undermine collective self-determined motivations. For example, those responsible for the technology (energy developers, Cornwall Council) could be perceived as authorities that are forcing Cornish people to have that technology in their county. The extent to which these motivations are autonomous (self-determined) could depend, in part, on the extent to which those actors responsible for the implementation of the geothermal technology (Cornwall council and energy developers) support the facilitation of collective self-determined motivations and so are perceived as autonomy-supportive rather than controlling. These actors could thus communicate with locals in a way that is either supportive or controlling of Cornish-group autonomy and so influence perceived collective autonomy which fuels the collective self-determination to accept geothermal energy (Deci & Ryan, 1985; Thomas et al., 2017).

In the present study, I assessed the effect of collective levels of autonomy perceptions and self-determined motivations on social acceptance. This type of collective autonomy theoretically differs from the conceptualisation by Kachanoff et al. (2019), in which collective autonomy is conceptualised as the extent to which "[group members] freedom to define and practice its own identity has been [...] restricted by other groups in society" (item example: "Other groups have tried to control what customsand practices we should follow"). I used the conceptualisation proposed by Thomas et al. (2017) which refers to the group members' perception that their ingroup is acting out of choice or obligation.

Congruent with van Prooijen's study (2009), it is also expected that perceived collective autonomy is related to the perceived fairness of the decision-making process. However, how these two are related to each other in the present context is unknown. The aim of van Prooijen's study was different from the aim of the present study as the authors showed that procedural fairness matters more when autonomy needs are not satisfied, concluding thus that procedural fairness is important because it informs about autonomy needs.

In particular, van Prooijen (2009) showed, in an experimental design, that people were more sensitive to fairness of the decision-making procedures when their autonomy need was deprived. That is, when people's autonomy perceptions were manipulated in a way that left them without opportunity of choice (no autonomy), people valued more an opportunity to voice their opinion (fair procedures) in a resource-allocation task. When people's autonomy perceptions were instead manipulated in a way that gave them opportunity of choice (high autonomy), people were less sensitive to cues regarding fair procedures (non-fair procedures). In a third correlational study, the author showed that the extent to which public employees experienced a sense of work autonomy (i.e., a measure of perceived choice on a variety of dimensions such as work methods and tasks) interacted with procedural fairness (i.e., measured as the perception of fair procedures related to decisions taken in the participants' work organisation) in explaining participants' tendency to report illegal/immoral actions of their colleagues to their seniors. In summary, the relationship between autonomy need and procedural fairness tested by van Prooijen (2009) was tested as an interaction.

Differently, Chou et al. (2021) showed, among other results, that procedural fairness mediated the relation between psychological need for autonomy and organisational outcomes such as helping behaviour (e.g., availability to help a colleague at work).

Moreover, since both autonomy need and perceived fairness are measured in the present study to reflect a group-level, rather than individual-level, constructs, van Prooijen's (2009) study and Chou et al's (2021) study cannot be directly compared with the present study. For the present research context, it seems plausible that fairness perception is grounded in the autonomy need so that the extent to which group-level autonomy need is supported or undermined by authorities involved in the decision outcome (i.e., in the implementation of the geothermal energy technology) predicts procedure-related fairness perceptions (in line with the relationships proposed by Chou et al., 2021). Additionally, the outcome variable used by Chou et al. (2021) is closer in terms of meaning to the outcome variable of the present study compared to the outcome variable of van Prooijen. However, since the present study is correlational in nature, the proposed sequential chain would need further examination in an experimental setting.

4.4 The present study

The present research considers the role of autonomy needs, procedural fairness, identity violation, and self-determined motivations in the acceptance of large-scale geothermal energy technology in a real-world context. These variables were applied at the group level. In fact, the first aim was to account for group-based individual evaluations of the geothermal technology. To achieve this, participants were invited to think more broadly about the geothermal technology, beyond their personal experience and individual opinion. The adaptation to the group level was based on the operationalisation of collective self-determined motivations from Thomas et al. (2007) which used the pronoun "they" instead of "I" or "we". Similarly, other authors such as Yang et al. (2007), building from the work of procedural justice climate (e.g., Naumann & Bennett, 2000), operationalised procedural justice to reflect a group reference as "As a whole, the people in my work group feel that [...]". Moreover, it is important to specify that the measure of procedural fairness reflected perceptions of general procedures without specifically referring to procedures of decisions made by ingroup authorities (e.g., Parish council) nor by outgroup authorities (e.g., energy developers).

Based on the literature research discussed in the previous sections, I aimed to verify the conditional indirect effect of group-based autonomy need on social acceptance, via procedural justice climate, on levels of the perceived social identity violation. At this point, an important question needs to be answered. In which direction does social identity violation moderate the relationship between procedural fairness perceptions and social acceptance? From Mayer at al.'s (2009) study, it is not clear whether the social identity violation effect might also occur when decision acceptance is the outcome variable since the authors used fairness perceptions as the outcome, while manipulating fair procedures as the independent variable and not the acceptance of authorities' decisions (i.e., the implementation of the geothermal technology) as in the present study. The closest previous study in terms of research context is Siegrist et al. (2012), where highly morally relevant issues led to a stronger effect of procedural fairness in the acceptance of genetically modified (GM) field experiments. However, Siegrist et al.'s (2012) results were not in line with previous literature on the moral mandate effect previously discussed (e.g., Skitka & Mullen, 2002). Furthermore, rather than examining the conditional effect of social identity violation in the relationship between procedural fairness and people's acceptance (as in the present study), Siegrist et al.'s (2012) study focused on morality aspects. Therefore, it is difficult to define a specific direction of the proposed interaction between procedural fairness and social identity violation on the social acceptance of geothermal energy. A strength of the present study is its use of a real-world context which provides high ecological validity when investigating the above proposed interaction. For these reasons, the present study does not specify the interaction direction.

Another aim was to assess whether the perception of group-level autonomy was associated with the extent to which individuals perceive their group (i.e., Cornish people) as intrinsically motivated to accept the geothermal energy, which in turn would predict individual acceptance of the technology. The model also includes covariates of perceived leader ingroup prototypicality and knowledge of the geothermal project, because these were shown to be very relevant when examining the association between procedural fairness and outcome decisions as previously discussed in section 2.1.2 (De Cremer et al., 2010; Ullrich et al., 2009; See, 2009).

Hypotheses

Two hypotheses are reported in this manuscript, which correspond to a more parsimonious and direct version of the pre-registered hypotheses. In fact, the pre-registered hypotheses referred to each step of the conceptual model, while here the two main paths are presented (see Figure 5).

H1: The relationship between group-level autonomy and social acceptance is mediated by procedural justice climate; this relationship is conditional to levels of social identity violation.

H2: The relationship between group-level autonomy and social acceptance is mediated by collective self-determined motivations.

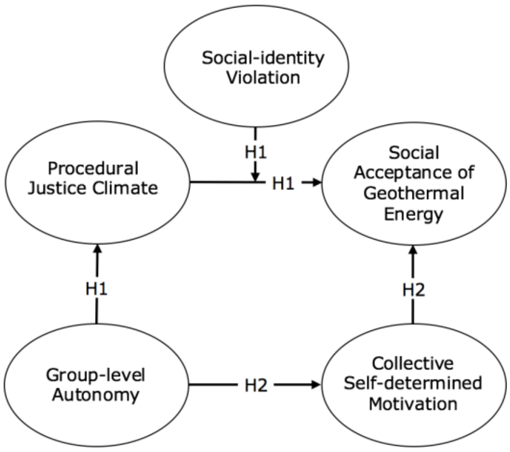

Figure 5. Conceptual model (Study 3).

4.5 Method

4.5.1 Participants

I recruited 530 participants. Participants living in Cornwall were recruited via the online survey platform CINT (n = 186), from social media advertisement (n = 230), and from Cornish students of the University of Plymouth (n = 115). The final sample consisted of 496 Cornish residents, after excluding those whose place of residence differed from Cornwall. A post-hoc power analysis based on population RMSEA (MacCallum et al., 1996) showed that 496 participants were sufficient to achieve power of 1. Null and alternative RMSEA were respectively fixed to .050 and .01 ($df = 179$; $\alpha = .01$).

225 participants were male (46.3%), 10 preferred to not answer. 29.2% were aged 18-30, 41.1% were 31-60, and 29.6% were 61-80+ ($M = 45.83$; $SD = 18.35$). About half of the participants had a university degree (47.98%), 6% preferred to not disclose their education. Concerning political orientation, about half of the participants were left (44.76%), the rest preferred a right (13.10%) and a centre (34.88%) orientation; 7.26% of participants preferred not to answer. Participants were the same as in Study 2.

4.5.2 Procedure

Since this study was part of a larger survey, the procedures are the same as in Study 2 (Chapter 3). Participants were told that the purpose of the study was to explore people's opinions of geothermal energy in Cornwall. Prior to starting the online questionnaire and after giving consent to participate in the study, participants were offered a brief description of what geothermal technology is. The information included was based on information provided by the British Geological Survey website (bgs.ac.uk) and reviewed by an expert geologist professor from the University of Plymouth. The order of questions in the online questionnaire represented the paths described by the conceptual model.[3]

4.5.3 Measures

Model complexity was simplified by excluding items from the collective non-self-determined motivations, which is a deviation from the pre-registered study. An agreement scale, from 1 (*strongly disagree*) to 7 (*strongly agree*) was used for items of social acceptance, leader ingroup prototypicality, and social identity violation variables. Responses regarding the participants' knowledge of the geothermal project ranged from 1 (*you don't know anything about the geothermal project – nothing*) to 7 (*you are really well informed about the geothermal project – very informed*). Collective self-determined motivation was measured using a 7-point scale, from 1 (*corresponds not at all*) to 7 (*corresponds exactly*). The perceived group-level autonomy was also measured via a 7-point scale, from 1 (*out of obligation*) to 7 (*out of choice*).

[3] The variables of the present study were presented after the variables measured in Study 2.

Group-level autonomy

Participants were asked to indicate the extent to which the acceptance of the geothermal technology of Cornish people would have to be due out of choice or out of obligation (1 item): "Thinking about the Cornish people's acceptance of geothermal energy, to what extent do you think this acceptance would be out of choice or obligation?". The item was adapted from Thomas et al. (2017).

Procedural justice climate

Participants were asked to think about the general decision-making procedures that led to the implementation of the geothermal technology. Then, they were invited to respond to the following five statements. *As a whole, I think people in Cornwall feel that*: "They had the opportunity to express their views and feelings during those procedures"; "They had the opportunity to influence the outcomes arrived at by procedures"; "They had the opportunity to collect as much information as they needed about the geothermal project"; "Details of the project have been communicated in a timely manner"; "They were treated with dignity and respect". Items were adapted from Naumann & Bennett (2000), Colquitt (2001), and Colquitt et al. (2002).

Collective self-determined motivation

Participants were invited to indicate the extent to which each of the following statements was a reason for people in Cornwall to accept the implementation of the geothermal energy (3 items): "Because they feel pleasure about protecting the environment through sustainable energy use"; "Because they value supporting geothermal energy"; "Because they think geothermal energy is important". Items were adapted from Thomas et al. (2017), Weinstein & Ryan (2010), and Pelletier et al. (1998).

Social identity violation

This variable was measured with four items, for which participants expressed their level of agreement: “I feel the decision is damaging to Cornish people’s identity”; “I feel the decision goes against Cornish people”; “I feel like something that is very important to Cornish people was violated by the decision”; “Some things that I value and that are a part of my identity as a Cornish person were disregarded by the decision”. Items were adapted from Mayer et al. (2009).

Leader ingroup prototypicality

Participants were invited to indicate their level of agreement on 5 statements. *Overall, I would say that Cornwall Council*: “Represents what is characteristic about Cornish people”; “Are representative of Cornish people”; “Are a good example of the kind of people who live in Cornwall”; “Stands for what people who live in Cornwall have in common”; “Are very similar to most people in Cornwall”. Items were adapted from Platow and van Knippenberg (2001).

Level of knowledge

Participants indicated how much they knew about the geothermal project in Cornwall (1 item): “How much do you know about the geothermal project in Cornwall?” (ex-novo).

4.5.4 Analytical strategy

Confirmatory factor analysis and structural equation model analysis was used to assess the measurement and the structural model. The analyses were conducted using R and the packages *lavaan* 0.6-7 (Rosseel, 2012) and *semTools* 0.5-5.912 (Jorgensen et al., 2021). A robust estimator (MLR, see Savalei & Rosseel, 2021) for multivariate nonnormal data was adopted to account for not normally distributed data inspected via density and Q-Q plots.

One of the model variables, group-level perceived autonomy, was formed by one observed indicator only, which was treated as latent using the sample variance of this single indicator and the estimated reliability ($\sigma \times 1\ [-\alpha]$). The estimated reliability was based on the closest construct of "collective autonomy" of Kachanoff et al. (2019), rounded down. This step was not specified in the pre-registration, but many scholars recommend this procedure (e.g., Kline, 2015; Brown, 2015) to avoid identification problems (Bollen, 1989). Furthermore, the results did not change when treating the variable as observed.

An unconstrained approach, via product indicators, was used to create the moderator variable (Marsh et al., 2004). A matched-pairs (see Marsh et al., 2012) and a double-mean-centering strategy (Lin et. al., 2010) were adopted for the product indicators procedure.

Given the sensitivity of the chi-square statistic (χ^2) to sample size, I relied on the comparative fit index (CFI), the Tucker–Lewis index (TLI), the root mean squared error of approximation (RMSEA), and the standardized root-mean-square residual (SRMR) to evaluate the model fit. For the RMSEA and the SRMR statistics, values $\leq .08$ indicate a reasonable fit, the lower these values the better the model fit (Hu & Bentler, 1999). For CFI and TLI, values close to 1 indicate good fit, values $< .90$ indicate poor fit.

The results are presented in the following sequence: preliminary analyses (i.e., correlations between observed variables, interval consistency test, and measurement model test), structural models, and follow-up analysis. In addition to the pre-registered structural model (Step 1), the moderated mediation was also tested including covariates (Step 2), excluding H2 path (Step 3), and only testing the simple moderation (Step 4).

This step-by-step procedure ensures a clear conclusion of the moderating role of social identity violation, as it controls for the covariance structure of the other latent variables involved. Given the results of the pre-registered hypotheses, a follow-up-exploratory analysis was further carried out to help the interpretation of the pre-registered path H1 (Step 5).

4.6 Results

4.6.1 Preliminary analyses

Prior to conducting the main analyses, correlations among the variables, internal consistency of the aggregated measures, and the measurement model were tested. Correlations among study variables, means and *SDs*, and Cronbach's Alpha are given in Table 8.

Table 8
Means, *SDs*, Cronbach's Alpha, and bivariate correlations.

	M (± SD)	α	1	2	3	4	5	6
1. Social Acceptance	5.92 (± 1.32)	.95	–					
2. Group-level Autonomy	4.41 (± 1.48)	n.a.	.33***	–				
3. Procedural Justice Climate	3.78 (± 1.50)	.94	.26***	.37***	–			
4. Coll. Self-deter. Motivation	4.91 (± 1.31)	.88	.46***	.47***	.38***	–		
5. Social Identity Violation	1.99 (± 1.35)	.94	-.57***	-.12*	-.04	-.22***	–	
6. Leader ingroup prototypicality	3.55 (± 1.41)	.94	.12**	.24***	.44***	.31***	.11*	–
7. Knowledge	2.90 (± 1.89)	n.a.	.25***	.20***	.30***	.15***	-.18***	.03

* $p < .05$**, $p < .01$, *** $p < .001$
Note. Cronbach's Alpha is calculated using polychoric correlations of the construct as latent variables via *semTools::reliability()*

4.6.1.1 Measurement model

The measurement model (CFA) showed acceptable model fit (χ^2_{279} 577.424, $p < .001$; SRMR = .038; RMSEA= .056, 90% confidence interval (CI) [.050, .063]; CFI= .963; TLI= .956). Modification indices suggested letting the first two items of the procedural justice climate variable correlate, which improved the χ^2 statistics by 141.803. An inspection of the model residuals covariance showed that the two items shared 2.15 of standardised disturbance. Considering the high Spearman correlation between these two items (r = .88), suggesting redundancy, and the recent evidence from Bandalos (2021) about the negative effect of items with similar meaning on correlated residuals, I decided to let the two items correlate (this step was not pre-registered). The new CFA model showed an improved fit to the data (χ^2_{278} 495.554, $p < .001$; SRMR = .037; RMSEA= .048, 90% CI [.041, .055]; CFI= .973; TLI= .968). Parameter estimates of the CFA model are presented in Table 9.

Table 9
Parameter estimates of the confirmatory factor analysis (Study 3).

Latent Factor	Indicator	B	SE	Z	*p*	*β*
Proced. Just. Clim.	pjc_1	1.000	.000			.872
	pjc_2	.924	.021	43.921	< .001	.838
	pjc_3	1.105	.031	36.352	< .001	.912
	pjc_4	1.084	.040	27.249	< .001	.889
	pjc_5	.898	.040	22.667	< .001	.825
Coll. Self-det. Mot.	csd_1	1.000	.000			.703
	csd_2	1.310	.078	16.666	< .001	.922
	csd_3	1.323	.083	16.031	< .001	.905
Social Acceptance	acc_1	1.000	.000			.947
	acc_2	1.013	.031	32.972	< .001	.963
	acc_3	.973	.042	23.240	< .001	.860
	acc_4	.921	.048	19.007	< .001	.894
Soc. Identity Violat.	siv_1	1.000	.000			.920
	siv_2	1.035	.035	29.995	< .001	.934
	siv_3	.988	.051	19.614	< .001	.890
	siv_4	.917	.054	17.058	< .001	.842
Interaction term	mod_1	1.000	.000			.906
	mod_2	1.030	.058	18.044	< .001	.867
	mod_3	.921	.090	10.102	< .001	.798
	mod_4	.663	.096	6.778	< .001	.668
Lead. ingroup protot.	pr_1	1.000				.880
	pr_2	1.076	.030	35.715		.918
	pr_3	1.075	.039	27.819	< .001	.890
	pr_4	1.106	.036	30.339	< .001	.928
	pr_5	.783	.048	16.409	< .001	.701
Gr. level Autonomy	aut_0	1.000	.000			.951

B = non-standardised estimate; *SE* = standard error; Z= test statistic; *p*-value = values of *p* corresponding to the z-statistic; *β* = standardised estimate. *Note.* The first indicator of each latent construct has been used as a marker for scaling and identification purposes.

4.6.2 Structural models

Step 1 – model without covariates

The structural model showed acceptable model fit (χ^2_{179} 349.845, $p < .001$; SRMR = .065; RMSEA= .056, 90% CI [.047, .065]; CFI= .969; TLI= .964). Graphical representation of the model is presented in Figure 6.

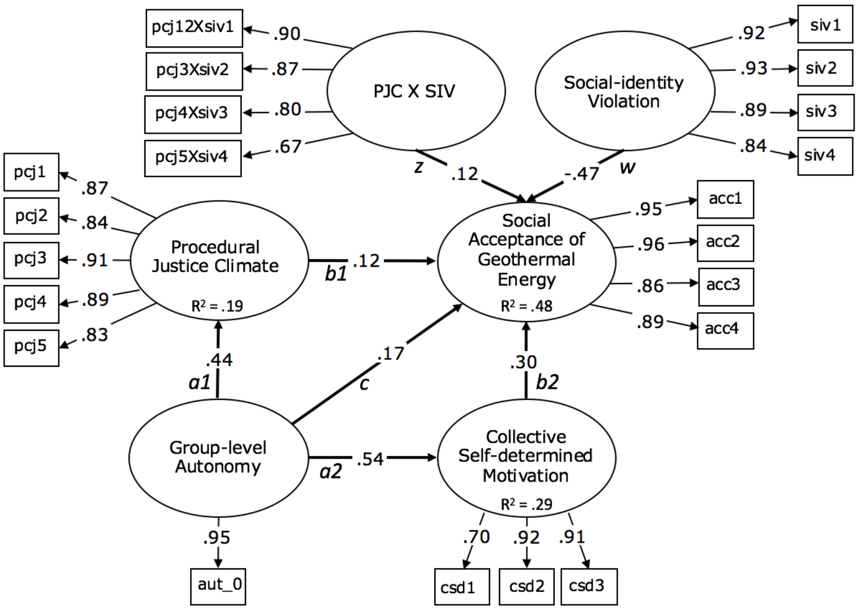

Figure 6. Graphical representation of the statistical model.
Note. Variance between exogenous variables, error variance, and correlated residuals between the first two items of the procedural justice climate variable are not reported in this figure to simplify the presentation. Coefficients presented are standardised linear regression coefficients. Paths have been labelled (e.g., a1, b1) to facilitate the interpretation of the indirect effects in Table 10. PJC X SIV = interaction term (procedural justice climate x social identity violation).

Both the direct and the indirect effects supported Hypothesis 1. With regard to the direct effects, group-level perceived autonomy was associated with procedural justice climate (β = .44 [.348, .526]; p = < .001) which, in turn, predicted social acceptance (β = .12 [.040, .200]; p = .003). Social identity violation negatively predicted social acceptance (β = -.47 [-.561, -.385]; p = < .001). The interaction between social identity violation and procedural justice climate positively predicted social acceptance (β = .12 [.033, .207]; p = .007). The conditional indirect effect showed that group-level autonomy was associated with social acceptance via procedural justice climate for certain levels of social identity violation (± 1 *SD*; see Figure 7). This effect was significant for high levels of the moderator social identity violation (β = .10 [.043, .166]; p = .001) but not for low levels as clearly indicated by the confidence intervals [-.041, .041]. In other words, when people felt that their identity was violated, the perceived group-level autonomy through procedural justice climate perception helped mitigate the negative effect of identity violation on the acceptance of the geothermal technology. Results also showed that the simple indirect effect of group-level perceived autonomy through procedural justice climate on social acceptance was significant but weak in magnitude (β = .05 [.017, .087]; *p* = .003).

Supporting Hypothesis 2, the direct effects showed that group-level perceived autonomy was associated with collective self-determined motivations (β = .54 [.443, .640]; *p* = < .001) which, in turn, predicted social acceptance (β = .30 [.192, .414]; *p* = < .001). The indirect effect of group-level autonomy on social acceptance via collective self-determined motivations was also significant (β = .16 [.098, .230]; *p* = < .001).

Interestingly, both the zero-order correlations and the results from the SEM model suggested that the strongest predictor of social acceptance was perceived social identity violation. These results confirm the central role of social identity violation in the acceptance of large-scale energy technology such as geothermal power plants.

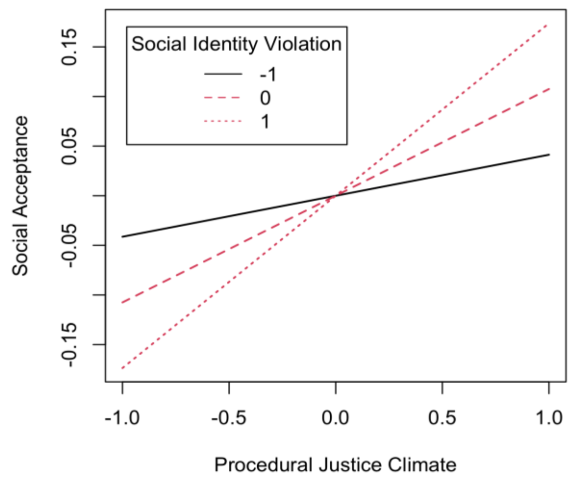

Figure 7. Graph of the moderation within the moderated mediation model.
Note. The black line indicates a non-significant slope.
Note 2. The model also included the H2 path.

4.6.2.1 Indirect effects confidence intervals: MLR, BCa, and MC methods

Since the data violated the assumption of normal distribution, a robust estimator was used (MLR; Huber-White *SE*, Huber, 1967; White, 1982), which performs better, in terms of standard errors (*SEs*) and confidence intervals (CIs), than other conventional robust estimators (e.g., MLM) under normality violation (Lai, 2018; 2019). As a further step, confidence intervals of the indirect effects were also calculated using bootstrapping and Monte Carlo methods. Bootstrapping and Monte Carlo are expected to perform similarly (Preacher & Selig, 2012), and consistency among these methods would increase the reliability of the results. Confidence intervals among MLR, Bootstrap, and Monte Carlo methods are presented in Table 10. For bootstrapping, an adjusted bootstrap percentile (BCa) method, correcting for bias in the central tendency of the estimate, was used (R = 5000). The Monte Carlo method was based on empirical sampling distributions of estimated model parameters (R = 5000) (MacKinnon et al., 2004).

Table 10

95% Unstandardised confidence intervals for the simple and conditional indirect effects.

		95% CIs	
Indirect effects	**MLR**	**Bootstrap**	**Monte Carlo**
a1*b1	.017 – .087	.018 – .084	.016 – .081
a1*(b1+(-1*w))	-.041 – .041	-.014 – .052	-.013 – .049
a1*(b1+(1*w))	.043 – .166	.037 – .126	.036 – .122
a2*b2	.098 – .230	.092 – .225	.091 – .219

a1*b1 = group-level autonomy (a1) procedural justice climate (b1) social acceptance
a1*(b1+(-1*w)) = a1*b1 at low levels of social identity violation
a1*(b1+(1*w)) = a1*b1 at high levels of social identity violation
a2*b2 = group-level autonomy (a2) collect. self-determ. motivations (b2) social acceptance
Note. See Figure 6 to better see the paths described.

Results in Table 10 indicate similar interval values among the methods used, and no differences on whether or not the intervals crossed zero. Looking at the lower confidence limits, the indirect effect that goes from group-level autonomy through collective self-determined motivations on social acceptance (i.e., a2*b2) showed the strongest effect size. In general, the CI width(s) of the (unknown) effects are consistent with the model complexity and the sample size.

Step 2 – adding covariates

The model with covariates level of knowledge and leader ingroup prototypicality showed acceptable model fit (χ^2_{306} 593.824, $p < .001$; SRMR = .060; RMSEA= .052, 90% CI [.046, .058]; CFI= .965; TLI= .960). Compared to the model without covariates, the direct effect of procedural fairness on social acceptance (β = .06 [-.033, .160]; p = .200), and the simple indirect effect of group-level autonomy via fairness on social acceptance (β = .02 [-.009, .043]; p = .197) were not significant; the other paths remained stable. Nonetheless, the significance of the conditional indirect effect remained stable for low and high levels of the moderator social identity violation. Interestingly, there was a positive association between procedural fairness and leader ingroup prototypicality (β = .38 [.299, .466]; p = < .001), as well as between collective-self determined motivations and leader ingroup prototypicality (β = .26 [.170, .353]; p = < .001), while the direct effect of leader ingroup prototypicality on social acceptance was not significant (β = .06 [-.022, .146]; p = .150). Level of knowledge significantly predicted social acceptance (β = .11 [.041, .181]; p = .002), procedural fairness (β = .30 [.221, .389]; p = < .001), and collective-self determined motivations (β = .09 [.015, .175]; p = .021).

Step 3 – excluding H2 paths

The moderated mediation was also tested excluding the path described in H2 and including the covariates (i.e., level of knowledge and leader ingroup prototypicality). Therefore, only the moderated mediation was tested. The model showed good fit to the data (χ^2_{238} 462.456, p < .001; SRMR = .048; RMSEA= .053, 90% CI [.046, .061]; CFI= .968; TLI= .963). Results showed that when excluding the H2 path, but controlling for the covariates, the moderated mediation model showed the same pattern of significant and non-significant paths as the model in Step 1. The model tested excluding both covariates and H2 showed good fit to the data as well (χ^2_{127} 235.842, p < .001; SRMR = .039; RMSEA= .056, 90% CI [.045, .067]; CFI= .975; TLI= .970). The conditional indirect effect, also in this model without covariates, showed the same coefficients pattern of the model in Step 1.

Step 4 – simple moderation model

As a further step, a simple slope analysis of a more parsimonious model consisting of procedural justice perception on social acceptance moderated by social identity violation was carried out (see Figure 8).

This model also included covariates and the fit was reasonably good (χ^2_{220} 416.618, p < .001; SRMR = .047; RMSEA= .053, 90% CI [.045, .060]; CFI= .971; TLI= .967). Social identity violation was negatively associated with social acceptance (β = -.53 [-.620, -.449]; p = < .001) while procedural justice climate was positively associated with social acceptance (β = .20 [.117, .295]; p = < .001). Across values of social identity violation, the simple slope of procedural justice climate was positive and stronger at increasing values of social identity violation (Figure 8). This model showed the same pattern of slopes when covariates were excluded.

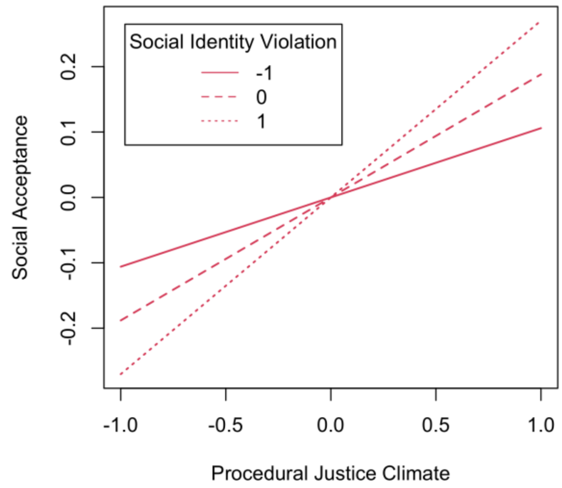

Figure 8. Graph of the simple moderation.
Note. This model controlled for covariates level of knowledge and leader ingroup prototypicality.

However, as opposed to the moderated mediation analysis of Step 1 and Step 3, the effect of procedural justice climate on social acceptance was significant also at low levels of social identity violation in this simple moderation analysis (Table 11). This means that when the effect of group-level autonomy was not taken into account (i.e., how much they perceived to have been free/forced to accept the decision), people's perception that their group as a whole have received fair procedures had a positive effect on social acceptance for both high and low levels of social identity violation from the decision outcome. This effect increased as levels of social identity violation increased. Importantly, the interaction was probed for three levels of the moderator social identity violation. Since the *high* level was computed via +1 standard deviation, the actual high level of social identity violation corresponded with what could actually be defined as *medium level* of social identity violation because the corresponding value of 1 *SD* above the mean of the aggregated measures was 3.34 on a scale from 1 to 7.

Table 11

Results of the latent simple slopes analysis

Test value of the social identity violation	Slope	SE	*p-value*
- 1 *SD*	.11	.05	.025
0	.19	.04	< .001
+ 1 *SD*	.27	.05	< .001

Note. These slopes refer to the simple moderation with included covariates (Figure 8)

4.7 Summary of H1 path and introduction to the exploratory follow-up analysis

The role of procedural fairness in the acceptance of the technology was more important at increasing values of social identity violation. This result needs a further consideration in light of the actual high level of the moderator social identity violation. In fact, the "high" level of the moderator social identity violation in the present study was computed as 1 *SD* above the mean which actually represented *medium-low level* of social identity violation (this happened because the moderator's distribution was positively skewed). These results are consistent with studies investigating the relationship between moral mandates and procedural fairness (Skitka & Mullen, 2002). Therefore, the present results offer important perspectives of what it might happen when an energy technology is associated with some degree of social identity violation, but not when the technology is perceived as something that strongly violates people's social identity. In this last case, fair procedures should have a very weak association with the acceptance of authorities' decisions (Skitka & Mullen, 2002). Therefore, a curvilinear interaction should be tested in future studies.

An important example of how different levels of perceived morality or identity violation could lead to the procedural fairness playing different roles in affecting people's response toward an outcome decision could be found in Blondé et al.'s (2021) study. The authors used a proxy of procedural fairness, the perceived legitimacy of authority. In fact, people who exercise their authority fairly are generally viewed as legitimate and their decisions are more likely accepted (e.g, Tyler 2000, Tyler, 2006). Blondé and colleagues (2021) found, among other results, that legitimacy of authority reduced people's intention to act against a decision which would have led to low disadvantages, but not to a decision that would had led to high disadvantages because "perception of moral violation and feeling of anger could not be reduced" (p. 276). The present study confirmed this pattern for a low level of social identity violation.

The results of the present study are in line with the hypotheses but lend themselves to two different interpretations.

One interpretation could be based on the results found by Siegrist et al. (2012). In their study, the more a genetically modified [GM] field experiment was perceived as a moral issue, the stronger perceived procedural fairness predicted the social acceptance of the field experiment. Based on these results, the authors explained that procedural fairness is important to people only if the issue of interest is *morally relevant*. Importantly, the items the authors used to measure moral conviction not only mentioned the *relevance* of the issue (i.e., referring to as a "question of conscience"), but also referred to the extent to which participants perceived the issue as something that threatened important values for them and as something that bothered them. Therefore, their results actually showed that procedural fairness was a weaker predictor the more the issue of interest was perceived as morally threatening.

In a similar way, for the present study it could be argued that when the geothermal technology was perceived as a social identity-relevant issue and, specifically, as something that violated participants' social identity, procedural fairness had a stronger association with the social acceptance of the geothermal technology. Napier and Tyler (2008) assumed that even if the issues of interest are high on moral conviction, fair procedures should still play an important role in positively shaping people's responses toward these issues. However, this does not reflect the results from

Siegriest et al.'s (2012), nor the results of the present study. Instead, Napier and Tyler (2008) simply argued that *even* reactions to threat to moral issues can be mitigated by procedural fairness, and not that this happens *mostly* when there is a threat. Therefore, this interpretation does not offer a theoretically relevant explanation.

A second interpretation is grounded on the value-group model (e.g., Tyler et al., 1996) and on the results from the qualitative study (Chapter 2). This interpretation calls into question the explanation of what it could mean to people to indicate lack of identity violation. In other words, why did most people indicate that geothermal technology was not something that violated their social identity? From results of the qualitative study in Chapter 2, the identity-related outcomes from the technology implementation seemed strong drivers of people's social acceptance of the technology. Low levels of social identity violation in the present study may represent a perceived support toward people's social identity, satisfying people's need for social self-esteem, from the decision to install the geothermal energy technology. Since procedural fairness gives people information regarding their value as group members and their group status (e.g., Tyler et al., 1996), when the outcome of a decision, i.e. in this case the decision to install the geothermal technology, is already supportive of the group status and therefore it is positively associated with feelings of pride and positive self-esteem, perceived fairness related to the decision-making process might be less important in affirming that the group to which people belong is valuable. Conversely, when the outcome of a decision violates people's social identity to a certain extent (and therefore is perceived as not supporting the group status) perceived fairness of the decision-making procedures could be more important in shaping the favourability toward the decision outcome because it informs about the group value. This result is also in line with studies highlighting the importance given to the distribution of the outcomes when people are in a group context rather than to the procedures associated with the decision (Leung et al., 2007). In particular, the consequences of the distribution of the outcomes were probably particularly positive for the Cornish group because of the positive identity-features. The distribution of the outcomes in the present study concerns the mere implementation of the technology in their county rather than elsewhere in the UK.

I ran follow-up analyses which could support this interpretation to investigate it further. According to the second interpretation based on the value-group model, one would expect the effect of procedural justice perception on social acceptance to be non-significant or less strongly associated with social acceptance at a high level of perceived support toward self-esteem motives from the decision to install the technology (i.e., the outcome itself). The closest indicator of self-esteem included in the survey was group-based pride emerged from the decision taken by local authorities to install the geothermal technology. Therefore, the follow-up analysis explored the moderating role of group-based pride in the relationship between procedural justice climate and social acceptance.

4.7.1 Testing the interaction between group-based pride and procedural justice climate

The goal of this follow-up analysis was to explore how procedural fairness was associated with social acceptance at conditions of low and high group-based pride related to the decision to implement the technology.

If the present study results support the interpretation based on the value-group norm, it should follow that procedural justice climate should be a weaker predictor of social acceptance at high levels of perceived group-pride from the decision to install the technology. If confirmed, theoretical and practical implications should be revised in light of the effect of symbolic identity-related outcomes of the decision.

The present study was part of a larger survey in which the role of group-based emotions was also investigated (group-based pride was measured as the extent to which participants felt proud when thinking about the decision to implement the geothermal technology in Cornwall, *M* = 4.95; *SD* = 1.72).

4.7.2 Results of the follow-up analysis

To test this interaction, aggregated measures were used. In fact, group-based pride related to the decision to install the geothermal technology was measured with one item only and ordinarily at least two product indicators are required to test the interaction with a latent variable using the same procedure I used in the previous analysis sections (Marsh et al., 2004). The R Package *Interaction* was used (*version* 1.1.5). A robust standard error estimator was employed ("HC3", see Long & Ervin, 2000). Consistent with the expectation, the relationship between procedural justice climate and social acceptance was stronger for low levels of perceived group-pride related to the decision to install the geothermal technology (Figure 9). This simple model explained 35% of variance.

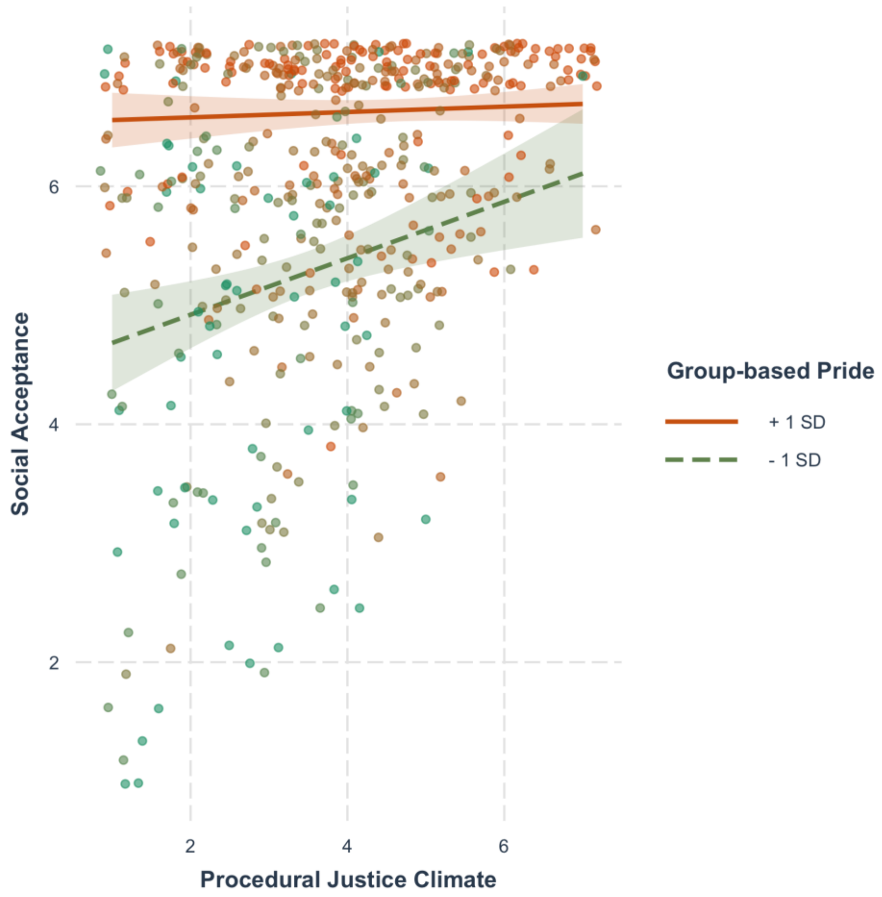

Figure 9. Interaction between procedural justice climate and group-based pride on social acceptance.
Notes. Observed values have been jittered using a 0.2 parameter to better visualise overlapping data points. Confidence intervals are at 95%.

Table 12. shows how the slope of procedural justice climate decreases as group-based pride increases. This result supports the interpretation that participants might have gathered their sense of group-pride from the decision outcome itself, and not from the perceived fairness of the decision-making procedures that led to the implementation of the technology.

Table 12
Results of the simple slopes of the follow-up analysis.

	Est.	SE	2.5%	97.5%	*p-value*
Slope of PJC when GBP = 3.23 (-1 *SD*)	.24	.07	.09	.38	< .001
Slope of PJC when GBP = 4.50 (*Mean*)	.13	.04	.06	.20	< .001
Slope of PJC when GBP = 6.67 (+1 *SD*)	.02	.03	-.04	.08	.44

PJC = procedural justice climate; GBP = group-based proudness

4.8 Discussion

This study verified the associations between group-level autonomy need, procedural justice climate (i.e., group-level procedural fairness), social identity violation, and collective self-determined motivations in the acceptance of a large-scale energy technology (i.e., deep geothermal energy). The study was based on a survey conducted among people resident in Cornwall (UK) where a deep geothermal power plant was being implemented. The aim of the study concerned the boundary conditions of procedural fairness when examining people's acceptance toward large-scale energy technology, and the link between group-level autonomy and both procedural fairness and collective self-determined motivations. This study was grounded on social identity theories (e.g., Tajfel & Turner, 1979), the group-value model of procedural justice perception (Tyler & Lind, 1992; Tyler et al., 1996) and (collective) self-determined motivation theories (Deci & Ryan, 2000; Thomas et al., 2017).

Results from structural equation model analysis confirmed the hypothesised pre-registered associations: social identity violation moderated the indirect effect of group-level autonomy, via procedural fairness, on social acceptance of the geothermal technology (H1), and group-level autonomy predicted, via collective self-determined motivations, the social acceptance as well (H2).

Since procedural fairness is sensitive to the level of knowledge toward the outcome decision and to the extent to which the ingroup leader (in this case Cornwall council) is seen as prototypical of the ingroup (e.g., See, 2009; Ullrich et al., 2009), the model was also tested including the covariates level of knowledge and leader ingroup prototypicality. The covariates weakened the relationship between procedural fairness and the outcome variable social acceptance (see Step 1a). The inclusion of either H2 path (i.e., group-level autonomy → collective self-determined motivations → social acceptance) and/or covariates significantly impacted the stability of the relationship between procedural fairness and social acceptance, while the direct and strongest relationship between social identity violation and social acceptance remained stable across all steps.

4.8.1 Discussion of the H1 path: group-level autonomy, social identity violation and procedural justice climate

The pre-registered conditional effect showed that the relationship between group-level autonomy and social acceptance via procedural justice climate was not significant at low levels of the moderator social identity violation. Due to the skewness of the moderator variable, low levels represented absence of social identity violation (i.e., the "strongly disagree" label of the scale). Therefore, a high level of the moderator refers to the medium-low level of violation when taking into consideration the scale range that was used (the 1*SD* above the mean value used to probe the high level of the moderator did not cross the central point of the scale).

When zooming in on the relationship between procedural justice climate and social acceptance moderated by social identity violation, therefore excluding from the model the variability explained by the other variables, the same pattern emerged (Step 4). However, contrary to the conditional indirect effect, the relationship between procedural fairness and social acceptance was also significant at low levels of social identity violation, albeit much weaker. Latent simple slopes analysis shows that at higher levels of social identity violation, procedural justice climate had a stronger positive relationship with social acceptance, thus mitigating the negative effect of social identity violation on social acceptance.

These results are partially consistent with Sigrist et al.'s study (2012), which showed that the more an issue was perceived as a moral threat and was generally morally-relevant, the more procedural fairness has a positive effect on the outcome variable. Moreover, the results of the H1 path are consistent with Blondé et al.'s study (2021) on the effect of perceived legitimacy of authorities on collective actions. Blondé and colleagues showed that when a decision produced some disadvantages, but not high disadvantages, perceived legitimacy from the authorities mitigated the intention to engage in collective actions. A similar pattern might also occur with the procedural fairness perception which is a proxy of the perceived legitimacy of the authorities (Tyler, 2006). However, according to Mayer et al.'s study (2009) on the effect of social identity violation and the results of the effect of moral mandates on the subsequent effect of procedural fairness (e.g., Skitka, 2002), the present study results seem to partially contradict these two studies. Therefore, next steps of the analyses aimed at clarifying why at low levels of social identity violation procedural justice climate was a weaker predictor of social acceptance.

The present results were interpreted in light of the value-group model: since procedural fairness gives people information about their value as group members and of their group status (Tyler et al., 1996), when the outcome of a decision (itself) positively supports the group status, the perceived fairness related to decision-making is less important in affirming that the group to which they belong is valuable. This means that people were proud of the development of the geothermal technology and that this feeling was probably triggered by the comparative context made salient by the implementation of the technology. The specific geological features of Cornwall made the implementation of a cutting-edge renewable energy technology (i.e., the geothermal technology) possible, the same geological features that allowed Cornish people to be among the best miners in the world in the past (see Study 1, Chapter 2). In other words, based on the new geothermal technology being implemented, Cornish people positively differentiated themselves from people living elsewhere in UK.

In summary, this could mean that there is a need for self-esteem that could be either satisfied by fair procedures or by the outcome of the decision itself. Once this need is already fulfilled by an outcome decision, procedural fairness might be less important for the acceptance of authorities' decisions.

This interpretation is also in line with Tyler and Blader's study (2002) addressing the role of autonomous status (i.e., status defined by internal standards based on prototypical group values and norms) and comparative status (i.e., status defined by external standards) in the relationship with procedural justice. Their study showed that procedural fairness affects people's status perception not because people compare their group to other groups, and that therefore feelings of pride do not mainly emerge because one feels better than others, instead: "fairness primarily expresses a sense of status that is autonomous, and not comparative, in nature" (p. 832). Since fairness primarily expresses a sense of status based on the group's internal standards, and since I argue that the comparative context is, in the present study, probably informative about the group status already, Tyler and Blader's study (2002) further confirmed the assumption that status-related information is no longer needed from fairness perception when the outcome decision is per se informative about the group value based on a comparative, intergroup, context (van Prooijen et al., 2002).

However, the role of procedural fairness on decision acceptance when the outcome decision is itself informative about intragroup status has not been addressed to date. The analysis of the pre-registered H1 hypothesis was followed by an exploratory analysis aimed to clarify this alternative interpretation. Since the study was part of a larger project which also considered the role of group-based sense of pride from the decision to install the geothermal technology, this variable was used as a moderator of the relationship between procedural fairness and social acceptance. In this sense, feeling of pride was used as an indicator of the positive contribute of the geothermal technology implementation to people's self-esteem.

Results of this follow-up analysis are consistent with the interpretation of the results of the moderated mediation model: the outcome itself (i.e., the implementation of the geothermal energy technology) was already supportive of those psychological needs that fair procedures should have fulfilled. Procedural justice climate predicted social acceptance only at low levels of perceived group pride. Future studies should more systematically verify this association by using experimental procedures and directly measuring outcome decisions as a source of status position and self-esteem.

4.8.2 Discussion of the H2 path: group-level autonomy and collective self-determined motivations

The results of this study also have important theoretical and practical implications for the effect of group-level autonomy need and collective-self-determined motivation on people's acceptance of large-scale energy technologies. To date, no studies have addressed the role of these variables, on a group level, and in the context of acceptance of large-scale technologies. Compared to similar research contexts, the present results corroborate with the previous, limited, studies that investigated the role of autonomous needs and self-determined motivation at an individual level of analysis in the context of policy acceptance (e.g., Contzen et al., 2021; Marshall et al., 2017). Furthermore, the present findings replicate the results of Thomas et al. (2017) that the perception that one's own group is free to act autonomously according to one's group values (i.e., collective self-determined motivation) shapes how people evaluate an outcome object. In fact, I found that when the Cornish people's acceptance was experienced as collectively self-determined, this fostered the individual acceptance of the geothermal energy.

4.8.3 Limitations and conclusion

The present study presents different limitations. As for the correlational nature of the analysis, it is not possible to draw conclusions about causality. In particular, the effect of group-level autonomy on procedural fairness could also be in the opposite direction. However, it seems more plausible, as in many other psychosocial contexts, that these two variables might actually influence each other. It might also depend on the specific context in which a person is involved and on their expectations about procedural fairness (e.g., Diekmann et al., 2007). Another limitation concerns the low variability of the moderator variable social identity violation, which limited the interpretation of the proposed path at a high-level of perceived violation. However, this low variability was also very informative. Participants in the present study perceived the decision to install the geothermal energy as probably supportive of their identity. However, a perceived lack of identity violation does not necessarily mean perceived support. For this reason, future studies should verify the role of social identity motives (e.g., self-esteem) in both supporting and undermining the acceptance of energy technologies. An attempt to preliminarily verify such association was made in the present study by using the perceived group-based pride related to the decision to install the geothermal technology as a moderator of the relationship between procedural fairness and acceptance, which shows promising results as previously discussed. Future studies should also test whether the group-level variables of the present study are distinct from individual-level perception of the same variables. In particular, experimental studies should verify if making salient/not salient one's ingroup identity would lead people to make different evaluations toward the proposed variables in the context of large-scale energy technology acceptance. Another limitation concerns the confidence interval ranges of the estimated effects, which were fairly wide for the indirect effects. This is probably due to the sample size of the present study; therefore, future studies should replicate the present results with larger samples to reach a more precise estimation. This limitation was partially accounted for by using different statistics for the estimated indirect effects based on the Huber-White standard errors, Bias-corrected bootstrap, and Monte Carlo method confidence intervals (MacKinnon et al., 2004; Savalei & Rosseel, 2021).

In conclusion, the present study shows that symbolic identity-related outcomes need to be addressed more when analysing people's response toward large-scale energy technologies. Energy companies, local and national governments would benefit from analysing the specific historical and social territory of the site implementation of large-scale technologies. They should analyse how the specific population interprets the new technology implementation and how these interpretations are associated with both practical and symbolic outcomes. In doing that, authorities should take a further step by going beyond instrumental and procedural considerations, also focusing on group-based psychological needs and motivations.

The role of support and threat toward group-level identity motives in people's responses toward deep geothermal technology.

Abstract

Governments are facing challenges in implementing controversial energy technologies such as deep geothermal energy and carbon capture storage. This study showed that social identity processes are likely to come into operation in the public evaluations of these controversial technologies, affecting people's responses and risk perception. Ad hoc measures for the threat and support toward group-level identity from geothermal technology implementation were developed. These measures were then used to expand our knowledge on the interplay between risk perception and identity dynamics. Main results revealed that (i) each support toward group-level identity motives weakened the effect of risk perception on the collective action intentions and on the specific intention to protest against the technology, (ii) permeability of the group boundaries was relevant in affecting the effect of threat toward group-level identity motives only in interaction with perceived group relative deprivation, and (iii) support toward identity motives were particularly relevant in the social acceptance and in collective action intention to act in favour, often above the variance explained by the risk perception. Theoretical and practical implications are discussed.

5.1 Introduction and research rationale

The transition toward a low-carbon society involves technological advancements as well as public acceptance of new energy technologies at different levels. Once an energy project has been authorised by the relevant authorities (e.g., government), the general population could potentially undermine the future development and deployment of the new energy technologies. This could happen especially if genuine consultancy processes aiming to engage local and general public from the first moment are not carried out.

Beyond contextual aspects such as trust toward authorities and perceived distributive or procedural fairness of the decision-making process (e.g., see Huijts, 2012, and Chapter 4), each type of energy technology comprises specific features that could potentially undermine its acceptance by the general population. Examples are wind turbines with their effect on landscape aesthetics (e.g., Betakova et al., 2015; Diógenes et al., 2020; Johansson & Laike, 2007), or risk perception associated with CO_2-leakage which plays a major role in the public acceptance of carbon capture and storage technologies (e.g., Arning et al., 2019; Whitmarsh et al., 2019).

Accordingly, understanding how such negative perceptions could be countered plays a central role in the field of public acceptance of energy technologies. In this sense, economic compensation and job prospects are opportunities to enhance public acceptance of (and avoid local objections toward) energy technologies, and such benefits have received considerable attention from scholars (e.g., Devine-Wright & Sherry-Brennan, 2019; Walker et al., 2014; van Wijk et al., 2021; Tyler et al., 2022). From a justice perspective, the idea is that those exposed to major risks and unpleasant consequences from the technology should be compensated to guarantee a fairer distribution of costs and benefits. However, financial compensations could actually trigger scepticism among local communities and be perceived as bribes (e.g., Aitken, 2010; Cass et al., 2010; Cowel et al., 2011; Jørgensen, 2020), especially if communities have not been previously consulted (Terwel et al., 2014) or if benefits are framed as project developers' discrete choice rather than policy requirements (Walker et al., 2017).

In recent years, studies have started to address the role of different factors in the acceptance of energy technologies: socio-cultural characteristics (Karimi et al., 2016; Karimi & Toikka 2014; 2018), social identity and intergroup relations (Chavot et al., 2018; Batel & Devine-Wright, 2007; 2018; Molone et al., 2017), and place-technology fit (Devine-Wright, 2009; Devine-Wright & Wiersma, 2020). These studies highlight how processes involved in cultural and identity dynamics shape the acceptability of energy projects. For example, Batel and Devine-Wright (2007) emphasised the importance of looking at socio-historical background and subsequent power relationships between those regional-level groups hosting an energy technology, and those who also benefit from a technology without directly hosting it in their region. Karimi and colleague's research, instead, highlighted - above other individual factors such as familiarity with technology - the effect of cultural dimensions (e.g., uncertainty avoidance) on risk perception of energy technologies. Consistently with the results of Study 1 of the present thesis, Chavot and colleagues (2018) suggested that lack of public acceptance of geothermal technologies is not a concern for those regions that are used to exploitation of their own underground resources, as this fits within their social identity:

"Overall, the reasons to oppose a project are not to be seen as irrational fear regarding the risks induced by drilling or as a type of NIMBY selfishness fuelled by ignorance of the technical or/and ecological specifics of the projects. Rather, they are related to each stakeholder's social situation, their inscription in different social worlds and their social identity." (p. 19).

Moreover, studies on coal-mining communities show the importance of considering the social and cultural reality of a community when analysing locals' responses toward an energy industry (Bell & York, 2010; Carley et al., 2018; Cha, 2020; Della Bosca & Gillespie, 2018; Lewin, 2019). Some of these communities have a strong historical tie with the coal industry (in informing them of "who they are"), and continue to support this industry despite a number of concrete disadvantages and risks (e.g., industrial pollution and lack of job opportunities). A rational costs-benefits analysis cannot explain the complexity of this social response. Therefore, support toward new renewable energies needs to consider how this transition is suitable to communities' identities and social contexts.

Supporting this line of research but from an affective perspective, De Dominicis and colleagues (2015) found that place attachment moderated the effect of natural hazard (high-level flood events) perceived risk on preventive behaviours. Specifically, in context of objective high risk and high perceived risk, the risk perception was strongly associated with preventive behaviours at low levels of place attachment. In this sense, place attachment was described as a barrier to environmental risk copying strategies.

An important body of research shows that energy projects can be perceived as a threat to people's *place* identity. From a psychological framework of place change, Devine-Wright (2009; 2011) argued that energy projects may threaten place-related distinctiveness, continuity, and self-efficacy.

The present study's aim was to contribute to this line of research by examining the extent to which the perceived threat and support toward group-level identity motives from the implementation of a large-scale energy technology (i.e., Enhanced Geothermal System) affected a series of outcome variables (e.g., intention to accept/collective actions) using responses from Scottish and Welsh populations (UK). I mainly drew from research on social identity theories (e.g., Tajfel & Turner, 1979), and identity processes and identity motives theories (Identity Process Theory, Breakwell, 1986; Motivated Identity Construction Theory, Vignoles et al., 2006; Vignoles, 2011), explained in more detail below.

Why Scottish and Welsh participants?

Three main reasons motivated the choice to focus on these groups. First, two groups were needed in order to test the measurement invariance of the novel measures. The focus of the novel measures is social identity; therefore, the two groups have to be particularly different for that specific aspect. At the same time, the two groups should not have been different for many other important aspects in this preliminarily phase, such as the official language of the nation. Examining cross-cultural and language invariance is certainly a very important step in scale validations. However, this would be better suited as the next step of the present research work.

Second, each group has its own strong country identity and they also shared a superordinate social identity (i.e., British identity). A superordinate social identity was important in this study because, as better explained in the next sections, a common alternative to the country-level identity was needed to account for possible coping strategies. An alternative to one of this group could have been participants from Northern Ireland. Here, the choice was motivated by the fact that the availability of these participants were much less in the online platform used for participants' recruitment. Therefore, this was mainly a practical choice. More generally, the UK context represent an ideal ground for examining countries and national identities.

Finally, there are potentials for geothermal energy technology development in Scotland, and to a lesser extent in Wales. This allowed well-informed participants to think that the scenario presented could have been realistic while also to gather data from relevant contexts.

5.1.2. Group-level identity motives

I argue that support and threat toward identity motives may represent the basic building blocks of social acceptance and individual/collective action related to energy technologies. Initial evidence suggests that identity threat is a key factor in understanding sustainable behaviours (e.g., Murtagh et al., 2012). If an energy technology is considered an important threat for social identity, people might display collective action such as protests (Stürmer & Simon, 2004; van Zomeren, et al., 2008) in the attempt to minimize the feeling of frustration toward these motives, enhancing group position (e.g., intergroup coping strategy, Breakwell, 1986). Conversely, satisfaction of the identity-related motives will lead to acceptance and to collective actions in favour of the new energy technology. In this sense, "identity motives push for certain ways of *seeing oneself*, which may thus necessitate engaging in certain actions" (Vignoles, 2011, p. 406).

The concept of individual and social identity motives, and the related threat toward these motives, has been discussed via three main relevant theoretical frameworks: social identity theories (e.g., Ellemers et al., 2002); identity process theory (e.g., Breakwell, 1989) and intergroup threat theory (e.g., Stephan et al. 2015). Based on identity process theory, Vignoles and colleagues, have further expanded the role of identity motives (and also threat toward these motives) particularly focusing on their role on identity construction (i.e., motivated identity construction theory, 2006; 2011).

The present study discussed group-relevant identity motives for the present context of research work based on identity process theory, motivated identity construction theory, and social identity theories. However, the main theoretical framework remains the social identity theories. The purpose of this preference is to emphasise the distinction between personal and social identity (abandoned in the identity process theory, Breakwell, 2001) (i), to consider group-based responses toward a perceived threat and support (ii), to situate the identity into a context (iii), and to account for group processes and social changes as meaningfully represented in the social identity theory (iv). Distinguishing between these theories is important, however is worth knowing that several overlaps between the two exist (see the fifth chapter of Jaspal & Breakwell, 2014, for a discussion into the topic).

Contrary to social process theory, it could be argued that social identity theories put more emphasis on the role of the support toward identity motives. A large part of Tajfel and Turner work revolve around the fact that people are motivated to maintain and achieve positive social identities and use a variety of strategies to maintain or improve their status. Concerning the threats, social identity theories discussed the concept of identity threat mainly referring to social status threat, distinctiveness threat, and threat to moral values (e.g., Ellemers et al., 2002; Tajfel & Turner, 1979).
Within the social identity theories, another important motive concerns the uncertainty reduction theory (Hogg, 2000) which reflects the need for control. These motive reflects people's need to know what to expect from the physical and social environment, which gives them feeling of control over reality.

The identity-relevant motives emerged from Study 1 of this research work referred to self-esteem, distinctiveness, and continuity motives which will be briefly explained below.

The need for positive self-esteem arises from the interaction between social identities: comparing one's own group (ingroup) with another relevant group (outgroup) represents the way by which people perceive the value of their ingroup (Turner, 1975). People use this perception to derive their sense of self-esteem.

Self-esteem is one of the motives that guide people's identity construction. It is considered a desirable state for the structure of the identity (Vignoles et al., 2006; Vignoles et al., 2008) and serves the need to maintain and enhance people's concept of themselves (*self-esteem motive*). People also satisfy other motives from belonging to a group. For example, people need to maintain a sense of distinctiveness (*distinctiveness motive*) and to believe that their own identity is continuous over time, where past, present and future are connected by common threads despite changes (*continuity motive*) (Becker et al., 2018; Breakwell 1986; Brewer, 1991; Sani et al., 2007; Vignoles et al., 2006)[4].

Beyond the identity construction purpose of these motives, Vignoles and colleagues' (2006) work on the Identity Process theory, drawing from Breakwell (1988), proposes that a given situation or message may represent a threat to people's identity to the extent to which satisfaction of these motives is undermined. Manzi and colleagues (2006) operationalised identity threat as "the participants' expectations that [an x fact] would pose problems for core identity motives" (p. 678) and showed that these motives can be either frustrated or supported. Congruently with this line of research/theorization, events that take place in people's social reality are thus perceived (among other factors) within a negative/positive continuum as a function of the four identity motives.

While self-esteem and distinctiveness motives have been widely discussed and are inextricable parts of social identity theories (e.g., Jetten & Spears, 1997), less is known about the continuity motive within the group context. The concept of continuity motive, conceptualised as collective continuity (e.g., Sani et al., 2007), is related to the motivation to reduce uncertainty (Hogg, 2000; Venus et al., 2019). In fact, Sani and

[4] Further motives are included in the Vignoles's theory (i.e., meaning, efficacy, belonging). However, I chose the most relevant ones for the specific context analysed as emerged from the qualitative study (Study 1, Chapter 2, of the present thesis).

colleagues (2007) found a positive and significant correlation between the two. Smeekes and Verkuyten (2013) found that when national group members are facing existential threat to their in-group (the existence of the in-group is undermined), their sense of collective self-continuity increases, and this leads to the opposition to a relevant out-group as a result of in-group defence mechanisms. In Smeekes's study, people retrieved the sense of collective continuity when threatened by an outgroup, thus showing the importance of this motive in group dynamics.

In the present study, I argue that if people's need for continuity is threatened, it will lead people to negatively react toward the threat. However, as for the other motives of self-esteem and distinctiveness, people's reactions toward identity motives could be shaped by coping cognitive strategies. These will be better explained in the next section.

5.1.3 Considering coping mechanisms and strategies

This section will focus on cognitive and behavioural strategies that people may use when they feel their identity threatened. Understanding that that a lack of collective strategies (e.g., behavioural strategies) against energy technologies does not indicate a genuine fit between people's identities and a technology is crucial. In fact, the cognitive coping strategies constantly shape the fit between people's identity and possible threatening circumstances.

According to social identity theories (e.g., Tajfel & Turner, 1979), actions such as protests aim to improve the circumstance of the in-group via a *social competition* type of strategy. Other than improving the collective situation via concrete actions, other cognitive-based strategies may be adopted when part of the self-concept is being devalued and threatened (e.g., individual mobility, social creativity). These cognitive-based strategies depend on three main structural elements known as *subjective belief structures* of the society in which a person lives: the perceived permeability of group boundaries, and the perceived legitimacy and stability of the group in relation to other groups (Tajfel & Turner, 1979). The adoption of collective strategies depends on the extent to which a person believes that "the only way for him[/her/they] to change these [disadvantageous] conditions is together with his[/her/they] group as a whole" (Tajfel, 1981, p. 247). Thus, a collective strategy intends to change the status quo of the whole group and not only create an advantage for the person as a single entity.

Generally, individual strategies, e.g., individual mobility, which assume that intergroup boundaries are permeable, are the dominant strategy to achieve a positive social identity (Tajfel & Turner, 1979). Via this strategy, the individual leaves the group psychologically and/or physically (e.g., identifying themselves with a higher superordinate identity and/or decreasing the identification-level with the in-group), improving their personal position in terms of social status and power relations; however, those of the whole group remain unchanged.

Beyond the individualistic strategies, a group-based *social creativity* strategy can be adopted when the *subjective belief structures* lead people to think that the intergroup relations are legitimate and stable (whether there is a reliable/unreliable reason for group differences in terms of advantages/disadvantages and how secure/unsecure the perceived relations are). In this case, people may find new comparable dimensions, redefine the value of certain dimensions, or choose a new outgroup with which they compare (Tajfel & Turner 1979; for an extended explanation see Abrams & Hogg, 2006).

For these reasons, a measure of perceived permeability of group boundaries (opportunities to leave the group) is included in the present third study as possible mediator. This will allow us to understand whether at least one of the preconditions of *subjective belief structures* in the intention to act collectively is satisfied. Specifically, low perceived permeability of group boundaries represents an important precondition that facilitated people's engagement in collective strategies such as protesting against the issue perceived as a threat. For example, people may not show intention to act collectively against the energy technology because they do not feel their identity has been threatened. However, they may have had this feeling in the first instance when they were asked to think about the technology, and have consequently adopted a cognitive-based strategy (which will not be detected in this study but inferred by measuring one of the *subjective belief structures*, i.e., perceived permeability) to make the situation congruent with their identity as they perceive boundaries of their group as permeable.

Following the hierarchy of inclusiveness of the self-concept posited by the social identity theory, the perceived permeability of the group boundaries will be detected by measuring how easy it would be for a Scottish/Welsh person to identify themselves as as British. This should represent the closest available social category for a Scottish/Welsh person in terms of nationality as it corresponds to the next higher superordinate identity. Looking at the 2011 Census (Office for National Statistics, 2011), the degree of country-level identities indicates that within Scottish residents, 62.4% indicated to identify as "Scottish only". In Wales, only 3.7% identify as "Welsh only".

5.1.4 Intergroup context: which is the outgroup?

While it would be obvious, in the first instance, to identify the outgroup as those who implement the technology and, consequently, that social protests will emerge against them, the conflict may actually be grounded on a different source. If social protests occur as a result of an intention to improve the status quo of the whole group because the higher status of the outgroup is not perceived as legitimate, in line with social identity theories, we could alternatively expect that the outgroup is represented by those people who do not live in the area in which the technology is implemented and, therefore, may be perceived as privileged. People may protest against actors of the technology implementation in a similar way the minority group protests against those who have the political power to reduce discrimination. Indeed, the comparative referent group of minority groups remains the privileged community (e.g., white community) and not only those powerful.

Therefore, which is the comparative group in the context of energy technology implementation? The out-group in the present study can be represented by other actors living outside the country's boundaries (of Scotland and Wales) within the UK (both in situations of perceived support or perceived threat from the technology). The specific category in the present study is expected to be subjectively identified according to the principles of the *outgroup relevance* and of *proximity and similarities* (Jetten, et al., 2004; Tajfel & Turner, 1979) and may differ across individuals (the main out-group is represented by those not living in Scotland/Wales within the UK). It could be "other British people" or "English people" for example. However, for 2/3 indicators of the specific measure of group-based relative deprivation discussed below, the outgroup was specified as the English to facilitate the comparison evaluation made by participants.

5.1.5 Group-based Relative Deprivation

The energy technology represents a dimension of group comparison and it could be identified as a type of *incidental disadvantage* according to the classification proposed by van Zomeren and colleagues (2008). This type of disadvantage is situation-based, other examples proposed by the authors are new tax imposed and wind farms implementation. Differently, *structural disadvantages* concern group status or discrimination, embedded thus in the social structure. The authors highlighted this difference to explain the role of social identities in people's collective actions such as protests. The present study, instead, focus on the role of group-based identity motives rather than social identities. As explained in the above sections, these motives could be supported or threatened by the energy technology. Specifically, this section wanted to emphasised that (i) the perceived identity threat was conceptualised as emerging from a perceived *incidental disadvantage* (i.e., the technology implementation) but that also the role of *structural disadvantages* was partially take into account as a baseline of the perceived threat. In fact, results from the first qualitative study of the present thesis (Chapter 2) indicated that the identity-related outcomes from energy technology implementation were better understood when interpreted in light of the socio-structural characteristic in which the group was involved (see also Batel & Devine-Wright, 2007). Based on relative deprivation theories (e.g., Smith et al., 2012), the *structural disadvantages* were taken into account in the present study as a group-based relative deprivation *subjective* perception. In particular, this measure was included as a possible baseline to test whether the permeability of the group boundary would have mediated or moderated the effect of threat toward group-level identity motives only, or *especially when*, the groups broadly perceive a structural negative intergroup discrepancy (i.e., a high level of [in]group-based deprivation; Mummendey et al., 1999a; Smith & Kessler, 2004).

Theories of Relative Deprivation distinguish between two types of perceived deprivation. A personal-egoist relative deprivation that refers to an individual level of analysis, and a group-specific level of relative deprivation (Runciman, 1966; Smith et al., 2012). In both types, one's individual and group status quo are compared with other relevant individuals and groups. The present work considers the group-specific level. The feeling of relative deprivation arises from the perception that one's group status of disadvantage is undeserved. In this sense, a perceived discrepancy between the current perceived status quo and an ideal standard occurs.

5.1.6 Risk perception

The concept of risk perception is a multidimensional construct (e.g., Wilson et al., 2018). The extent to which people evaluate an event as risky has been explained through two main dimensions which operate in parallel (Slovic et al., 2004). The cognitive component of the risk perception concerns the likelihood that an event, and its consequences, will occur; the affective component represents the feelings associated with an event, which guide people's risk evaluation (Loewenstein et al., 2001; Slovic, 1987; Slovic et al., 2004; 2007).

Early work on risk perception highlighted that events associated with a high level of uncertainty and catastrophic consequences are perceived as the riskiest, even if the actual probability to occur is low (Slovic, 1987). One of the potential negative consequences associated with deep geothermal energy is the risk of induced-seismicity (Chen et al., 2020; Jeanne et al., 2015; Spada et al., 2021) which incorporates both the uncertainty and the catastrophic aspects (Knoblauch et al., 2018). In general, both benefits and risks associated with energy technologies influence their acceptability (e.g., de Groot et al., 2020; Visschers & Siegrist, 2013). However, the provision of benefits-related information associated with the positive renewable feature of geothermal energy as well as the positive impact on climate change mitigation does not seem to increase the acceptability of the induced-seismicity from geothermal systems (McComas et al., 2016; see also Cousse et al., 2021 for similar results). Consistently, support for geothermal energy is low compared to other renewable energies such us wind and solar (e.g., Dubois et al., 2019; Hart et al., 2015; Stadelmann-Steffen & Dermont, 2021). Therefore, it is important to understand which psychosocial factors could increase the general acceptance of the geothermal energy technology and in particular those factors that could potentially counter the negative effect of risk perception (especially for objective low-probability risks such as those of the geothermal technology).

5.1.7 The present study

The role of group-level identity motives on people's acceptance and collective action toward geothermal technology was assessed controlling for the effect of risk perception regarding the outcome variables. This was done because risk perception in the context of people's acceptance toward geothermal technology seems a prominent explanatory variable. Furthermore, results from Study 1 suggested that the risk perception, together with procedural fairness contents, might be less relevant in affecting the acceptability of the geothermal technology as long as group-level identity motives are supported. Study 3 confirms that fairness-related perceptions were led by symbolic factors such as violation of people's social identities[5]. Study 3 used a concise operationalization of threats to the identity motives by referring to the closest construct of social identity violation (Mayer et al., 2009). In fact, to date no studies have validated a scale that accounts for the effect of threat and support toward group-level identity motives in the context of energy technology implementation.

The present study aimed to: (i) validate a scale measuring threat and support toward group-level identity motives from the implementation of a geothermal energy technology; (ii) test the moderating role of support toward these motives on the effect of risk perception for a series of outcome variables (e.g., collective action intentions); (iii) test the mediating effect of permeability of the group boundary on the relationship between threat toward group-level identity motives and the outcome variables; (iv) explore the possible role of perceived relative deprivation, in interaction with

[5] Items used to measure social identity violation could also capture aspects that go beyond the symbolic aspects of social identity (i.e., material resources).

permeability of the group boundary, in the relationship between threat toward identity motives and the intention to protest against the geothermal technology. These are better explained in the hypotheses section.

Concerning the novelty of the proposed measures, it is important to mention that a first attempt to take into account the effect of identity motives in a similar research context was made by Dan Venables et al. (2012). Among other aims, the authors measured the extent to which a power station was perceived as related to people's sense of place of self-efficacy, self-esteem, continuity, and distinctiveness (i.e., PSSoP). Their results showed that attitude to a new nuclear build was positively predicted by PSSoP. The authors proposed one item for each motive related to a specific local level (i.e., community). The validity of the scale was evaluated only through exploratory factor analysis and Cronbach's Alpha which present limitations under current practices of scale validation (Flake et al., 2017; Hussey & Hughes, 2020).

In summary, this fourth study aims to explore the key variable from Study 2 (social identity violation), which in turn was inspired by Study 1, in a more detailed way. The idea was to unpack this variable into dimensions. To do that, (i) I considered identity dimensions using the aforementioned theories and, specifically, including those that emerged in Study 1; (ii) I framed the dimensions both in a positive and negative way; (iii) I evaluated the importance of the identity motives by including the effect of risk perception. Figure 10 presents the main path considered.

Pre-registered hypotheses

From multi-group confirmatory analysis (measurement invariance test)

H1) The factor structure of threat to identity motives and support to identity motives will be valid across two samples (items composing these first order factors are related to the continuity, distinctiveness, and self-esteem motives).

From the structural model analysis

H2a) Motives of support will moderate the effect of risk perception on the intention to act against the energy technology: a weaker effect of risk perception on negative collective action intentions is expected when motives of support are high.

H2b) Motives of support will moderate the effect of risk perception on the specific intention to protest against the energy technology: a weaker effect of risk perception on the intention to protest is expected when motives of support are high.

H3a) Perceived permeability of the group boundaries will mediate the effect of motives of threat on the intention to act against the energy technology.

H3b) Perceived permeability of the group boundaries will mediate the effect of motives of threat on the specific intention to protest the energy technology.

Additionally, paths described in H2 and H3 will also be tested using two different outcome variables: acceptance and intention to act in favour. Importantly, especially for the intention to act in favour, there was not a strong theoretically background. Therefore, it is important to notice that the pre-registration did declare that these paths were included in the investigation plan, but these paths remain exploratory:

H4a: Motives of support will moderate the effect of risk perception on the social acceptance of the energy technology: a weaker effect of risk perception on social acceptance is expected when motives of support are high.

H4b: Motives of support will moderate the effect of risk perception on the intention to act in favour of the energy technology: a weaker effect of risk perception on positive collective action intentions is expected when motives of support are high.

For the same exploratory purposes, also the H3 path will be tested in the outcome variables social acceptance and intention to act in favour:

H5a) Perceived permeability of the group boundaries will mediate the effect of motives of threat on the social acceptance.

H5b) Perceived permeability of the group boundaries will mediate the effect of motives of threat on the intention to act in favour.

Finally, the pre-registration also indicated that a measure of perceived relative deprivation could have been potentially considered. Therefore, the pre-registration did not specify how this measure was going to be taken into account. As better explained in the next section, this choice was based on results from study 1 which suggested that controlling for the perceived socio-structural characteristics in which groups are embedded could have helped in the explanation of the hypothesised paths.

Non-pre-registered exploratory analysis

1) The role of the permeability of the group boundary will also be assessed as a moderator (i.e., other than as a mediator) using aggregated measures to simplify the procedures, given that the variable group-based relative deprivation will be included as an additional moderator (i.e., three-way interaction).

2) Since the factor structure of the group-level identity motives was found to be more complex than expected, an additional important step was included: the association between group-level identity motives and the outcome variables will be tested together.

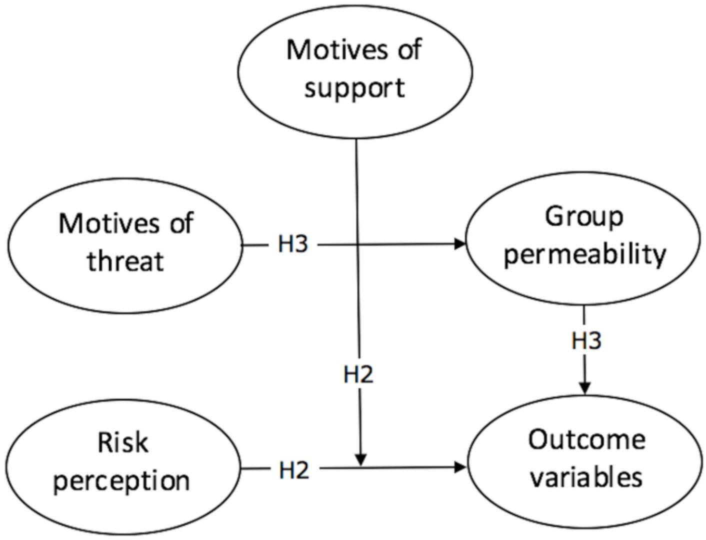

Figure 10. Conceptual model (Study 4).

5.1.8 Analytical strategy

The general analytical strategy was preregistered on the Open Science Framework (OSF) before data were collected. However, more analyses were included once the data had been collected mainly because the expected factor structure could not be confirmed. Specifically, the study's analytical strategy consisted of:

First, prior to data collection, two power analyses for the multi-group CFA and for the SEM model were carried out. A series of post-hoc power analyses were further carried out to account for the different factor structures of the final model. The multi-group power analysis was based on population RMSEA, while the power for the SEM model involved a more statistical advanced procedure consisting of a Monte Carlo power simulation experiment.

Second, I established whether the items of the novel constructs subtended two first-order factors (i.e., support and threat) or if they represented a different factor structure. A final model structure was chosen based on exploratory factor analysis, confirmatory factor analysis, factor loadings, residual correlation, convergent and discriminant validity. This step only used the Scottish sample. The CFA guided the final decision on the factor structure. Then, a single CFA was also tested in the Welsh sample.

Third, the model measurement invariance was tested across population and gender. Once the possibility to merge the two datasets (i.e., Scottish and Welsh) was achieved, the model was tested against four alternative factor structures. The final factor structure was further tested to better examine cross-loadings (EFA).

The final model consisted of a six-factor structure. Testing the hypotheses in one unique model was not feasible due to the complexity of the model and sample size limitation of the present study. The strategy chosen aimed at testing a SEM model that was as close as possible to the model priory simulated in the Monte Carlo experiment. In order to achieve this goal, the role of support and threat toward group-level identity motives was assessed separately for each group-level identity motive types and for each outcome variable (see Table 13). These models were also tested including socio-demographic covariates (age, gender, and education).

To clarify the competing role of the different group-level identity motives, these were tested together on each of the four outcome variables.

The role of the permeability of the group boundaries was examined in interaction with the perceived group relative deprivation.

Table 13

Adapted plan for hypotheses testing.

	Outcome variables			
Variables included in the models	**Coll. Act. Against**	**Intent. to Protest**	**Social Accept.**	**Coll. Act. in Favour**
1) Supp. - Group-level *Continuity motives*; 2) Threat - Group-level *Continuity motives*; 3) Risk Perception; 4) Permeab. Gr. Boundar.	Model 1	Model 4	Model 7	Model 10
1) Supp. - Group-level *Self-esteem motives*; 2) Threat - Group-level *Self-esteem motives*; 3) Risk Perception; 4) Permeab. Gr. Boundar.	Model 2	Model 5	Model 8	Model 11
1) Supp. - Group-level *Distinctiv. motives*; 2) Threat - Group-level *Distinctiv. motives*; 3) Risk Perception; 4) Permeab. Gr. Boundar.	Model 3	Model 6	Model 9	Model 12

Importantly, the procedure used partially mirrors best practices recommended by Flake et al. (2017) and Hussey and Hughes (2020). The latter argued that the structural validity of self-report measures is rarely assessed in a rigorous manner in social and personality psychology, with an excessive reliance on internal consistency measures such as Cronbach's α. In particular, the authors reported that assessment of measurement invariance across contexts and populations is rarely conducted.

5.2 Sample size plan: power analyses

For each analysis, the strategy used to determine an appropriate sample size to achieve a sufficient statistical power was based on the specific model complexity.

Both prior and post-hoc power analyses were used. In summary, power analyses for the multi-group CFA used for the measurement invariance testing, single CFAs, and CFAs' model comparisons were based on the population RMSEA approach (MacCallum et al., 1996). Results indicated that all CFA models achieved power > .80. Appendix A reports a detailed explanation of these analyses and results.

For the structural model, the sample size was based on Monte Carlo simulations.

5.2.1 Structural equation model: Monte Carlo simulation power analysis (prior)

A minimum number of 400 – 500 participants has been suggested when running a simple model with latent interaction effects computed using a product indicator approach (Kline, 2015). A common guideline classifies a sample of 100 as poor, 200 as fair, 300 as good, 500 as very good, and 1,000 as excellent (Comrey, 2013). Therefore, it could be said that researchers should aim at recruiting very large sample sizes (i.e., N = 1000) to ensure stable covariation among items, especially when there is lack of information about parameter values to be estimated in the true population.

Beyond the importance of reaching a sufficient statistical power, a realistic and feasible plan for sample size estimation has to consider economic constraints related to participant recruitment. Therefore, a prior power analysis was conducted using Monte Carlo simulation in R (Pornprasertmanit et al., 2021) with 1000 replications × 81 conditions. This procedure accomplishes both aims to observe true relationships between the variables when analysing real data, and therefore to find true statistical estimates, and to choose a sample size that would limit project costs.

5.2.1.1 Population parameters for the power analysis

The Monte Carlo simulation power analysis included the estimate of the direct, indirect, and interaction effects. The goal of the simulation was to determine an approximate minimum sample size to detect power of at least .80 (Cohen, 1988) at $\alpha = .05$, for each effect of the hypothesized model. While the variance and covariance structure of the population model was held constant across all simulations, factor loadings and regression coefficients varied across different samples sizes.

Variants of the true population model were created adopting a conservative approach, namely testing the minimum loadings and regression coefficients that can be considered acceptable in the context of the present project, and given previous studies in related areas. The indicators of exogenous and endogenous factors were simulated under conditions of multivariate normality and maximum likelihood estimation. As there was not a solid base for setting specific values, the choice relied on average values used in simulation studies in social science for some of the model specifications (e.g., Wolf et al., 2013). Constant population values were fixed as follows:

- residual factor loadings were calculated as the square root of $1 - \lambda^2$, with λ being the lambda (loading) of a latent variable;
- residual covariance of the endogenous variables (ψ) was set to .3, which was standardised by multiplying .3 to the standard deviation of their variance;
- variance and covariance of the exogenous latent variables, (ϕ), were set to 1 and .4 respectively;
- all intercepts and means were set to 0.

To generate multivariate normal data, the package *simsem* version 0.5-16 was used (Pornprasertmanit et al., 2021). The simulation design was a 3 (factor loadings) × 3 (paths coefficients) × 9 (sample sizes) conditions. These different conditions were tested because reliability of the scores (i.e., loadings) tend to highly affect power (e.g., Kline, 2015). Moreover, due to the novelty of the proposed measures, effect estimates from prior literature were not available. This is also the reason why a Monte Carlo simulation experiment was carried out instead of simulating a unique model specification.

Factor loading intervals ranged from .50 to .70, from sufficient to good indicators representation. The lower and upper bounds of coefficient values were set to .10 and .30 respectively. Therefore, the following sets of population values were specified:

- Factor loadings: .50, .60, .70
- Regression coefficients: .10, .20, .30
- Sample size: 200, 300, 400, 500, 600, 900, 1000

The way in which the interaction was computed is explained in Appendix A.

5.2.1.2 Results of the Monte Carlo simulation power analysis

Figure 11 displays the power of the parameters estimated across sample size, magnitude of factor loadings and regressive paths. In general, results show that models with larger factor loadings and regression coefficients would require a smaller sample size compared to models with lower values. Overall, stable power was achieved with a sample size of at least N = 500-600 even for a condition of not optimal loadings and regression coefficients as shown in the .20 × .60 panel.

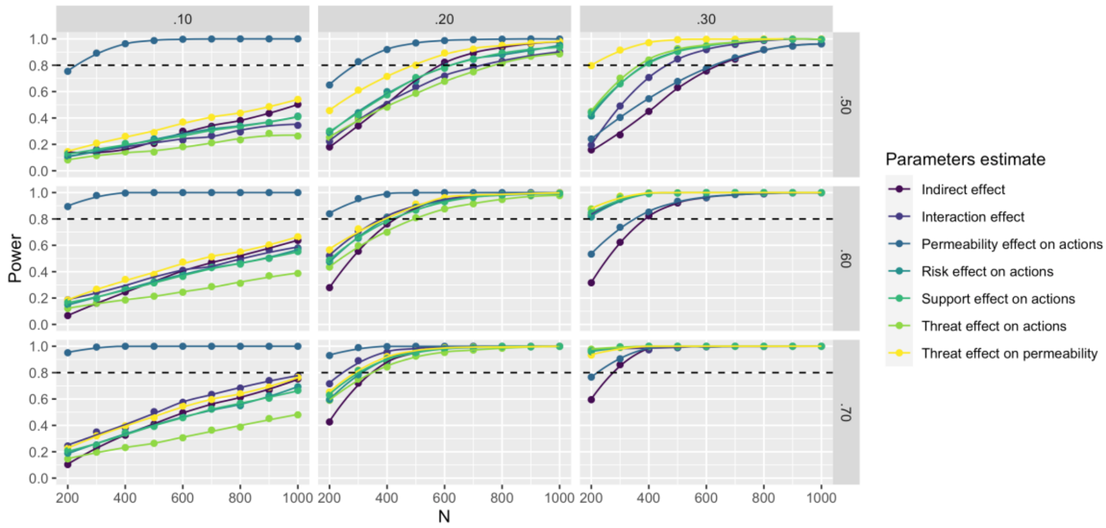

Figure 11. Power of the parameter estimate as a function of sample size (N), magnitude of factor loading (.50, .60, .70), and magnitude of regressive path (.10, .20., 30).

The present sample size plan has some limitations that were also explained in the pre-registration. First of all, the number of indicators per factor could have changed depending on the results of the single and multi-group confirmatory analysis. This was the case in the present study. As explained in the next sections, the number of items for the factors support and threat toward identity motives was not the same as in the simulation. The Monte Carlo simulation did not account for different values in the variance and covariance matrices, therefore the true power might be different from what was estimated. However, the results from the present analyses are consistent with previous studies and general rules of thumb for structural models (e.g., see Kline, 2015) which supports the reliability of the present simulation results.

5.3 Method

5.3.1 Participants and procedure

Two groups of participants were recruited, 300 were Scottish residents and 300 were Welsh residents. Participants were recruited through the online service Prolific Academic using the platform Qualtrics. Criteria were nationality (UK-Scotland/UK-Wales), current UK area of residence (Scotland/Wales) and that they had not participated in the pilot studies. Participants' gender was balanced (i.e., 150 males and 150 females for each group), with four participants indicating non-binary or preferred not to answer when asked about their gender. Participants' age-range was as follows: 18% age-range 18-25; 47% age-range 26-40; 28% age-range 41-60; 0.7% age 61+. Participants' level of education was distributed as follows: 14% preferred not to answer this question, 30% had attended college, 36% held a first university degree, 20% held a post-graduate university degree.

Participants were first informed that the aim of the study was to investigate what people think about the geothermal energy and that potential developments of the geothermal technology were currently being considered in Scotland/Wales. A brief explanation about the specific geothermal technology (i.e., enhanced geothermal systems, EGS) was presented and it was specified that the energy extracted from their territory (i.e., Scotland/Wales) would also be used in other parts of the UK. This was done to present a realistic scenario and based on information from the British Geological Survey. Participants were also given the opportunity to visit the British Geological Survey website (https://www.bgs.ac.uk/) if they wanted further information. After giving their consent, the survey began.

The survey contained four attention checks, randomly distributed in the survey, where participants were asked to answer the question "I am reading attentively the questions on this survey" on a Likert scale, from 1 (*strongly disagree*) to 7 (*strongly agree*). The response format of this question was the same as the other measures in the survey. Participants were also excluded based on completion time of the survey (+/- 3 *SD*). In total, seven participants were excluded; the recruitment ended when I reached a sample of 300 participants for each group. The questionnaire was presented in separate blocks by construct, with item order within the blocks randomly presented for each participant. The block order was random apart from the three outcome variables, which were always presented at the end of the survey, before the socio-demographic questions. After completing the survey, participants were debriefed and informed that the development of the geothermal technology was not actually being considered in their location.

5.3.2 Measures

In the following measures, the word in brackets [*Country*] can mean Scotland or Wales. In the same way, the word [*group type*] can mean Scottish or Welsh. All items included in the survey that were not part of the main analyses can be consulted in the Appendix B.

Collective action intentions against the technology

Participants were asked to indicate how likely they would be willing to take a series of actions against the implementation of the geothermal technology: 1) participating in a protest; 2) attending a discussion meeting; 3) signing a petition; 4) sharing a post on social media (e.g., Facebook); 5) voting for a political party that is against the technology; 6) meeting supporters of the technology to persuade them to change their mind. Participants indicated their answer on a scale from 1 (*Extremely unlikely*) to 7 (*Extremely likely*).

Collective action intentions in favour of the technology

Participants were asked to indicate how likely they would be willing to take a series of actions in favour the implementation of the geothermal technology: 1) making a donation; 2) attending a discussion meeting; 3) signing a petition; 4) sharing a post on social media (e.g., Facebook); 5) voting for a political party that is in favour of the technology; 6) meeting opponents of the technology to persuade them to change their mind. Participants indicated their answer on a scale from 1 (*Extremely unlikely*) to 7 (*Extremely likely*).

Social acceptance

Participants were asked to express their level of agreement on five statements: 1) "I would accept the construction of geothermal technology in [*Country*] as a source of energy for the entire UK"; 2) "I think that the geothermal technology is an efficient alternative compared to other existing energy technologies"; 3) "Geothermal technology in [*Country*] would be an effective technology to produce renewable energy"; 4) "I would genuinely agree with the decision to implement the geothermal technology in [*Country*]"; 5) "I would accept the geothermal technology, regardless of where it will be placed". Participants indicated their answer on a scale from 1 (*Strongly disagree*) to 7 (*Strongly Agree*). Items 2 and 3 were adapted from Vlassenroot et al. (2011).

Social identity violation

Participants were asked to express their level of agreement on a four statements: 1) "I feel the decision would damage the [*group type*] people's identity"; 2) "I feel the decision goes against [*group type*] people"; 3) "I feel like something that is very important to [*group type*] people would be violated by the decision"; 4) "Some things that I value and that are a part of my identity as a [*group type*] person would be disregarded by the decision". Participants indicated their answer on a scale from 1 (*Strongly disagree*) to 7 (*Strongly Agree*). Items were adapted from Mayer et al. (2009).

Permeability of the group boundaries

Participants were asked to express their level of agreement on five statements:1) reverse scored "In principle, it is difficult for a [*group type*] person to be considered as a British person”; 2) “For a [*group type*] person it is possible to be regarded as a British person”; 3) reverse scored “A [*group type*] person will never primarily identify as a British person”; 4) “I think [*group type*] people, when circumstances require so, can easily identify as primarily British”; 5) “To be identified as “[*group type*]” or “British” would have the same meaning for me”. Participants indicated their answer on a scale from 1 (*Strongly disagree*) to 7 (*Strongly Agree*). Items 1 and 2 were adapted from Kessler and Mummendey (2002). Item 3 was adapted from Mummendey et al. (1999b).

Risk perception

Participants were asked to express their level of concern, worry, and anxiety on three statements: 1) “Considering any potential negative effects that the geothermal technology might have on [*group type*] people, how concerned are you about it?”; 2) “When you think about the geothermal technology in [*Country*], to what extent do you feel worried?”; 3) “When you think about the geothermal technology in [*Country*], to what extent do you feel anxious?” Participants indicated their answer of these items on a scale from 1 (*Not at all concerned/worried/anxious*) to 7 (*Extremely concerned/worried/anxious).* Participants were asked to express their level of agreement on three statements: 4) “It is likely that geothermal technology would represent a threat to people’s safety in [*Country*]”; “5) It is likely that geothermal technology would have negative knock-on effects over the years for the natural environment in [*Country*]”; 6) “It is likely that seismic events from geothermal technology would occur in [*Country*]”. Participants indicated their answer on a scale from 1 (*Strongly disagree*) to 7 (*Strongly Agree*). All items were adapted from Wilson et al. (2018).

Group-level relative deprivation

A common outgroup, English people, was chosen so that each group of participants gave their answer thinking about the same reference group.

Participants were asked to express their level of agreement on one statement: 1) "I feel frustrated and dissatisfied about the amount people earn in [*Country*] compared to people in England". Participants indicated their answer on a scale from 1 (*Strongly disagree*) to 7 (*Strongly Agree*). Then, they were asked to express their opinion on the following statement: 2) reverse scored "People in [*Country*] generally earn ... than people in England". Participants indicated their answer on a scale from 1 (*Much less*) to 7 (*Much More*). Finally, they were asked to express their opinion on the following statement: 3) "To what extent do you think people in [*Country*]are disadvantaged compared to those living elsewhere in the UK?" Participants indicated their answer on a scale from 1 (*Not at all*) to 7 (*Very much*). Items 1 and 2 were adapted from Abrams and Grants (2012), item 3 was adapted from Thomas et al. (2020).

Group-level identity motives

The final indicators used for the constructs of support and threat toward group-level identity motives were chosen from a pool of items. The next sections will explain how these were generated and the procedures used to select the final items.

5.3.2.1 Group-level identity motives – item generation

The generation of items for the novel construct of identity motives of support and threat was mainly inspired by the group discussions in Study 1. The operationalisation process also considered the construct definitions and explanations provided by relevant literature (Bagci et al., 2020; Tajfel & Turner, 1979; Vignoles et al., 2006; Vignoles et al., 2008; Breakwell 1986; Sani et al., 2007; Manzi et al., 2006). The construct definitions and item development constitute major problems in construct definition and validation in psychology. Constructs are often partially represented, with either positive or negative content ranges being measured, resulting in polarity ambiguity (Tay & Jebb, 2018). Ultimately, a construct measured with an agreement Likert-type scale might bring ambiguity in the meaning of what the lower bound of the scale means as the authors pointed out. For example, in the present study context, the lower range of factors related to the *support toward identity motives* could either mean absence of support or absence *or* perceived threat. To avoid ambiguity, the two aspects - support and threat - were measured separately as unipolar constructs but still theoretically representing the extremes of a continuum. A small pilot study was carried out to ensure participants' understanding of the items. This is explained in Appendix C.

5.3.2.2 Group-level identity motives – item selection plan

The goal of the pre-registered plan was to offer a parsimonious six-item observed measure for each of the new latent constructs (support and threat toward identity motives). The pre-registered plan could not be implemented based on CFA model fit indices. Based on Breakwell's (2021) identity motive factor structures, the new items selection plan was adapted. The adapted goal was to retain three items per factor to pursue both parsimony and to avoid empirical under-identification (Kline, 2015). In summary, the scale development was based on exploratory factor analysis, item correspondence with the construct, factor loadings, residual correlations, content and discriminant validity. Details of this section are reported in Appendix C.

5.3.2.3 Criteria for scale validity

The convergent and discriminant validity were expected to be confirmed by results of the measurement model (i.e., CFA). Additionally, convergent validity was further evaluated from the strength of the association between the novel measures and the more established measure of "social identity violation" (Mayer et al., 2009). Further, the Average Variance Extracted (AVE) and the Omega coefficient (Fornell & Larcker, 1981; McDonald, 1999) were examined. The recommended thresholds are respectively ≥ .50 and ≥ .70. These last analyses were carried out using the function *reliability* of the package *semTools* (version 0.5.5.912). In case AVE is < .50 but the Omega value is > .60, the convergent validity of the constructs is still adequate. The discriminant validity (i.e., whether the six scales were empirically distinct), was evaluating following Rönkkö and Cho (2022) who stressed the importance of shifting from a cut-off to a classification system in the assessment of discriminant validity. According to the recommended classification system, the upper bound (UL) limit of the confidence interval of covariance between each pair of factors should be interpreted as follows: if UL < .8 *no problem*, if UL ranges from ≤ .8 to < .9 *marginal problem*; if UL ranges from ≤ .9 and <.1 *moderate problem*; if UL ≤ 1 *severe problem*. More details on this section can be found in Appendix C.

5.4 Items development – Results

5.4.1 Item selection results

Based on exploratory factor analysis, item correspondence with the construct, factor loadings, residual correlations, the final items used to represent the six factors were chosen. See Appendix C for more details on this section. This solution was then evaluated for the convergent and discriminant validity.

5.4.2 Results of the scale validity

AVE and Omega coefficients were above the recommended thresholds indicating convergent validity. *Threat toward continuity motives* was just above the AVE thresholds (i.e., .52), and also had the lower Omega coefficient among other factors (i.e., .76). The others AVEs ranged between .64 and .73. The other Omega coefficients ranged between .84 and .89.

Results of the discriminant validity based on the CI upper limits of the covariance between the latent constructs (Rönkkö & Cho, 2022) suggested that, overall, discriminant validity was supported: 12/15 pairs of factors were classified as “no problem”, 2/15 as “marginal problem”, and 1/15 as “moderate problem”. Latent-based correlations among among the novel measures and the measure of social identity violation (Mayer et al., 2009) further supported the construct validity (these ranged from -.20 to .84). Details of these analyses are reported in Appendix C.

5.4.3 Single CFAs – final model

The final model fit the data well (χ^2_{120} 204.742, $p < .001$; SRMR = .045; RMESA= .053, 90% CI [.040, .065]; CFI= .971; TLI= .963). After three months, data from the Welsh sample were collected and the model initially fit on the Scottish sample was tested on the Welsh one. Results indicated that model fit was sufficient (χ^2_{120} 213.549, $p < .001$; SRMR = .048; RMSEA= .058, 90% CI [.045, .070]; CFI= .966; TLI= .957). Items and factor loadings included in final model are presented in Table 14 (CFA on the Scottish sample), and Table 15 (CFA on the Welsh sample).

Table 14

Single CFA – Scottish sample

Latent Factor	Indicators	*B*	SE	*β*
Support *Continuity* Motive	I think that the GT may contribute to preserve Scotland's traditions.	1.123	.083	.809
	I perceive a sense of continuity between the past energy technologies in Scotland and the future prospect use of geothermal energy technology in Scotland.	.777	.089	.593
	Despite societal changes, the geothermal energy technology may help to preserve the Scottish culture and identity over time.	1.298	.075	.886
Support *Distinctiveness* Motive	GT would be one more thing to put Scotland on the map.	1.124	.072	.835
	GT would make my country (Scotland) positively different from others.	1.138	.075	.874
	GT would make Scotland stand out from the rest of the UK.	1.183	.078	.852
Support *Self-esteem* Motive	I think people in Scotland would be proud of the development of GT.	1.104	.079	.864
	Using the GT would make Scotland feel closer to my ideal country.	1.145	.076	.772
	In general, I think people from elsewhere would think positively about the implementation of the GT in Scotland.	.962	.088	.769
Threat *Continuity* Motive	The GT does NOT fit with the historical past of Scotland.	.913	.107	.641
	I don't see why we should implement the GT while we could keep using the ones we have been using so far.	1.141	.087	.800
	Instead of implementing the GT, people should work on the improvement of the current energy technologies that we already have in Scotland.	1.138	.076	.787
Threat *Distinctiveness* Motive	The implementation of the GT would make Scotland less unique.	1.106	.082	.862
	I believe that the implementation of GT in Scotland would create undesirable similarities between Scotland and the rest of the UK.	1.044	.073	.826
	I think that the GT would undermine some aspects that differentiate Scotland from the rest of the UK.	1.150	.067	.799
Threat *Self-esteem* Motive	The GT may devalue some aspects of my country (Scotland).	1.255	.082	.790
	I think the GT may undermine the image of Scotland.	1.273	.080	.899
	I may be embarrassed, and in some way ashamed, by telling people living elsewhere that Scotland hosts the GT.	.978	.085	.829

Note. All factor loadings are significant ($p < .001$). *B* = non-standard. estim.; *SE* = standard error; *β* = standard. estim; GT = geothermal technology (note that participants saw complete words, not abbreviations).

Table 15
Single CFA – Welsh sample

Latent Factor	Indicators	*B*	SE	*β*
Support *Continuity* Motive	I think that the GT may contribute to preserve Wales's traditions.	1.348	.064	.872
	I perceive a sense of continuity between the past energy technologies in Wales and the future prospect use of geothermal energy technology in Wales.	.940	.086	.649
	Despite societal changes, the geothermal energy technology may help to preserve the Welsh culture and identity over time.	1.363	.069	.882
Support *Distinctiveness* Motive	GT would be one more thing to put Wales on the map.	1.343	.080	.879
	GT would make my country (Wales) positively different from others.	1.284	.074	.877
	GT would make Wales stand out from the rest of the UK.	1.105	.093	.808
Support *Self-esteem* Motive	I think people in Wales would be proud of the development of GT.	1.335	.074	.887
	Using the GT would make Wales feel closer to my ideal country.	1.311	.072	.796
	In general, I think people from elsewhere would think positively about the implementation of the GT in Wales.	1.211	.082	.843
Threat *Continuity* Motive	The GT does NOT fit with the historical past of Wales.	.906	.105	.573
	I don't see why we should implement the GT while we could keep using the ones we have been using so far.	1.124	.090	.753
	Instead of implementing the GT, people should work on the improvement of the current energy technologies that we already have in Wales.	1.138	.086	.760
Threat *Distinctiveness* Motive	The implementation of the GT would make Wales less unique.	.938	.083	.775
	I believe that the implementation of GT in Wales would create undesirable similarities between Wales and the rest of the UK.	1.104	.098	.809
	I think that the GT would undermine some aspects that differentiate Wales from the rest of the UK.	1.269	.083	.880
Threat *Self-esteem* Motive	The GT may devalue some aspects of my country (Wales).	1.285	.085	.764
	I think the GT may undermine the image of Wales.	1.248	.089	.912
	I may be embarrassed, and in some way ashamed, by telling people living elsewhere that Wales hosts the GT.	.956	.103	.810

Note. All factor loadings are significant ($p < .001$). *B* = non-standard. estim.; *SE* = standard error; *β* = standard. estim.; GT = geothermal technology (note that participants saw complete words, not abbreviations).

5.5 Measurement invariance, model comparisons, and unrestricted model

This section presents the results of the hypothesis H1 regarding the measurement invariance of the novel measures group-level identity motives across the Scottish and Welsh samples. Then, the invariant measures will be further tested against four alternative models.

5.5.1 Criteria for the measurement invariance test

Evidence of noninvariance was based on (i) non-significant chi-square differences between nested models or (ii) relative differences in model fit indices (Δ). If neither of these two criteria were met, (iii) partial invariance was tested (i.e., one or more estimates are allowed to be free).

In terms of cut-off criteria for differences in model fit indices (ii), these were based on a series of simulation studies carried out by Chen (2007). The most stringent criteria suggested by Chen were chosen: *Δ* CFI ≥ - .010 paired with *Δ* RMSEA ≥ .015 or SRMR *Δ* ≥ .010. However, it is important to note that evaluating measurement invariance using fixed cut-offs comes with limitations, especially for Type I error, as conditions differ across studies (Jorgensen et al., 2018).

5.5.2 Results of the measurement invariance

Table 16, 17, and 18 present the output of the measurement invariance. Each of the invariance test result is described below.

Model 1: Configural invariance (structural model)

An unrestricted baseline model was specified; each group was allowed to estimate their parameters and equality constraints were not imposed. Model fit was adequate (χ^2_{240} 418.637, $p < .001$; SRMR = .044; RMSEA= .055, 90% CI [.046, .064]; CFI= .968;

TLI= .960). This model represented the baseline against which model comparisons across levels of invariance were tested.

Model 2: Factor loadings invariance ("metric" – "weak")

Nested within the configural invariance model, loadings of this model were constrained to be equal across groups. The chi-square difference was not significant indicating invariant loadings across Scottish and Welsh groups, therefore supporting a full-metric model.

Model 3: Intercepts invariance ("scalar" – "strong")

A further constraint consisted of equality of intercepts across Scottish and Welsh samples. This level of invariance, nested within factor loadings invariance model, supported the hypothesis of full-scalar invariance (i.e., equal factors structure, equal factor loadings, equal intercepts). In other words, the chi-square difference between Model 2 and Model 3 was not significant.

Model 4: Residuals invariance

The most restrictive model tested the invariance of the residuals across the two groups. This level of invariance supported equality across the two groups as the chi-square difference between Model 3 and Model 4 was not significant.

Table 16
Nested model comparisons – Robust (MLR) Chi-Squared Difference Test

MI level	*df*	AIC	BIC	χ^2	$\Delta\ \chi^2$	$\Delta\ df$	*p value*
Configural	240	31550	32157	513.34			
Weak	252	31550	32104	537.45	17.303	12	.1385
Strong	264	31542	32043	553.17	15.869	12	.1973
Residual	282	31536	31958	583.68	16.737	18	.5412

In summary, the invariance was accepted by chi-square differences and no other criteria were used. The hypothesis H1 was partially supported: the pre-registered factor structure could not be accepted by fit indices of the CFA and so it was not possible to test the invariance. However, the adapted factors structure was invariant across groups. The measurement invariance was also supported across gender (see Appendix D).

Table 17
Model fit indices – Robust estimator (MLR)

	χ^2	*df*	*p value*	RMSEA	CFI
Configural	418.637	240	< .001	.055	.968
Weak	435.473	252	< .001	.055	.967
Strong	452.267	264	< .001	.054	.967
Residual	462.724	282	< .001	.052	.967

	TLI	SRMR	AIC	BIC
Configural	.960	.044	31.549.973	32.156.749
Weak	.960	.050	31.550.085	32.104.098
Strong	.961	.050	31.541.806	32.043.056
Residual	.964	.051	31.536.321	31.958.426

Table 18
Non-significant differences in fit indices

	df	RMSEA	CFI	TLI	SRMR	AIC	BIC
Weak – Config.	12	.000	-.001	.001	.006	.111	-52.652
Strong – Weak	12	-.001	-.001	.001	.000	-8.279	-61.042
Resid. – Strong	18	-.002	.000	.003	.001	-5.485	-84.630

5.5.3 Nested factor structure model comparisons

Using the complete dataset (N = 600) to ensure sufficient power, the six-factor structure was initially tested against three alternative models: a two-factor model, a bifactor model, and a second-order model. The Bayesian information criterion (BIC) was used to evaluate the optimal model (Li et al., 2017). The results showed that the six-factor structure was the best model (see Figure 12). Fit indices of the two-factor model were poor (χ^2_{134} 874.254, $p < .001$; SRMR = .079; RMSEA= .111, 90% CI [.104, .118]; CFI= .856; TLI= .835). Model fit indices of the second-order was sufficiently good, confirming the plausibility of two common higher level factors (χ^2_{128} 306.561, $p < .001$; SRMR = .063; RMSEA= .055, 90% CI [.047, .063]; CFI= .966; TLI= .959). Indices of the bifactor model were good, however factor loadings were not significant. This required further investigation testing whether one factor acts as a marker measure for *G* in an alternative bifactor model-type framework, i.e., the *bifactor S–1* in which a referent domain is used (see Eid et al., 2017; 2018). For both support and threat of the group-level identity motives, self-esteem was chosen as a marker standard. The model fit the data well (χ^2_{108} 184.915, $p < .001$; SRMR = .029; RMSEA= .040, 90% CI [.030, .049]; CFI= .985; TLI= .979) and, contrary to the classic bifactor model, all loadings were significant in the *bifactor S–1* model. However, the variance-covariance matrix of the estimated parameters was not positive definite. A non-positive matrix was also obtained when using the other two group-level identity motives as the dimension markers. Finally, the BIC showed that the six-factor structure was still the best model compared to all alternatives. For the purpose of the current study, the six-factor model was retained and no further model was tested.

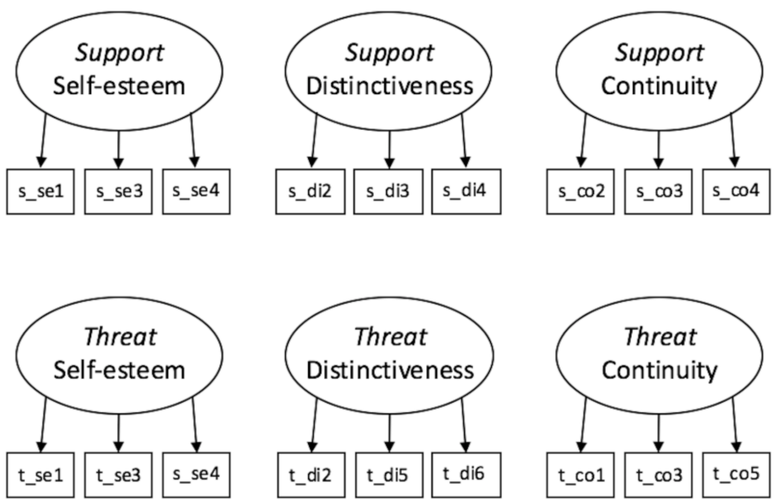

Figure 12. Factors structure of threat and support of group-level identity motives from energy technology implementation.

5.5.4 Unrestricted measurement model

Finally, the factor structures were also evaluated via an unrestricted measurement model (EFA) with an oblique rotation (*oblimin*). Since all indicators were allowed to depend on all factors, this analysis tested the degree of independence between items of the three different factors (Figure 13). Results showed no evidence for cross-loadings: no items loaded more than .3 on other factors. In Figure 13, numbers below the name of the identity motives represent the expected items. For example, "Support – Gr. Continuity Motives (1, 2, 3)", these numbers indicate which item should load on this factor.
Item 1 (i.e., number 10 in Figure 13) of the threat toward continuity motives showed the weakest loading (see Appendix B for items correspondences). The magnitude of the factor loadings was different compared to the factor loadings of the CFA, although this difference between EFA loadings and CFA loadings is normal as, differently from EFA, cross-loadings are fixed to zero in CFA (see Brown, 2015).

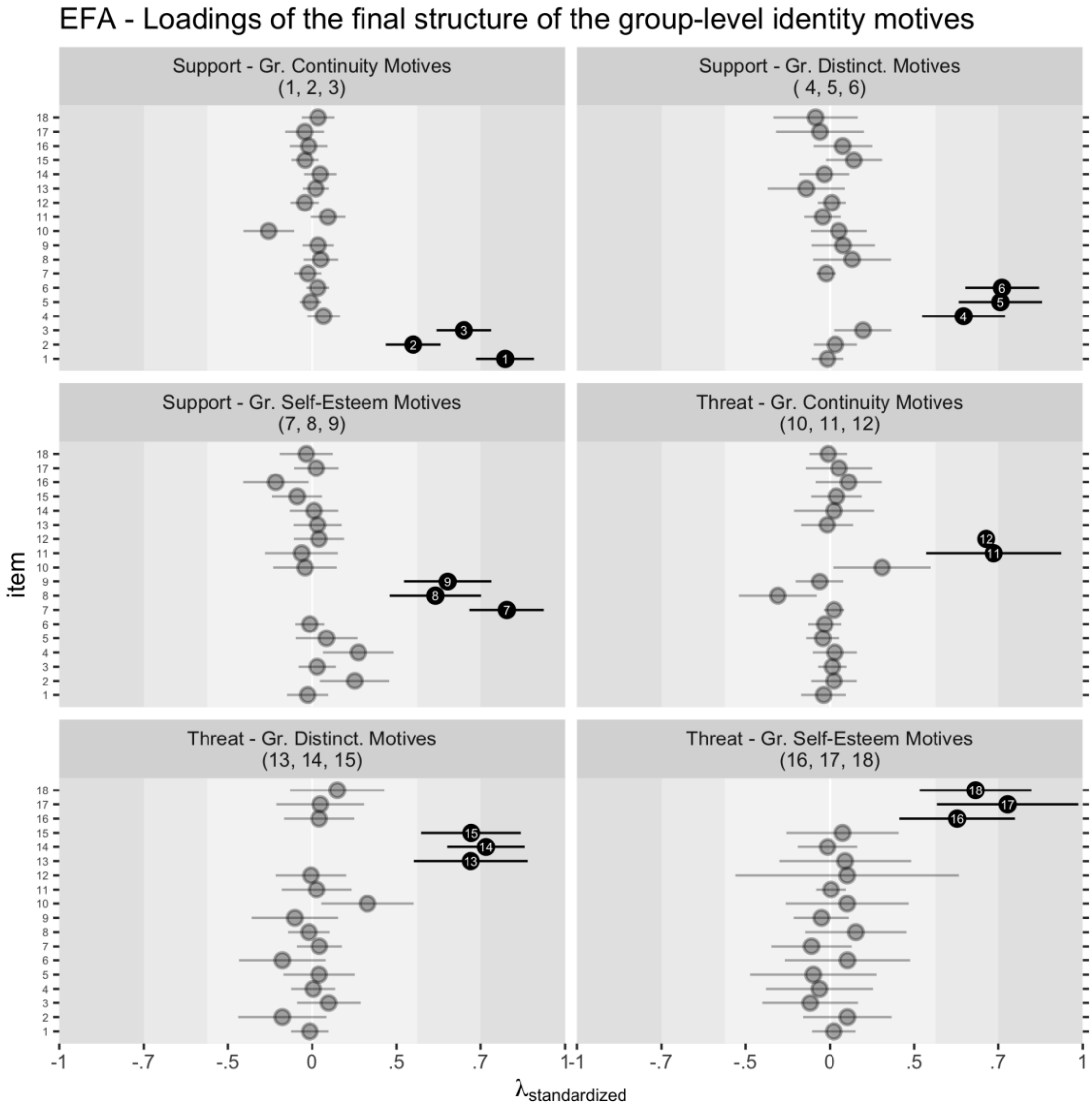

Figure 13. EFA with items of the final factor structures.
Note. For numerical indices of this graph, see Appendix B.
Note 2. Loadings ≥ +/- .4 are numbered.

5.6 Structural equation model analyses

Given the sensitivity of the chi-square statistic to sample size, structural models were evaluated using the root mean square error of approximation (RMSEA), the comparative fit index (CFI), the Tucker–Lewis index (TLI), and the standardized root mean square residual (SRMR). All models were tested using a robust estimator (MLR, Savalei & Rosseel, 2021) to account for multivariate non-normal data inspected via density and Q-Q plots. A fixed-factor method was used for scale identification.

Reasonable fit indices were accepted as follows: CFI and TLI >.90, RMSEA and SRMR < .08 (Byrne, 1998; Hu & Bentler, 1999).

An unconstrained approach, via product indicators, was used to create the moderator variable (Marsh et al., 2004). Matched-pairs (see Marsh et al., 2012) and double-mean-centering strategies (Lin et. al., 2010) were adopted for the product indicators procedure. For the interaction, the variable risk perception was reduced into three parcels to create an equal match with the number of items of the support toward group-based identity motives. Parcels were created based on correlation strengths within items. Specifically, the affect-related items formed one parcel, a second parcel was formed by items measuring the likelihood that the geothermal technology would represent a threat to people safety and that it would have negative knock-on effects on the environment, while the item measuring the likelihood that seismic events from geothermal technology would occur was not parcelled. These were then matched, separately, with items of the continuity, distinctiveness, and self-esteem motives in the exact same order as they were originally labelled. Some other matches were tested, and results remained stable.

When using the single item "intention to protest" as the outcome variable, this was treated as latent using the sample variance of this single indicator and the estimated reliability ($\sigma \ \times 1 \ [-\alpha]$). The estimated reliability was based on the reliability of the "collective intention to act against" construct.

5.6.1 Descriptive statistics

Means, standard deviation, Omega coefficients, as well as indices of univariate normality (i.e., skewness and kurtosis) are reported in Table 19. Considering the sample size (i.e., ≥ 500), and the robust estimator used in the SEMs analyses, skewness and kurtosis were acceptable (Lei & Lomax, 2005).

The bivariate correlations of the aggregated measures (Table 20) were in the expected direction. Perceived permeability of the group boundary and group-level relative deprivation significantly correlated, in line with Mummendey et al. (1999a). However, the association between perceived permeability of the group boundary and all other variables was not significant. This indicated that the expected mediation path might not be confirmed (H3a). Country-level identity and British identity were not included in the correlation matrix as these were not part of the main analyses. However, it is interesting to mention that country-level identity significantly correlated with collective action intentions (r = .12, $p = < .001$), and with all, expect for threat of self-esteem, group-level identity motives ranging from .12 to .24 ($p = < .001$). Country-level identity was also significantly associated with relative deprivation (r = .14, $p = < .001$) and permeability (r = -.21, $p = < .001$). British identity significantly correlated only with relative deprivation (r = -.19, $p = < .001$) and permeability (r = .70, $p = < .001$).

On average, participants identified themselves more with their country-level identity ($M = 5.82$; $SD = 1.23$) than with the British identity ($M = 4.07$; $SD = 1.71$). Looking at the differences between the Scottish and the Welsh samples, the observed regional identity of the Scottish sample ($M = 5.90$; $SD = 1.14$) was slightly stronger than the regional identity of the Welsh sample ($M = 5.74$; $SD = 1.30$). However, the mean difference was not significant ($t_{587.33} = 1.59$; $p = .11$). Consistently with data from the UK Census 2011 (Office for National Statistics, 2011), the Scottish sample showed, on average, to identify less with the British identity ($M = 3.63$; $SD = 1.73$) compared to the Welsh sample ($M = 4.52$; $SD = 1.57$). This difference was significant ($t_{592.85} = -6.59$; $p = < .001$).

Table 19
Descriptive statistics (N = 600)

	M (± *SD*)	*ω*	*Skew*	*Kurtosis*
1. Actions Against	2.13 (± 1.25)	.88	1.32	1.46
2. Int. to Protest	1.73 (± 1.30)	–	1.99	3.45
3. Soc. Acceptance	4.65 (± 1.29)	.88	-.46	.27
4. Actions in Favour	3.09 (± 1.35)	.86	.24	-.77
5. Supp. Continuity	4.33 (± 1.25)	.84	-.24	-.09
6. Supp. Self-esteem	5.06 (± 1.28)	.86	-.79	.65
7. Supp. Distinctiv.	5.33 (± 1.27)	.89	-.81	.67
8. Thr. Continuity	3.02 (± 1.21)	.77	.39	-.03
9. Thr. Self-esteem	2.31 (± 1.25)	.87	1.25	1.67
10. Thr. Distinctiv.	2.32 (± 1.18)	.86	.99	1.05
11. Risk perception	3.05 (± 1.33)	.93	.51	-.15
12. Soc. Id. Violation	2.36 (± 1.30)	.94	.98	.74
13. Permeab. Gr. B.	4.30 (± 1.41)	.81	-.27	-.36
14. Rel. Deprivation	4.63 (± 1.22)	.77	-.01	-.60

Note. Omega of the "Int. to Protest" is not displayed because it is one single item.

Table 20

Bivariate correlations (N = 600)

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Actions Against	—												
2. Int. to Protest	.82***	—											
3. Soc. Accep.	-.54***	-.37***	—										
4. Act. in Favour	-.02	.01	.53***	—									
5. Sup. Continuit.	-.22***	-.11	.47***	.41***	—								
6. Sup. Self-Est.	-.38***	-.24***	.67***	.49***	.59***	—							
7. Sup. Distinc.	-.30***	-.21***	.55***	.38***	.61***	.70***	—						
8. Thr. Continuit.	.44***	.29***	-.62***	-.40***	-.33***	-.55***	-.40***	—					
9. Thr. Self-Est.	.56***	.41***	-.63***	-.31***	-.29***	-.55***	-.40***	.68***	—				
10. Thr. Distin.	.46***	.33***	-.47***	-.24***	-.16***	-.43***	-.28***	.60***	.74***	—			
11. Risk percep.	.60***	.42***	-.66***	-.31***	-.28***	-.50***	-.34***	.61***	.70***	.55***	—		
12. Soc. Id. Viol.	.58***	.45***	-.61***	-.29***	-.18***	-.47***	-.34***	.63***	.76***	.74***	.67***	—	
13. Perm. Gr. B.	-.04	-.08	.07	-.01	-.06	-.02	-.03	-.04	-.02	-.10	-.01	-.11	—
14. Rel. Depriv.	.05	.05	.01	.07	.08	.02	.08	.00	.00	.02	.07	.05	-.26***

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

5.6.2 Results of the structural equation models analyses

The structural models were analysed by mirroring (as close as possible) the factor structure tested in the Monte Carlo simulation power analyses to ensure the reliability of the results. This means that each support and threat toward social identity motives model was analysed separately and for each outcome variable. Model fit indices for all CFAs were sufficiently good (see Table 1E in the Appendix E). Parameter estimates of all the confirmatory models were good (see Table 2E-13E in the Appendix E). Fit indices of the SEM models 1-6 were adequate as well (see Table 21 below). The R^2 of the outcome variables are reported in Table 22.

Table 21
Model fit indices of the SEM models (Models 1-6).

	df	**χ^2**	**RMSEA CI Low.**	**RMSEA**	**RMSEA CI Upp.**	**SRMR**	**CFI**	**TLI**
M1	287	759.434	.054	.059	.064	.052	.932	.923
M2	287	727.152	.052	.057	.063	.048	.943	.935
M3	287	724.860	.053	.058	.063	.050	.938	.930
M4	178	425.575	.048	.054	.061	.046	.950	.941
M5	178	400.348	.046	.052	.059	.039	.961	.954
M6	178	405.384	.047	.054	.061	.046	.956	.948

Note. All *p-values* of the χ^2 values were < .001. M = Model; Low = Lower; Upp. = Upper

Table 22
R^2 of the outcome variables (Model 1-12).

	Coll. Actions Aga. R^2	**Intention to Protest R^2**	**Social Acceptance R^2**	**Coll. Actions in Favour R^2**
Continuity	.462 (Mod 1)	.243 (Mod 4)	.734 (Mod 7)	.326 (Mod 10)
Self-esteem	.498 (Mod 2)	.272 (Mod 5)	.733 (Mod 8)	.330 (Mod 11)
Distinctiveness	.485 (Mod 3)	.269 (Mod 6)	.693 (Mod 9)	.249 (Mod 12)

Results of the H2 paths in the intention to act against and the intention to protest

Overall, both H2a and H2b were supported. Each interaction term between support toward social identity motives and risk perception on both the intention to act against and the specific intention to protest was significant and in the expected direction (see Table 23). This means that the effect of risk perception on these outcome variables was weaker as levels of perceived support toward social identity motives increased. Therefore, all three types of support toward social identity motives (i.e., continuity, self-esteem, and distinctiveness) showed this interaction effect. However, the magnitude of the coefficient interactions was mostly weak.

Table 23

Results of the structural equation models (Models 1-6).

Endogenous Var.	Exogenous Var.				
Model 1		***β***	**CI L.**	**CI U.**	***p***
Coll. Actions Against	Perceived Risks	.504	.390	.618	< .001
Coll. Actions Against	Threat - Continuity Motives	.140	.006	.275	.041
Coll. Actions Against	Support - Continuity Motives	-.027	-.108	.054	.509
Coll. Actions Against	Interaction - Support X Risks	-.136	-.217	-.055	.001
Coll. Actions Against	Perm. of Group Bound.	-.055	-.130	.021	.157
Perm. of Group Bound.	Threat - Continuity Motives	-.033	-.141	.076	.557
Model 2		***β***	**CI L.**	**CI U.**	***p***
Coll. Actions Against	Perceived Risks	.409	.282	.536	< .001
Coll. Actions Against	Threat - Self-esteem Motives	.282	.111	.453	.001
Coll. Actions Against	Support - Self-esteem Motives	.034	-.076	.144	.541
Coll. Actions Against	Interaction - Support X Risks	-.157	-.249	-.065	.001
Coll. Actions Against	Perm. of Group Bound.	-.055	-.128	.017	.136
Perm. of Group Bound.	Threat - Self-esteem Motives	-.045	-.147	.056	.380
Model 3		***β***	**CI L.**	**CI U.**	***p***
Coll. Actions Against	Perceived Risks	.480	.371	.589	< .001
Coll. Actions Against	Threat - Distinc. Motives	.170	.042	.298	.009
Coll. Actions Against	Support - Distinc. Motives	-.076	-.158	.005	.066
Coll. Actions Against	Interaction - Support X Risks	-.146	-.232	-.059	.001
Coll. Actions Against	Perm. of Group Bound.	-.039	-.115	.037	.314
Perm. of Group Bound.	Threat - Distinc. Motives	-.136	-.237	-.034	.009
Model 4		***β***	**CI L.**	**CI U.**	***p***
Intention to Protest	Perceived Risks	.394	.256	.533	< .001
Intention to Protest	Threat - Continuity Motives	.057	-.095	.209	.461
Intention to Protest	Support - Continuity Motives	.035	-.055	.126	.446
Intention to Protest	Interaction - Support X Risks	-.120	-.238	-.002	.046
Intention to Protest	Perm. of Group Bound.	-.110	-.195	-.024	.012
Perm. of Group Bound.	Threat - Continuity Motives	-.033	-.141	.076	.556
Model 5		***β***	**CI L.**	**CI U.**	***p***
Intention to Protest	Perceived Risks	.292	.140	.445	< .001
Intention to Protest	Threat - Self-esteem Motives	.234	.026	.442	.028
Intention to Protest	Support - Self-esteem Motives	.091	-.036	.218	.160
Intention to Protest	Interaction - Support X Risks	-.136	-.273	.001	.050
Intention to Protest	Perm. of Group Bound.	-.112	-.195	-.029	.008
Perm. of Group Bound.	Threat - Self-esteem Motives	-.045	-.146	.056	.381
Model 6		***β***	**CI L.**	**CI U.**	***p***
Intention to Protest	Perceived Risks	.339	.214	.465	< .001
Intention to Protest	Threat - Distinc. Motives	.101	-.053	.256	.199
Intention to Protest	Support - Distinc. Motives	-.047	-.140	.046	.325
Intention to Protest	Interaction - Support X Risks	-.153	-.275	-.032	.014
Intention to Protest	Perm. of Group Bound.	-.103	-.188	-.019	.017
Perm. of Group Bound.	Threat - Distinc. Motives	-.136	-.237	-.034	.009

Note. In the SEM framework, the "endogenous" variables are the outcome variables; the "exogenous" variable are the independent variables (e.g., see Kline, 2015). Permeability of the group boundary is primarily an endogenous variable in the present study. This table should be read as follows: variable in the "Endogenous Var." column is predicted by variable in the "Exogenous Var." column.

Results of the latent simple slope analysis in the intention to act against and in the intention to protest

A latent simple slope analysis of these models further showed that the effect of risk perception on intention to protest was also non-significant at high level of both self-esteem and distinctiveness motives (see Table 24).

Table 24

Results of the latent simple slopes analysis (Model 1-6).

Each raw represents the slope of the risk perception at three levels (- 1 *SD, 0,* +1 *SD*) of the identity motives on the outcome variables "Coll. Action Intent." and "Intention to Protest".

	Latent Slopes		
	-1 SD (SE)	0 (SE)	+ *1 SD* (SE)
Coll. Action Intent.			
Mod 1 - Continuity	.873*** (.112)	.687*** (.097)	.501*** (.114)
Mod 2 - Self-est.	.798*** (.140)	.577*** (.104)	.356** (.108)
Mod 3 - Distinct.	.872*** (.117)	.669*** (.095)	.466*** (.114)
Intention to Protest			
Mod 4 - Continuity	.591*** (.106)	.453*** (.088)	.315** (.120)
Mod 5 - Self-est.	.502*** (.140)	.343*** (.094)	.184^.103 (.113)
Mod 6 - Distinct.	.576*** (.111)	.397*** (.080)	.218^.051 (.111)

* $p < .05$**, $p < .01$, *** $p < .001$. *Note.* The actual *p-values* of slopes with $p > .05$ is presented.

In order to simplify the interpretation of the interaction effects, one of the interaction effects is also presented graphically (i.e., of self-esteem x risk perception; Figure 14).

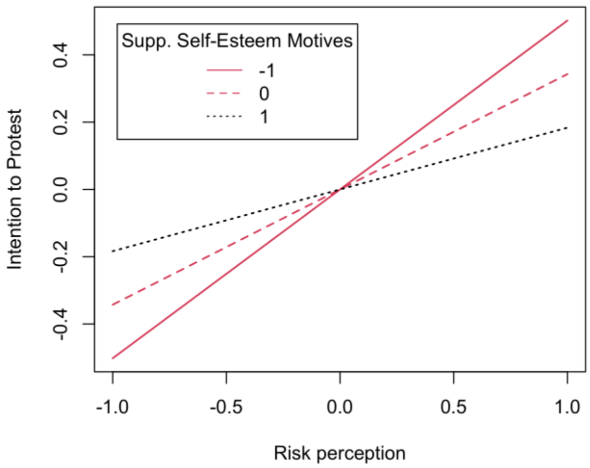

Figure 14. Interaction effect: self-esteem motive X risk perception.
The black line indicates non-significant effect. This interaction controls for the effect of the other variables included in Model 5 (Table 23).

Results of the H3 path in the intention to act against and the intention to protest

These results concern the mediation path from permeability of group boundary to the outcome variables via threat toward group-level identity motives.

H3a was not supported when considering the overall intention to act against the energy technology. Therefore, the mediation effect of permeability of group boundary on the intention to act against was not significant (see Table 13). When considering the specific intention to protest, it seems that a weak mediation effect occurred only in the model that considered threat toward distinctiveness motives (Model 6, Table 13). However, the indirect effect was not significant (Monte Carlo CI = [0, .039]). Each indirect effect is presented in Table 1F, in the Appendix F.

H3b aimed at overcoming the possible difficulty of measuring perceived permeability of group boundary by testing the mediation using a measure of British identity identification instead of perceived permeability. Results of this path are not reported for conciseness – they were non-significant.

Results of the direct associations between group-level identity motives and the intention to act against, and the intention to protest

More generally, the results showed that the observed magnitude of the risk perception coefficients was consistently significant across models, and stronger than the effect of the social identity motives. Nonetheless, it is important to note that the significance of threat toward identity motives remained stable for most models even after controlling for the effect of risk perception, which is one of the most important explanatory variables in the field of public opinion of large-scale controversial energy technology.

The direct effect of support toward identity motives on the outcome variables collective action intentions and intention to protest was significant (but with a low estimate) only when considering the continuity motives (Model 1, Table 13).

Results of the H4 paths in the social acceptance and in the intention to act in favour

Since the current study employed novel measures, the pre-registration included the investigation of the same paths using two more outcome variables commonly used in similar research contexts: social acceptance and intention to act in favour.

These measurement models (i.e., CFAs; see Appendix E) and the structural models (see Table 25 below) showed good and sufficient fit to the data respectively.

Table 25
Model fit indices of the SEM models (Models 7-12).

	df	χ^2	RMSEA CI Low.	RMSEA	RMSEA CI Upp.	SRMR	CFI	TLI
M7	263	612.877	.047	.052	.058	.049	.950	.943
M8	263	592.358	.046	.051	.057	.042	.959	.953
M9	263	597.404	.047	.052	.058	.048	.954	.948
M10	287	713.296	.050	.055	.060	.056	.935	.927
M11	287	698.722	.049	.054	.059	.052	.946	.939
M12	287	702.030	.050	.055	.060	.056	.941	.933

Note. All *p-values* of the χ^2 values were < .001. M = Model; Low = Lower; Upp. = Upper

Results showed that support toward continuity motives weakened the negative effect of risk perception on social acceptance. That is, the more people perceived support of their continuity motives from the implementation of the geothermal energy, the less the perceived risks negatively affected the social acceptance of the technology (see Table 26, Model 7). Latent simple slopes analysis showed that risk perception estimates significantly changed from -.908 (SE = .109, *p* = < .001) to -.302 (SE = .127, *p* = .017) at respectively + 1 *SD* and -1 *SD* levels of support toward continuity motives.

Differently, the effect of risk perception on social acceptance did not change depending on the level of perceived support toward self-esteem motives but changed weakly depending on the level of perceived support toward distinctiveness motives (Model 8 and 9).

The interaction effect on the intention to act in favour was not significant for all types of social identity motives (Model 10, 11 and 12). However, Model 10 and 11 (i.e., that respectively included continuity and self-esteem motives) showed that risk perception was not significant either. Instead, the effect of risk perception was significant in Model 12 (i.e., distinctiveness motives).

Results of the H3 path in the social acceptance and in intention to act in favour

Consistently with Models 1-6, the mediation effect of permeability of group boundary, via threat toward each of the social identity motives, was not significant either on the outcome variables social acceptance and intention to act in favour (i.e., Models 7-12). Results of indirect effect are in Table 3F, Appendix F.

Results of the direct associations between group-level identity motives and the social acceptance and the intention act in favour

Model 7 showed that the observed effect of threat toward continuity motives on social acceptance was stronger than the effect of perceived risks. Moreover, Model 10 showed that the effect of risk perception on the intention to act in favour became non-significant, while the effect of both support and threat toward continuity motives were significant and medium in magnitude.

The consistency of the effect of threat toward continuity motives indicates that the continuity motives might be particularly important in affecting the social acceptance and the intention to act in favour above the perceived risks. In fact, as explained above, continuity motive was also the only variable that significantly weakened the effect of risk perception on social acceptance (Model 7).

Regarding the direct effect of support toward social identity motives, it could be argued that each of these motives seems particularly important when considering social acceptance and intention to act in favour, often above the negative effect of risk perception (Model 8, 10, 11, and 12).

Table 26
Results of the structural equation models (Models 7-12).

Endogenous Var.	Exogenous Var.				
Model 7		***β***	**CI L.**	**CI U.**	***p***
Social Acceptance	Perceived Risks	-.312	-.406	-.217	<.001
Social Acceptance	Threat - Continuity Motives	-.405	-.508	-.302	<.001
Social Acceptance	Support - Continuity Motives	.265	.201	.329	<.001
Social Acceptance	Interaction - Support X Risks	.156	.090	.222	<.001
Social Acceptance	Perm. of Group Bound.	.048	-.011	.106	.111
Perm. of Group Bound.	Threat - Continuity Motives	-.032	-.140	.077	.567
Model 8		***β***	**CI L.**	**CI U.**	***p***
Social Acceptance	Perceived Risks	-.315	-.410	-.219	<.001
Social Acceptance	Threat - Self-esteem Motives	-.180	-.313	-.047	.008
Social Acceptance	Support - Self-esteem Motives	.478	.382	.574	<.001
Social Acceptance	Interaction - Support X Risks	.008	-.052	.068	.793
Social Acceptance	Perm. of Group Bound.	.048	-.011	.108	.111
Perm. of Group Bound.	Threat - Self-esteem Motives	-.046	-.147	.055	.373
Model 9		***β***	**CI L.**	**CI U.**	**p**
Social Acceptance	Perceived Risks	-.481	-.560	-.403	<.001
Social Acceptance	Threat - Distinc. Motives	-.106	-.199	-.012	.027
Social Acceptance	Support - Distinc. Motives	.403	.336	.470	<.001
Social Acceptance	Interaction - Support X Risks	.078	.008	.149	.028
Social Acceptance	Perm. of Group Bound.	.046	-.015	.108	.137
Perm. of Group Bound.	Threat - Distinc. Motives	-.136	-.237	-.034	.009
Model 10		***β***	**CI L.**	**CI U.**	***p***
Coll. Actions in Favour	Perceived Risks	-.021	-.152	.110	.754
Coll. Actions in Favour	Threat - Continuity Motives	-.358	-.497	-.218	<.001
Coll. Actions in Favour	Support - Continuity Motives	.326	.232	.421	<.001
Coll. Actions in Favour	Interaction - Support X Risks	-.013	-.094	.068	.757
Coll. Actions in Favour	Perm. of Group Bound.	-.016	-.099	.067	.705
Perm. of Group Bound.	Threat - Continuity Motives	-.032	-.141	.076	.560
Model 11		***β***	**CI L.**	**CI U.**	***p***
Coll. Actions in Favour	Perceived Risks	-.064	-.192	.064	.328
Coll. Actions in Favour	Threat - Self-esteem Motives	-.024	-.184	.137	.771
Coll. Actions in Favour	Support - Self-esteem Motives	.548	.408	.688	<.001
Coll. Actions in Favour	Interaction - Support X Risks	-.074	-.174	.026	.145
Coll. Actions in Favour	Perm. of Group Bound.	-.020	-.106	.067	.654
Perm. of Group Bound.	Threat - Self-esteem Motives	-.045	-.147	.056	.379
Model 12		***β***	**CI L.**	**CI U.**	***p***
Coll. Actions in Favour	Perceived Risks	-.184	-.288	-.079	.001
Coll. Actions in Favour	Threat - Distinc. Motives	-.077	-.192	.039	.192
Coll. Actions in Favour	Support - Distinc. Motives	.354	.257	.450	<.001
Coll. Actions in Favour	Interaction - Support X Risks	.012	-.078	.102	.796
Coll. Actions in Favour	Perm. of Group Bound.	-.023	-.113	.066	.609
Perm. of Group Bound.	Threat - Distinc. Motives	-.136	-.237	-.034	.009

Note. In the SEM framework, the "endogenous" variables are the outcome variables; the "exogenous" variable are the independent variables (e.g., see Kline, 2015). Permeability of the group boundary is primarily an endogenous variable in the present study. This table should be read as follows: variables in the "Endogenous Var." column are predicted by variables in the "Exogenous Var." column.

Model testing including socio-demographics

All models were also tested including three socio-demographic covariates: age, gender, and education. However, the variable education had 86 *NA* values due to participants preferring to not disclose such information. The pattern of relationships found in the models without covariates was mostly confirmed in the models which included covariates (with few exceptions made by the level of education). These exceptions concern Model 9, where, even if the level of education did not significantly predict the outcome variable social acceptance, it weakened the effect of threat toward distinctiveness motives which was found to be non-significant (p = .186). In Model 11, the effect of risk perception became significant but was weak (β = .14, CI [-.279, -.004], p = .044). Also in this model, the education level was not significantly associated with the outcome variable intention to act in favour.

5.6.3 Model comparisons via direct matrix calculation of $R^2_{Reduced}$

Finally, I computed the ΔR^2 in models that only included group-level identity motives and risk perception. Therefore, in this analysis the interaction effect and the permeability of the group boundaries were not estimated. The goal of this analysis was to clarify the magnitude of the association between group-level identity motives and the outcome variables. The method used is named "direct matrix calculation of $R^2_{Reduced}$" which use the model-implied covariances obtained from the full model (Hayes, 2021). As pointed out by the author, this method overcomes the limitations of other methods to calculate ΔR^2 such as dropping the measurement model or constraining some regression paths to zero. The new models showed sufficient fit to the data (see Table 2F, Appendix F).

For the specific way in which I have specified the syntax for the ΔR^2 analysis, results should be interpreted as follows: the larger the ΔR^2, the lower the importance of the role of group-level identities motives in explaining the outcome variables (see Table 27).

Results showed that the largest ΔR^2 were found in models measuring the associations with the outcome variable collective action intention, although the ΔR^2 of models that accounted for the effect of self-esteem motives was less pronounced (.074). Models that maintained an almost equal amount of explained variance were those measuring the associations with the outcome variable collective action in favour. Hayes (2021) classified ΔR^2 effect size as small (.05), medium (.13), and large (.26).

Table 27
R^2 differences across group-level identity motives and type of outcome variable. The intersection between each group-level identity motives type and each of the outcome variables represents separated models.

	$(R^2_{\text{Full}}) - (R^2_{\text{Reduced-adj}})$ **(ΔR^2_{adj})**			
Group-level identity motive	**Coll. Actions Against**	**Intention to Protest**	**Social Acceptance**	**Coll. Actions in Favour**
Continuity	(.476) – (.311) **(.163)**	(.215) – (.120) **(.091)**	(.711) – (.642) **(.068)**	(.326) – (.324) **(.001)**
Self-esteem	(.509) – (.433) **(.074)**	(.241) – (.208) **(.030)**	(.732) – (.688) **(.043)**	(.328) – (.322) **(.002)**
Distinctiveness	(.494) – (.323) **(.168)**	(.230) – (.154) **(.172)**	(.690) – (.536) **(.153)**	(.255) – (.226) **(.025)**

Note. $R^2_{Full} = R^2$ from both group-level identity motives and risk perception; $R^2_{Reduced-adj} = R^2$ without risk perception; $\Delta R^2_{adj} = R^2_{Full} - R^2_{Reduced-adj}$; *adj* = adjusted R^2 values.

Results of the competing role of the group-identity motives in one model across the four outcome variables

As a last step, the effect of each support and threat of the group-level identity motives was tested together on the four outcome variables. The variables were preliminarily analysed via multiple regressions using aggregate measures to verify if the degree of correlation between the variables was problematic based on the Variance inflation factor

(VIF). Threshold of VIF < 5 was set. Results showed that VIFs values ranged from 1.79 to 2.72.

This exploratory analysis clarified the importance of each group-level identity motives when accounting for the explanatory power of the other identity motives. Also in this case, each outcome variable was tested separately to ensure sufficient power of the estimates.

Support and threat of group-level identity motives on collective intention to act against

Results showed that model fit when considering the collective intention to act against as the outcome variable was sufficiently good (χ^2_{231} 616.192, $p < .001$; SRMR = .054; RMSEA= .059, 90% CI [.053, .064]; CFI= .947; TLI= .936). Collective intention to act against the geothermal energy technology was significantly associated only with threat toward self-esteem (β = .539 [.278, .807]; p = < .001). R^2 of collective intention to act against was .401.

Support and threat of group-level identity motives on the intention to protest

Model fit of the model that included only the intention to protest against the geothermal technology was acceptable as well (χ^2_{132} 315.249, $p < .001$; SRMR = .048; RMSEA= .054, 90% CI [.047, .062]; CFI= .965; TLI= .955). Also in this model, only threat toward self-esteem was significant (β = .462 [.154, .770]; $p = .003$). R^2 of the intention to protest was .214.

Support and threat of group-level identity motives on social acceptance

Model that included the social acceptance as the outcome variable had good fit (χ^2_{209} 448.800, $p < .001$; SRMR = .047; RMSEA= .048, 90% CI [.042, .055]; CFI= .968; TLI= .961). In this model, within factors of the threat toward group-level identity motives, both continuity (β = -.343 [-.494, -.193]; p = < .001) and self-esteem (β = -.335 [-.518, -.151]; p = < .001) were significant. Within factors of support toward group-level identity motives, only self-esteem was significantly associated with social acceptance (β = .334 [.150, .519]; p = < .001). R^2 of the social acceptance was .731.

Support and threat of group-level identity motives on collective intention to act in favour

Finally, the model that tested the associations with collective action intentions to act in favour of the geothermal technology showed sufficient model fit (χ^2_{231} 585.984, p < .001; SRMR = .056; RMSEA= .055, 90% CI [.049, .060]; CFI= .950; TLI= .941). Within factors of the threat toward group-level identity motives, only continuity was significant (β = -.325 [-.523, -.128]; p = < .001). Instead, within factors of the support toward group-level identity motives, both continuity (β = .185 [.043, .327]; p = .011) and self-esteem (β = .384 [.156, .612]; p = < .001) were significantly associated with the intention to act in favour. R^2 of collective intention to act in favour was .372.

5.6.4 The interaction effect of group-level relative deprivation

As mentioned in the pre-registration, the role of perceived relative deprivation was also investigated. In particular, since hypothesis H3a was not supported, this part of the analysis explored the interactive effect between perceived relative deprivation and permeability of the group boundary in influencing the association between threat toward social identity motives and both collective actions and the intention to protest against the technology. In this sense, a three-way interaction was tested using aggregate measures. This analysis will only present the effect of self-esteem motives because this was the most relevant in the general social identity framework (e.g., Ellemers et al., 1999). With additional analyses, I also tested the other two motives. Briefly, while the distinctiveness motive showed the same pattern of results of the self-esteem motive, the interaction with the continuity motives was not significant.

In summary, I expected that threat toward social identity motives would strongly predict the *intention to protest* at a high level of perceived relative deprivation (+ 1 *SD*) and at a low level of perceived permeability of the group boundary (- 1 *SD*). Therefore, the more people perceived that their group was in a disadvantaged position and that their group permeability was low, the stronger the association between threat toward social identity motives and intention to act against would be. This would result in a stronger likelihood of collective strategy (i.e., intention to protest) when the feasibility of an individual identity management strategy, such as *individual mobility*, is not available because a person finds it difficult to shift to another still plausible social identity type (i.e., British identity) given that the perceived permeability of the group boundary is low (i.e., Scottish/Welsh identity) (see Ellemers, 1993).

To test the above interaction, the R Package *Interaction* was used (version 1.1.5). A robust standard error estimator was used ("HC1", see Long & Ervin, 2000). Consistently with the expectation, the three-way interaction was significant, although weak (-.068, p = 0.006).

Results of the slope analysis (Figure 15) showed that at high levels of perceived relative deprivation (mean + 1 *SD* = 5.85) and at low levels of perceived permeability of the group boundary (mean - 1 *SD* = 2.88), the effect of threat toward self-esteem motives on the intention to protest was stronger (B = .57, 97.5% CI [.41, .72], p = < .001) than at medium and high levels of perceived permeability of the group boundary. The estimates decreased at .38 (97.5% CI [.24, .51], p = < .001) and at .19 (97.5% CI [.00, .37], p = .05) at respectively the mean value (4.30) and mean + 1 *SD* value (5.71) of perceived permeability of the group boundary.

At low levels of perceived relative deprivation (mean - 1 *SD*= 3.41), the estimate of threat toward self-esteem motives on the intention to protest changed little at different levels of perceived permeability of the group boundary (i.e., .37, .41, .46.). Finally, slopes at the mean level of perceived relative deprivation (4.63) for the values group permeability (i.e., mean -1 SD, mean, mean + 1 SD) were at .47, .40, and .32, respectively (p = < .001). Also, note that the interaction was neither significant when excluding the *group-level relative deprivation* nor when excluding the permeability of the group boundaries.

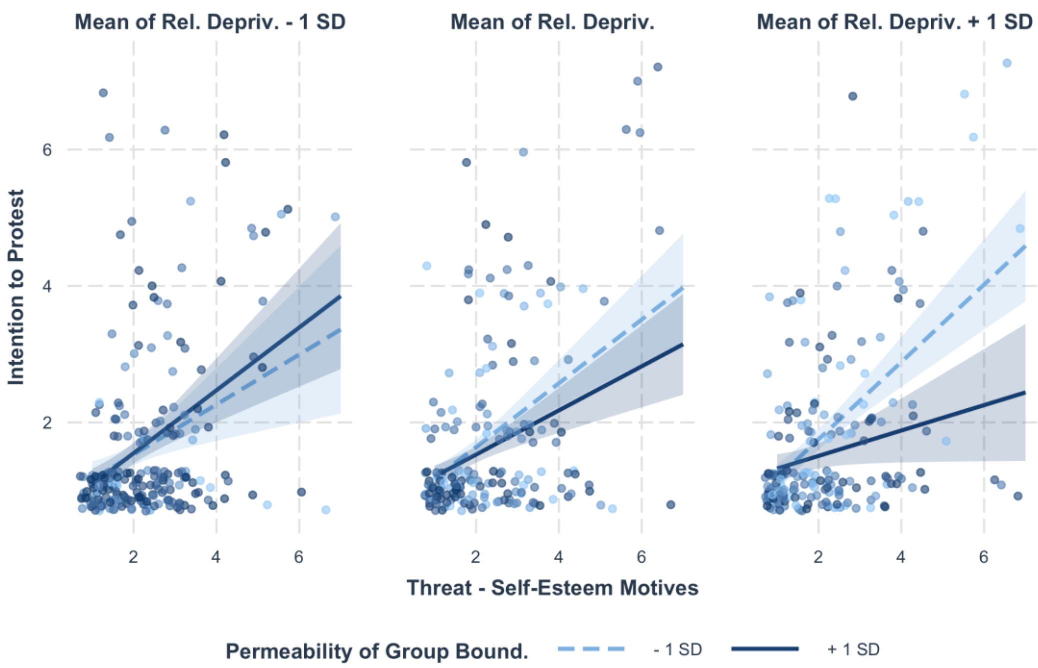

Figure 15. Interaction between perceived relative deprivation X permeability of the group boundaries X threat toward self-esteem motives.
Notes. Observed values have been jittered using a 0.2 parameter to better visualise overlapping data points. 95% confidence intervals are also shown around regression lines.

5.7 Discussion and conclusion

The present study examined whether the extent to which individuals perceived the implementation of large-scale energy technologies as supportive and threatening for their country-level social identity impacted their individual level of social acceptance and collective action intentions toward the implementation of these technologies. Inspired by research on social identity theories (e.g., Tajfel & Turner, 1979) and identity processes and motives (Identity process Theory, Breakwell, 1986; Motivated Identity Construction Theory, Vignoles et al., 2006; Vignoles, 2011), the role of group-level support and threat toward continuity, self-esteem, and distinctiveness motives was investigated. To this scope, I generated and tested three first-order factors accounting for the threat toward group-level identity motive of continuity, self-esteem, and distinctiveness and three first-order factors accounting for the support toward group-level identity motive of continuity, self-esteem, and distinctiveness. The measurement invariance of these novel constructs was supported across two groups (i.e., Scottish people and Welsh people) and across gender. Model fit of the factor structures were sufficiently good both as a six-factor structure and two second-order structure, in line with the recent development of identity motives in another research field (Breakwell et al., 2021).

Perceived support and threat were examined presenting participants with a scenario where the feasibility of the implementation of an Enhanced Geothermal System (i.e., deep geothermal energy) was being investigated in participants' country of residence (i.e., Scotland and Wales) by experts in the field. Common to other underground sources, environmental and safety risks associated with deep geothermal energy are categorised as low-probability high-consequence (LPHC) events. These consequences concern the probability of induced-seismicity (Chen et al., 2020) which, in the worst scenario, could result in catastrophic damage and fatalities (Knoblauch et al., 2018). As a consequence, acceptability of deep geothermal energy is subject to controversies (e.g., Kunze & Hertel, 2017) and counterbalancing risks (by providing climate change related benefits arguments) does not seem to weaken the perceived risks (McComas et al., 2016).

In a real-world context of a deep geothermal technology implementation in Cornwall (UK), the perceived risks did not seem to undermine the acceptance of the technology as the technology was perceived as supportive of group-level identity motives of continuity, self-esteem, and distinctiveness and generally consistent with their social norms (qualitative Study 1 of the present thesis). Furthermore, studies that looked at socio-cultural and identity aspects associated with public acceptance of energy technologies highlighted the importance of evaluating the extent to which energy technologies are suitable within communities' identities and social-cultural contexts (e.g., Bell & York, 2010; Batel & Devine-Wright, 2007; Cha, 2020; Chavot et al., 2018; Devine-Wright, 2009).

In order to understand the association between group-level identity motives and the outcome variables social acceptance and collective action intentions (i.e., both against and in favour), other focal variables were included in the present study: risk perception, permeability of the group boundaries, and group-level relative deprivation.

Group-level identity motives vs risk perception

The variability explained by the risk perception was included by using latent variables via structural equation models. Controlling for the effect of risk perception allowed me to understand a more realistic role of the group-level identity motives on the outcome variables. In particular, I expected a weaker effect of risk perception on collective action intentions and on the specific intention to protest when motives of support were high (H2a and H2b). These hypotheses were supported, although the interaction effects were mostly weak. Since the implementation of the geothermal technology was presented as a possible scenario, and therefore participants were not actually experiencing the implementation of the geothermal technology in their country, future studies should verify if this effect replicates and if it is stronger in a real-world context.

As for the novelty of the group-level identity motives measures, the interaction effect was also tested for other two outcome variables for exploratory purposes, as indicated in the pre-registration. The results showed that support toward continuity and distinctiveness motives moderated the effect of risk perception on social acceptance, while support toward self-esteem did not. However, the direct effect of self-esteem motives presented the largest observed coefficient magnitude, above the coefficient of risk perception. The interactions tested for the outcome variable intention to act in favour toward the geothermal technology were all non-significant. However, the effect of risk perception on the intention to act in favour was not significant either when controlling for support and threat toward both continuity and self-esteem, and its effect was weak in the model accounting for the distinctiveness motives.

When considering the outcome variable intention to protest against the geothermal technology, the threat toward continuity and distinctiveness group-level identity motives were not significant, while observed coefficients showed a similar effect of threat toward the self-esteem motive on the intention to protest compared to the coefficient involving risk perception. Conversely, the observed coefficient of support toward self-esteem motives was the strongest among models that included the intention to act in favour of the technology, presenting small confidence intervals.

These results are in line with social identity theories regarding the importance of self-definition enhancement in intergroup contexts (e.g., Oakes & Turner, 1980; Turner et al., 1979). Further, looking at the R-squared of each model, models that included self-esteem motives generally explained a larger amount of variance compared to other models. Also, looking at bivariate correlations, both support and threat toward self-esteem motives showed the largest correlation size among group-level identity motives on all the outcome variables. Finally, the CFI index of the models that included self-identity motives was better compared to other models. Importantly, these differences were not empirically tested. Therefore, these differences should be interpreted with caution and in a qualitative manner.

To clarify the direct role of group-level identity motives on the outcome variables, a series of ΔR^2 were analysed within models that included only group-level identity motives and risk perception. This analysis showed that, among group-level identity motives, the ΔR^2 of the self-esteem motives model was the smallest. That is, the explained variance of the self-esteem model was the largest.

Competing role of group-level identity motives

While it was not within the main aims of this study to understand how the group-level identity motives were differently associated with the outcome variables as well as in interaction with risk perception, results suggest that these differences are worthy of attention. Differently from Social identity theories (e.g., Tajfel & Turner, 1986), Identity process theories (e.g., Breakwell, 1986) put emphasis on the notion that no particular identity principle was more important than others. However, in the current applied research context, it seemed that self-esteem motives did have a more important role in explaining the outcome variables. Furthermore, even if in social identity theories, self-esteem and distinctiveness have been conceptualised as strongly inter-connected, with distinctiveness informing about self-esteem, the current study showed that these motives were differently associated with the outcome variables, even if they were strongly correlated to each other (r = .70, p = < .001) which is theoretically consistent. The plausibility of a *bifactor S–1* model (Eid et al., 2017), where self-esteem motives act as a marker dimension, should be further investigated with a larger sample to confirm that the non-positive variance-covariance matrix was due to misspecifications and not to sample size limitations.

To further clarify the different weight of the group-level identity motives, these were regressed all together on each of the outcome variables. These analyses confirmed that self-esteem motives, both support and threat, were the most important group-level identity motives because they were the only motives significantly associated with all the outcome variables. The effect of the distinctiveness motives did not contribute to the models significantly. This was probably due to self-esteem motives covariance with the outcome variables overlapping with the covariance of the distinctiveness motives. This is consistent with the degree of the discriminant validity among them, which was the weakest.

Even if not part of the main analysis, bivariate correlations were inspected also with Scottish and Welsh identities. Threat toward self-esteem motives was the only variables, among the group-level identity motives, that did not significantly correlate with the county-level social identity. This could represent an identity management strategy which would need further attention in future studies. However, the significant but weak correlations between the other group-level identity motives and the county-level social identity could be attributed to the simple fact that all these variables were based on identity-related features. Therefore, these correlations should be interpreted with caution.

Threat toward group-level identity motives and permeability of the group boundaries

A second objective of the present study was to understand if at least one of the preconditions of *subjective belief structures* in the intention to act collectively was satisfied. It was hypothesised that the perceived permeability of the group boundaries would mediate the relationship between threat toward group-level identity motives and both collective action intentions and specific intention to protest. This hypothesis could not be supported. As mentioned in the pre-registration, also the role of the *group-level* *relative deprivation* was planned to be included as a possible necessary condition for the permeability of the group boundaries to act as a moderator. Therefore, follow-up analyses examined the effect of permeability as a moderator rather than as mediator, and the role of *group-level relative deprivation* was included as a second moderator. Results showed that high and low levels of *group-level relative deprivation* significantly interacted with permeability of the group boundaries in affecting the slopes of threat toward group-level identity motives (i.e., in this case self-esteem motives) on the outcome variables intention to protest. That is, the more people (i.e., Scottish and Welsh) felt that they were in a disadvantaged conditions compared to a relevant outgroup (i.e., English people), and the more the group boundaries were perceived as impermeable the higher was the effect of threat toward self-esteem motives on the intention to protest. This result corroborates other research findings (e.g., Mummendey et al., 1999a; van Zomeren et al., 2012). Researchers interested in replicating this result are invited to include a third and fourth measure that account for perceived legitimacy of the group status and its perceived stability. More generally, future studies should better investigate how the *subjective belief structures* act as baselines that shape the way in which a large-scale energy technology is perceived as supportive or as a threat for group-level identity motives.

Limitations and practical implications

This study presents several limitations. First, the cross-sectional design of the study and the lack of participants' involvement in a real-world context should be mentioned. Therefore, future studies should (i) investigate the present observed relations when participants are actually experiencing the implementation of a large-scale technology in their country and (ii) examine the stability and the evolution of the observed relations in different phases of the technology implementation. For example, if people perceive a threat toward the continuity motives in the initial stage of the energy project implementation, would the technology still be perceived as a threat for their continuity motives months or years after the implementation? Furthermore, are the self-esteem motives only important at the very first stage of the energy technology implementation? Would the perceived support toward group-level self-esteem motives still mitigate the negative effect of risk perception on the intention to act against if people experienced a minor induced-seismicity event caused by the technology?

Second, given the limited sample size, an exploratory factor analysis (EFA) could not be carried out in a different sample but was conducted on the same Scottish sample. Splitting the sample in two, one for the EFA and one for the CFA/SEM, was not a feasible option because the Monte Carlo power simulation analysis clearly indicated that at least N = 500 were needed to reach reasonable power in the SEM analysis. Furthermore, focusing only on the EFA, rather than on the CFA/SEM, would have greatly limited the understanding of the novel constructs. Also, the primary utility of the EFA is to understand which factor a certain item belongs to, as well as exploring cross-loadings (e.g., DeVellis & Thorpe, 2021). Even if the items were new, the theory behind the factors structure is established and has also been confirmed recently in a different research context (Breakwell et al., 2021). Therefore, this study starts with prior assumptions within a confirmatory framework. The factor structure (CFA) was tested and confirmed across two different groups in a different time frame and the measurement invariance was confirmed across both population and gender. Moreover, results from the EFA analysis with all items included was presented for transparency, even if this analysis did not guide the final factor structure. Finally, the selected items were also inspected via EFA to examine cross-loadings. For this reason, the operationalisation of the new constructs was evaluated as reliable but it would benefit from further investigation to confirm this result.

Another limitation concerns the weakness of some significant coefficient magnitudes, especially for the interaction effect. The Monte Carlo power simulation showed that regression coefficients of .10 did not reach sufficient power, regardless of loadings and sample sizes. The interaction coefficients mostly fell in a grey zone (i.e., about .15) which was not tested in the power simulation. Therefore, these results should be read with caution as these estimates could be biased.

While the role of the group-level identity motives was weighted by the role of risk perception, the important role of group efficacy beliefs in collective action intention was not included (e.g., van Zomeren et al., 2008). Future studies could investigate a possible mediation path that includes the perception that the ingroup is able to solve the ingroup-related problems (i.e., group efficacy beliefs, Bandura, 1995, 1997). The group efficacy beliefs might act as a mediator between perceived threat toward group-level identity motives and collective action intentions such as intention to protest.

Lastly, the present study did not test the interaction effect using the *G* factor "support toward group-level identity motives". The factor structure of a second-order model was plausible; however, the measurement invariance was not tested across the two samples. Future studies should address this limit by testing the measurement invariance of the second-order factor (Chen et al., 2005; Byrne et al., 2006) to then compute the interaction via Bayesian method (Lee et al., 2007; 2012) which calculates the product terms between the latent factor scores.

Practical implications of the results suggest that stakeholders interested in the implementations of large-scale technologies with low-probability high-consequence events should carefully analyse the specific social-context and identity dynamic related to the technology implementation. In particular, the present study emphasizes that public acceptance and actions toward large-scale energy technologies with low-probability high-consequence might not mainly depend only on risk perception, but that the extent to which the technology is perceived as supportive and threatening for group-level identity motives also matters. Crucially, support toward group-level identity motives was particularly important in explaining variability in the intention to act in favour of the technology, such as making a donation and attending a discussion meeting. While the majority of studies focused on passive behaviours such as acceptance of the technology and behaviours that aim to resolve a perceived problem, such as intention to act against controversial technologies (e.g., Batel, 2020), this study highlighted that people are willing to actively participating in energy technologies implementations as long as their identity motives are supported.

General Discussion

Introduction

In the present research work, I examined the role of social identity processes in the acceptance of and collective actions toward the renewable energy technology "Enhanced Geothermal System (EGS)" (geothermal energy technology) in the UK. The overarching question addressed in my research programme was: how does social identity perspective significantly contribute to our understanding people's responses to controversial energy technology implementation? Considering social identity processes involves moving away from an individual-centric and risk perception perspective in the study of people's acceptance of large-scale technology. In this research, I presented work which showed that both intra- and intergroup social identity processes matter and will need further attention in future research.

Improving the energy system (i.e., using innovative clean energy technologies to shift from oil, natural gas and coal production) is necessary to achieve the ambitious UK government goal of substantially reducing greenhouse gas emissions by 2035. Using different types of renewable energies, along with innovative systems that store the energy produced, is also important to tackle energy security issues.

Importantly, the deployment of new renewable energy technologies needs to consider public concerns and opposition at the local, regional, and national level (Boudet, 2019). The ultimate challenge is to understand how people could reach an intrinsic level of motivation to accept large-scale energy technologies in order to limit public opposition.

Understanding public response toward these technologies is not only relevant for a utilitarian view which sees the understating of public opinion toward energy technologies *as a means to* avoid public opposition, but it also important to limit adverse effects on public mental well-being from energy project implementation. For example, risk perception associated with living near a waste incineration has been shown to be associated with psychological distress (Lima, 2004). It has also been shown that technology implementation can trigger experience of injustice, which could then lead to negative emotional responses such as anger (e.g., Agostini & van Zomeren, 2021). More generally, feeling forced or pressured to accept or to do something has detrimental effects on well-being (Deci & Ryan, 2008; Ryan & Deci, 2000; Thomas et al., 2017) and affect (Contzen et al., 2021). Therefore, understanding psychosocial drivers of public acceptance of energy technologies is important with regard to climate change issues as well as public well-being.

Summary of research work

The theoretical framework used to understand socio-psychological processes in the acceptance of the geothermal technology was consolidated through the first qualitative exploratory study which was carried out in a real context of geothermal technology implementation. The framework was based on social identity theories (e.g., Abrams & Hogg, 1988; Hogg, 2000; Tajfel & Turner, 1979) and research on identity processes and identity motives (Identity process Theory, Breakwell, 1986; Motivated Identity Construction Theory, Vignoles et al., 2006; Vignoles, 2011; Sani et al., 2007).
Study 1 adopted a qualitative approach using focus groups, while the other studies were based on correlational designs which involved the use of structural equation modelling techniques.

In particular, Study 1 identified two possible pathways worth of further attention. The first pathway highlighted the relevance of investigating environmental concerns, normative and collective efficacy beliefs in the acceptance of large-scale energy technologies. The second pathway highlighted the relevance of investigating socio-psychological dimensions such as *social identity perceived support and threat from the technology*, perceived sense of volition and choice, fairness perception, and risk perception. Adopting an abductive approach (e.g., Reichertz, 2019), this study went beyond the simple illustration of preselected social theories (Blaikie, 2010). In this sense, the extracts were interpreted using an interplay between theory and data, involving both inductive and deductive reasoning.

The relationships between variables identified in the first pathway are meaningfully explained in the SIMPEA model (Fritsche et al., 2018). However, when this research project started, no studies had tested this model. To my knowledge no study has investigated one of the main paths proposed in the SIMPEA model yet, from appraisal of the environmental crisis to collective actions or proxy variables such as intentions. The second study investigated an adaptation of this path in the context of the social acceptance of deep geothermal energy. Results showed that appraising the environmental consequences of the energy system as urgent to solve was important for the development of group-based positive and negative feelings toward the implementation of the geothermal technology. The group-based positive emotions, in turn, positively predicted normative and collective efficacy beliefs. Normative and efficacy beliefs were both significantly associated with social acceptance when tested separately. However, the efficacy beliefs were no longer important in the explanation of social acceptance when social descriptive norms were included in the model. The role of social identity was explained as a predictor, and not as a moderator. This is in line with studies highlighting the different role of social identity on pro-environmental behaviours depending on the type of pro-environmental behaviour considered (Masson & Fritsche, 2014). The results of this study were also interpreted in light of Masson et al.'s (2016) study results, as explained in the next section.

Study 3 of this research programme aimed to clarify another important result that emerged from the first qualitative study. This concerned the role of procedural fairness when taking into account perceived identity-related outcomes associated with the geothermal energy technology. The identity-related outcomes were captured using the construct of social identity violation (Mayer et al., 2009). Results showed that procedural fairness was important especially when people perceived mild levels of identity violation. Moreover, the importance of procedural fairness was also examined in association with the primary basic psychological need of autonomy (Ryan & Deci, 2000) which in turn, was associated with self-determined motivations. Both autonomy need and self-determined motivations were measured as group-level beliefs, based on the novel adaptation of the self-determination theory into the group context discussed by Thomas et al. (2017). Group-level autonomy was analysed as a predictor of both procedural fairness and collective self-determined motivations. These were significantly positively associated with social acceptance.

Finally, Study 4 examined the role of *primary* identity processes when controlling for risk perception; in addition, I explored mediation and moderation paths which accounted for the perceived *subject beliefs of the social structure*. Main results showed that the implementation of risky energy technologies would find an ideal ground if the technology is perceived as consistent with the general historical past of the groups and if the technology is seen as an opportunity to enhance the ingroup status position and to distinguish the ingroup from other groups. Differently from Social identity theories (e.g., Tajfel & Turner, 1986), Identity process theories (e.g., Breakwell, 1986) put emphasis on the notion that no particular identity principle is better or more important than others. However, self-esteem motives did have a more important role for the outcome variables. Lastly, results showed that the association between threat toward self-esteem and intention to protest was stronger at high levels of perceived group-relative deprivation and low levels of perceived permeability of the group boundaries.

The next section will focus on the consistency of the social identity implications found across four studies.

Social identity implications of energy technology implementations

Through testing different models, I found that social identity implications associated with technology developments should not be ignored in the context of social acceptance of energy technologies. These implications were direct drivers of social acceptance (Study 1, Study 3, Study 4) and collective actions (Study 4). Differently, the identity implications in Study 2 were the results of a theoretically-relevant interpretative process based on the direct relationships between ingroup identification and both descriptive norms and collective efficacy, as well as on the indirect effects of ingroup identification on social acceptance via descriptive norms and collective efficacy.

In Study 1, these implications were clearly stated by participants involved in the focus groups. Specifically, in Study 1 participants interpreted the geothermal project as consistent with community members' identities, maintaining the historical continuity with the past. The general geothermal project was also described as a matter of pride for Cornwall, and a project with characteristics that allowed Cornwall to stand out from the rest of England.

In Study 2, descriptive norms and collective efficacy increased as a function of ingroup identification. These mediations, based on cross-sectional data, might indicate that people were motivated to evaluate ingroup norms and efficacy beliefs (i.e., whether their group accepted the technology and beliefs on what their group was able to achieve in terms of renewables) in a way that supported their ideal group prototypes. Based on Masson and et al. (2016), the mediation path could be explained considering the need for self-esteem, which motivates members to see their ingroup in a positive light as a result of an identity management strategy. In this sense, accepting the geothermal energy technology was seen as a positive attribute for the ingroup, which might have led to biased ingroup descriptive norms and efficacy beliefs.

In Study 3, the identity implications were inferred by the relationship between social identity violation and social acceptance but they also appeared relevant in light of the relation between procedural fairness and social acceptance at different levels of social identity violation. Firstly, among other predictions, social identity violation was the strongest predictor in terms of coefficient magnitude. Secondly, a follow-up analysis supported the interpretation that the weak relationship between procedural fairness and social acceptance might have been due to the actual support toward people's social identity from the technology implementation: since procedural fairness gives people information about their value as group members and of their group status (Leung et al., 2007; Tyler et al., 1996), when the outcome of a decision positively supports the group status, the perceived fairness related to decision-making is less important in affirming that the group to which they belong is valuable.

In Study 4, positive and negative identity implications from a geothermal energy technology were directly captured by proposing new measures accounting for these implications adapted to the specific context of energy technology implementation. These measures were inspired by the first study and social identity theories (Tajfel & Turner, 1979). Main results showed that when investigating the explained variance of group-level identity motives of self-esteem, distinctiveness, continuity and risk perception, the identity motives accounted for almost all variance explained in the intention to act in favour of the geothermal technology. Moreover, when comparing the explained variance between group-level identity motives, self-esteem motives were the most important for the outcome variables collective action intentions, intention to protest and social acceptance, and equally important as the continuity motives for the intention to act in favour. Importantly, all measures of support toward group-level identity motives weakened the negative effect of risk perception on the outcome variable (collective action intentions to act against) and in the specific intention to protest against the technology.

Methodological and statistical considerations: strengths and limitations

All quantitative studies of the present research work were pre-registered on a trusted repository (OSF). This research programme thus followed the Transparency and Openness Promotion (TOP) Guidelines (Nosek et al., 2015). The preregistrations ensured the distinction between confirmatory and exploratory analyses. Each change to the pre-registration has also been summarised in the Appendix D. Moreover, all data and R scripts were made available.

The fourth study was the one that mostly changed compared to the pre-registration. Although this study has considered a complex modelling structure, it has provided an in-depth view into how different support and threat toward group-level identity motives might interact in real-world contexts of controversial energy technology implementations. The strength of considering multivariate relations lies in its potential for guiding future hypotheses and correlational/experimental investigations of the phenomena considered here.

Another important aspect to discuss is related to the statistical power of the correlational studies. Each of the studies provided justifiable power considerations. The power to detect the estimates in Study 2 and Study 3 was based on both rule of thumbs and population RMSEA (MacCallum et al., 1996). However, these methods are not without limitations as each model is unique. Power evaluations based on population RMSEA do not take into account what happens to the model when considering, for example, the specific item loadings or magnitude of the regression coefficients. For this reason, Study 4 used a more statistically advanced procedure to evaluate the power of each latent regression, namely a Monte Carlo simulation. However, the structure of the model that was actually tested slightly changed from the previously simulated model so limitations concerning this point were also discussed.

In terms of limitations of Study 1, it is important to mention that this study examined people's opinions only during the first stages of the energy technology implementation. Therefore, feelings of excitement that emerged during the group discussions might be related to the novelty of the project implementation (Huijts, 2018) rather than to the project itself. Future studies should examine changes of energy projects' appraisal across different phases of energy technology implementation. Importantly, the novelty associated with the geothermal project does not mean that social category salience was led by the novelty feature of the technology *per se* (Oakes, 1994; Oakes & Turner, 1986). Rather, the 'fit X accessibility' hypothesis, i.e., the metacontrast principle, determined its salience based on the *stimulus context as a whole* (Oakes & Turner, 1990). More generally, qualitative data is subject to interpretation and I cannot exclude the possibility that my educational background influenced how I interpreted what people said. Importantly, the results were discussed and revised by experts in geology with little knowledge of sociopsychology processes giving thus more pragmatic evaluations of the discussed results. As with most qualitative research, this study's findings are not generalizable to other energy technology implementation contexts. Having said that, generalizability is a controversial topic in qualitative research anyway since criteria from a positivist paradigm might not be appropriate within interpretivist approaches (Carminati, 2018).

The three correlational studies have some common limitations. First, some variables had skewed distributions. To address nonnormality problems, a robust standard estimator was used. In addition, Monte Carlo and bootstrapping confidence intervals were included to confirm the stability of the indirect effects.

Second, most of participants were recruited from online crowdsourcing platforms, such as Cint and Prolific, and from social media. Therefore, participants did not constitute representative samples of county and national populations. In general, all quantitative studies of the present research work would benefit from future studies replicating the correlational design, possibly in real-world contexts of risky and less risky energy technology implementation. Accordingly, the results must be taken with caution and considered as a starting point for future research. Furthermore, the cross-sectional character of the data limits the possibility of causal inferences.

For what specifically concerns Study 2, further studies might test the discriminant validity between collective efficacy and measures concerning trust toward ingroup relevant authorities. Moreover, the positive and negative emotions shared an important amount of residuals. Future studies should attempt to measures positive and negative emotions using a different response scale to avoid correlated residuals, or by including a filler task between the two measures.

In Study 3, the interpretation of the moderating role of social identity violation was limited to its range values due to its skewness. Future studies should replicate these results by using measures developed in Study 4 of support and threat toward group-level identity motives. In Study 4, it was not possible to test this effect because participants were not involved in a real-world context of energy technology implementation. Therefore, information about fair procedures was not available since participants did not actually experienced technology implementation.

In Study 4, the generalizability of the study results was limited as it involved a hypothetical scenario. Therefore, future studies should (i) replicate the results when participants are experiencing the implementation of a large-scale technology in their country and (ii) examine the stability and evolution of observed relations in different phases of technology implementation. Finally, even if the plausibility of the two second-order factors of support and threat toward group-level identity motives was supported, the measurement invariance across populations was only tested in the first-order factors. Therefore, future studies should address this limit (Byrne et al., 2006; Chen et al., 2005).

Conclusion

In conclusion, this thesis highlights the importance of adopting a collective-level analysis that considers intra and intergroup dynamics in the acceptance and collective action toward large-scale energy technologies such as EGS. In this sense, the present research work expands the work of previous studies on the importance of adopting a collective-level analysis in environmental psychology field studies (e.g., Fielding & Hornsey, 2016; Fritsche et al., 2018; Hart, 2021; Jans, 2021; Mackay et al., 2021; Masson et al., 2016; Masson & Fritsche, 2021; Milfont et al., 2020; Rees & Bamberg, 2014; Schulte et al., 2020). The take-home message is that how one defines oneself should not be ignored in the study of pro-environmental behaviour, and that defining oneself at a certain level of categorisation means defining oneself in relation to other categories (Turner, 1982), which also needs to be taken into consideration. Considering both *which* salient identity is leading in a certain context and *how* behavioural changes could be triggered according to both intra and intergroup identity processes is thus the goal behind studies that adopt a social identity approach in the field of pro-environmental behaviour. The ultimate goal is to understand how people can behave in a way that limits greenhouse gas emissions which are causing climate change. The complexity of this problem required common shared pro-environmental goals across multiple levels of identities as well as intergroup dynamics that support these goals.

Bibliography

Abrams, D., & Grant, P. R. (2012). Testing the social identity relative deprivation (SIRD) model of social change: The political rise of Scottish nationalism. *British Journal of Social Psychology*, *51*(4), 674–689. https://doi.org/10.1111/j.2044-8309.2011.02032.x

Abrams, D., & Hogg, M. A. (1988). Comments on the motivational status of self-esteem in social identity and intergroup discrimination. *European Journal of Social Psychology*, *18*(4), 317–334. https://doi.org/10.1002/ejsp.2420180403

Abrams, D., & Hogg, M. A. (2006). *Social identifications: A social psychology of intergroup relations and group processes*. Routledge

Agostini, M., & van Zomeren, M. (2021). Toward a comprehensive and potentially cross-cultural model of why people engage in collective action: A quantitative research synthesis of four motivations and structural constraints. *Psychological Bulletin, 147*(7), 667–700. https://doi.org/10.1037/bul0000256

Aitken, M. (2010). Why we still don't understand the social aspects of wind power: A critique of key assumptions within the literature. *Energy policy*, *38*, 1834-1841. https://doi.org/10.1016/j.enpol.2009.11.060

Aitken, M. (2010). Wind power and community benefits: Challenges and opportunities. *Energy Policy*, *38*(10), 6066–6075. https://doi.org/10.1016/j.enpol.2010.05.062

Aitken, N. M., Pelletier, L. G., & Baxter, D. E. (2016). Doing the difficult stuff: Influence of self-determined motivation toward the environment on transportation proenvironmental behavior. *Ecopsychology*, *8*, 153-162. https://doi.org/10.1089/eco.2015.0079

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

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, *50*, 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Altman, I., & Low, S. M. (Eds.). (1992). *Place attachment, human behavior and environments: Advances in theory and research*. New York: Plenum Press. DOI: 10.1007/978-1-4684-8753-4_1

Andrich, D., & Styles, I. M. (1998). The structural relationship between attitude and behavior statements from the unfolding perspective. *Psychological Methods*, *3*, 454–469. https://doi.org/10.1037/1082-989X.3.4.454

Arning, K., Offermann-van Heek, J., Linzenich, A., Kaetelhoen, A., Sternberg, A., Bardow, A., & Ziefle, M. (2019). Same or different? Insights on public perception and acceptance of carbon capture and storage or utilization in Germany. *Energy Policy*, *125*, 235–249. https://doi.org/10.1016/j.enpol.2018.10.039

Asch, S. E. (1961). Effects of group pressure upon the modification and distortion of judgments. In M. Henle (Ed.). *Documents of gestalt psychology* (pp. 222-236). Berkeley: University of California Press. https://doi.org/10.1525/9780520313514-017

Baek, H., Chung, J. B., & Yun, G. W. (2021). Differences in public perceptions of geothermal energy based on EGS technology in Korea after the Pohang earthquake: National vs. local. *Technological Forecasting and Social Change*, *172*, 121027. https://doi.org/10.1016/j.techfore.2021.121027

Bagci, S. C., Verkuyten, M., Koc, Y., Turnuklu, A., Piyale, Z. E., & Bekmezci, E. (2020). Being tolerated and being discriminated against: Links to psychological well-being through threatened social identity needs. *European Journal of Social Psychology*, *50*(7), 1463–1477. https://doi.org/10.1002/ejsp.2699

Balzan-Alzate, D., López-Sánchez, J., Blessent, D., Raymond, J., Dezayes, C., Portela, J. P., ... & Le Borgne, T. (2021). An online survey to explore the awareness and acceptance of geothermal energy among an educated segment of the population in five European and American countries. *Geothermal Energy*, *9*, 1-21. https://doi.org/10.1186/s40517-021-00188-x

Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of environmental psychology*, *27*, 14-25. https://doi.org/10.1016/j.jenvp.2006.12.002

Bamberg, S., Rees, J. H., & Schulte, M. (2018). Environmental protection through societal change: What psychology knows about collective climate action—And what it needs to find out. In Clayton S., Manning, C. (Eds.). *Psychology and climate change* (pp. 185-213). Academic Press. https://doi.org/10.1016/B978-0-12-813130-5.00008-4

Bamberg, S., Rees, J., & Seebauer, S. (2015). Collective climate action: Determinants of participation intention in community-based pro-environmental initiatives. *Journal of Environmental Psychology*, *43*, 155-165. https://doi.org/10.1016/j.jenvp.2015.06.006

Bandalos, D. L. (2021). Item Meaning and Order as Causes of Correlated Residuals in Confirmatory Factor Analysis. *Structural Equation Modeling: A Multidisciplinary Journal*, 1-11. https://doi.org/10.1080/10705511.2021.1916395

Bandura, A. (1995). *Self-Efficacy in Changing Societies*. Cambridge University Press.

Bandura, A. (2000). Exercise of human agency through collective efficacy. *Current directions in psychological science*, *9*, 75-78. https://doi.org/10.1111/1467-8721.00064

Barth, M., Masson, T., Fritsche, I., Fielding, K., & Smith, J. R. (2021). Collective responses to global challenges: The social psychology of pro-environmental action. *Journal of Environmental Psychology*, *74*, 101-562. https://doi.org/10.1016/j.jenvp.2021.101562

Basosi, R., Bonciani, R., Frosali, D., Manfrida, G., Parisi, M. L., & Sansone, F. (2020). Life cycle analysis of a geothermal power plant: Comparison of the environmental performance with other renewable energy systems. *Sustainability*, *12*, 2786. https://doi.org/10.3390/su12072786

Batel, S. (2020). Research on the social acceptance of renewable energy technologies: Past, present and future. *Energy Research & Social Science*, *68*, 101544. https://doi.org/10.1016/j.erss.2020.101544

Batel, S., & Devine-Wright, P. (2017). Energy Colonialism and the Role of the Global in Local Responses to New Energy Infrastructures in the UK: A Critical and Exploratory Empirical Analysis. *Antipode*, *49*(1), 3–22. https://doi.org/10.1111/anti.12261

Batel, S., & Devine-Wright, P. (2018). Populism, identities and responses to energy infrastructures at different scales in the United Kingdom: A post-Brexit reflection. *Energy Research & Social Science*, *43*, 41–47. https://doi.org/10.1016/j.erss.2018.05.011

Becker, J. C. (2012). The system-stabilizing role of identity management strategies: Social creativity can undermine collective action for social change. *Journal of Personality and Social Psychology*, *103*(4), 647–662. https://doi.org/10.1037/a0029240

Becker, M., Vignoles, V. L., Owe, E., Easterbrook, M. J., Brown, R., Smith, P. B., Abuhamdeh, S., Cendales Ayala, B., Garðarsdóttir, R. B., Torres, A., Camino, L., Bond, M. H., Nizharadze, G., Amponsah, B., Schweiger Gallo, I., Prieto Gil, P., Lorente Clemares, R., Campara, G., Espinosa, A., … Lay, S. (2018). Being

oneself through time: Bases of self-continuity across 55 cultures. *Self and Identity*, *17*(3), 276–293. https://doi.org/10.1080/15298868.2017.1330222
Bell, D., Gray, T., & Haggett, C. (2005). The 'social gap' in wind farm siting decisions: explanations and policy responses. *Environmental politics*, *14*, 460-477. https://doi.org/10.1080/09644010500175833
Bell, D., Gray, T., Haggett, C., & Swaffield, J. (2013). Re-visiting the 'social gap': public opinion and relations of power in the local politics of wind energy. *Environmental Politics*, *22*, 115-135. https://doi.org/10.1080/09644016.2013.755793
Bell, S. E., & York, R. (2010). Community Economic Identity: The Coal Industry and Ideology Construction in West Virginia. *Rural Sociology*, *75*(1), 111–143. https://doi.org/10.1111/j.1549-0831.2009.00004.x
Benighaus, C., & Bleicher, A. (2019). Neither risky technology nor renewable electricity: Contested frames in the development of geothermal energy in Germany. *Energy Research & Social Science*, *47*, 46-55. https://doi.org/10.1016/j.erss.2018.08.022
Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological bulletin*, *107*, 238. https://doi.org/10.1037/0033-2909.107.2.238
Betakova, V., Vojar, J., & Sklenicka, P. (2015). Wind turbines location: How many and how far? *Applied Energy*, *151*, 23–31. https://doi.org/10.1016/j.apenergy.2015.04.060
Bissing-Olson, M. J., Fielding, K. S., & Iyer, A. (2016). Experiences of pride, not guilt, predict pro-environmental behavior when pro-environmental descriptive norms are more positive. *Journal of Environmental Psychology*, *45*, 145-153. https://doi.org/10.1016/j.jenvp.2016.01.001
Blader, S. L., & Tyler, T. R. (2003). A four-component model of procedural justice: Defining the meaning of a "fair" process. *Personality and social psychology bulletin*, *29*(6), 747-758. https://doi.org/10.1177/0146167203029006007
Blaikie, N. (2010). *Designing Social Research*. Second Edition, Polity Press: Cambridge.
Blondé, J., Iacoviello, V., Lampropoulos, D., Vétois, M., & Falomir Pichastor, J. M. (2021). Legitimacy of Authority and Protest Actions in Response to Collective Disadvantages. *Social Justice Research*, *34*, 3, 255-284. https://doi.org/10.1007/s11211-021-00374-z
Bolderdijk, J. W., & Jans, L. (2021). Minority influence in climate change mitigation. *Current Opinion in Psychology*, *42*, 25-30. https://doi.org/10.1016/j.copsyc.2021.02.005
Bollen, K. A. (1989). *Structural equations with latent variables*. John Wiley & Sons.
Bonaiuto, M., Breakwell, G. M., & Cano, I. (1996). Identity processes and environmental threat: The effects of nationalism and local identity upon perception of beach pollution. *Journal of Community & Applied Social Psychology*, *6*, 157-175. https://doi.org/10.1002/(SICI)1099-1298(199608)6:3<157::AID-CASP367>3.0.CO;2-W
Boudet, H. S. (2019). Public perceptions of and responses to new energy technologies. *Nature Energy*, *4*(6), 446–455. https://doi.org/10.1038/s41560-019-0399-x
Bowen, G. A. (2008). Naturalistic inquiry and the saturation concept: a research note. *Qualitative research*, *8*, 137-152. https://doi.org/10.1177/1468794107085301
Boyle, G. J. (1991). Does item homogeneity indicate internal consistency or item redundancy in psychometric scales? *Personality and Individual Differences*, *12*(3), 291–294. https://doi.org/10.1016/0191-8869(91)90115-R

Brandt, H., Umbach, N., Kelava, A., & Bollen, K. A. (2020). Comparing estimators for latent interaction models under structural and distributional misspecifications. *Psychological Methods, 25*(3), 321–345. https://doi.org/10.1037/met0000231
Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, *3*, 77-101. DOI: 10.1191/1478088706qp063oa
Braun, V., & Clarke, V. (2013). *Successful Qualitative Research: A Practical Guide for Beginners*. SAGE.
Breakwell, G. M. (1986). Coping with Threatened Identities. London: Methuen.
Breakwell, G. M. (2001). Social representational constraints upon identity processes. In K. Deaux & G. Philogène (Eds.), *Representations of the social: Bridging theoretical traditions* (pp. 271–284). Blackwell Publishing.
Breakwell, G. M. (2015). *Coping with Threatened Identities*. Psychology Press.
Breakwell, G. M., Fino, E., & Jaspal, R. (2021). The Identity Resilience Index: Development and Validation in Two UK Samples. *Identity*, *0*(0), 1–17. https://doi.org/10.1080/15283488.2021.1957895
Breakwell, G.M. (1986). *Coping with Threatened Identities Methuen.* London and New York.
Brockner, J., & Wiesenfeld, B. (2005). How, When, and Why Does Outcome Favorability Interact with Procedural Fairness? In J. Greenberg & J. A. Colquitt (Eds.), *Handbook of organizational justice* (pp. 525–553). Lawrence Erlbaum Associates Publishers.
Brockner, J., & Wiesenfeld, B. M. (1996). An integrative framework for explaining reactions to decisions: Interactive effects of outcomes and procedures. *Psychological Bulletin*, 120, 189-208. https://doi.org/10.1037/0033-2909.120.2.189
Brown, R., & Cehajic, S. (2008). Dealing with the past and facing the future: Mediators of the effects of collective guilt and shame in Bosnia and Herzegovina. *European Journal of Social Psychology*, *38*, 669-684. https://doi.org/10.1002/ejsp.466
Brown, T. A. (2015). *Confirmatory Factor Analysis for Applied Research, Second Edition*. Guilford Publications.
Bryant, A., & Charmaz, K. (Eds.). (2007). The SAGE handbook of grounded theory. London: Sage.
Burningham, K. (2000). Using the language of NIMBY: a topic for research, not an activity for researchers. *Local environment*, *5*, 55-67. https://doi.org/10.1080/135498300113264
Byrne, B. M., & Stewart, S. M. (2006). TEACHER'S CORNER: The MACS Approach to Testing for Multigroup Invariance of a Second-Order Structure: A Walk Through the Process. *Structural Equation Modeling: A Multidisciplinary Journal*, *13*(2), 287–321. https://doi.org/10.1207/s15328007sem1302_7
Carminati, L. (2018). Generalizability in Qualitative Research: A Tale of Two Traditions. *Qualitative Health Research*, *28*(13), 2094–2101. https://doi.org/10.1177/1049732318788379
Caprara, G. V., Barbaranelli, C., Borgogni, L., & Steca, P. (2003). Efficacy beliefs as determinants of teachers' job satisfaction. *Journal of educational psychology*, *95*, 821-832. https://doi.org/10.1037/0022-0663.95.4.821
Carley, S., Evans, T. P., & Konisky, D. M. (2018). Adaptation, culture, and the energy transition in American coal country. *Energy Research & Social Science*, *37*, 133–139. https://doi.org/10.1016/j.erss.2017.10.007
Carr-Cornish, S., & Romanach, L. (2014). Differences in public perceptions of geothermal energy technology in Australia. *Energies*, *7*, 1555-1575. https://doi.org/10.3390/en7031555

Carrus, G., Passafaro, P., & Bonnes, M. (2008). Emotions, habits and rational choices in ecological behaviours: The case of recycling and use of public transportation. *Journal of environmental psychology*, *28*, 51-62. https://doi.org/10.1016/j.jenvp.2007.09.003
Cass, N., Walker, G., & Devine-Wright, P. (2010). Good Neighbours, Public Relations and Bribes: The Politics and Perceptions of Community Benefit Provision in Renewable Energy Development in the UK. *Journal of Environmental Policy & Planning*, *12*(3), 255–275. https://doi.org/10.1080/1523908X.2010.509558
Çetiner, Z. S., Ertekin, C., & Gültay, B. (2016). Initial assessment of public perception and acceptance of geothermal energy applications in Çanakkale, NW Turkey. *Energy Procedia*, *97*, 194-201. https://doi.org/10.1016/j.egypro.2016.10.052
Cha, J. M. (2020). A just transition for whom? Politics, contestation, and social identity in the disruption of coal in the Powder River Basin. *Energy Research & Social Science*, *69*, 101657. https://doi.org/10.1016/j.erss.2020.101657
Chavot, P., Heimlich, C., Masseran, A., Serrano, Y., Zoungrana, J., & Bodin, C. (2018). Social shaping of deep geothermal projects in Alsace: politics, stakeholder attitudes and local democracy. *Geothermal Energy*, *6*, 1-21. https://doi.org/10.1186/s40517-018-0111-6
Chen, F. F. (2007). Sensitivity of Goodness of Fit Indexes to Lack of Measurement Invariance. *Structural Equation Modeling: A Multidisciplinary Journal*, *14*(3), 464–504. https://doi.org/10.1080/10705510701301834
Chen, F. F., Sousa, K. H., & West, S. G. (2005). Teacher's Corner: Testing Measurement Invariance of Second-Order Factor Models. *Structural Equation Modeling: A Multidisciplinary Journal*, *12*(3), 471–492. https://doi.org/10.1207/s15328007sem1203_7
Chen, F. F., West, S. G., & Sousa, K. H. (2006). A Comparison of Bifactor and Second-Order Models of Quality of Life. *Multivariate Behavioral Research*, *41*(2), 189–225. https://doi.org/10.1207/s15327906mbr4102_5
Chen, M. F. (2015). Self-efficacy or collective efficacy within the cognitive theory of stress model: Which more effectively explains people's self-reported proenvironmental behavior?. *Journal of Environmental Psychology*, *42*, 66-75. https://doi.org/10.1016/j.jenvp.2015.02.002
Chen, S., Zhang, Q., Andrews-Speed, P., & Mclellan, B. (2020). Quantitative assessment of the environmental risks of geothermal energy: A review. *Journal of Environmental Management*, *276*, 111287. https://doi.org/10.1016/j.jenvman.2020.111287
Choi, S., & Hart, P. S. (2021). The influence of different efficacy constructs on energy conservation intentions and climate change policy support. *Journal of Environmental Psychology*, *75*, 101618. https://doi.org/10.1016/j.jenvp.2021.101618
Chou, S. Y., Nguyen, T., Ramser, C., & Chang, T. (2021). Impact of basic psychological needs on organizational justice and helping behavior: a self-determination perspective. *International Journal of Productivity and Performance Management*. https://doi.org/10.1108/IJPPM-08-2019-0372
Cialdini, R. B., & Goldstein, N. J. (2004). Social influence: Compliance and conformity. *Annual Review of Psychology*, *55*, 591-621. https://doi.org/10.1146/annurev.psych.55.090902.142015
Cialdini, R. B., & Jacobson, R. P. (2021). Influences of social norms on climate change-related behaviors. *Current Opinion in Behavioral Sciences*, *42*, 1-8. https://doi.org/10.1016/j.cobeha.2021.01.005

Cialdini, R. B., Kallgren, C. A., & Reno, R. R. (1991). A focus theory of normative conduct: A theoretical refinement and reevaluation of the role of norms in human behavior. In Zanna, M. P. (Ed.), *Advances in experimental social psychology* (Vol. 24, pp. 201-234). Academic Press. https://doi.org/10.1016/S0065-2601(08)60330-5

Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct: recycling the concept of norms to reduce littering in public places. *Journal of personality and social psychology*, *58*, 1015-1026. https://doi.org/10.1037/0022-3514.58.6.1015

Coelho, F., Pereira, M. C., Cruz, L., Simões, P., & Barata, E. (2017). Affect and the adoption of pro-environmental behaviour: A structural model. *Journal of Environmental Psychology*, *54*, 127-138. https://doi.org/10.1016/j.jenvp.2017.10.008

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences (2nd ed.).* Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

Colquitt, J. A. (2001). On the dimensionality of organizational justice: A construct validation of a measure. *Journal of Applied Psychology*, *86*, 386-400.

Colquitt, J. A., Noe, R. A., & Jackson, C. L. (2002). Justice in teams: Antecedents and consequences of procedural justice climate. *Personnel psychology*, *55*, 83-109. https://doi.org/10.1111/j.1744-6570.2002.tb00104.x

Comrey, A. L., & Lee, H. B. (2013). *A First Course in Factor Analysis* (2nd ed.). Psychology Press. https://doi.org/10.4324/9781315827506

Contzen, N., Handreke, A. V., Perlaviciute, G., & Steg, L. (2021). Emotions towards a mandatory adoption of renewable energy innovations: The role of psychological reactance and egoistic and biospheric values. *Energy Research & Social Science*, *80*, 102232. https://doi.org/10.1016/j.erss.2021.102232

Cotton, M., & Devine-Wright, P. (2011). Discourses of energy infrastructure development: a Q-method study of electricity transmission line siting in the UK. *Environment and planning A*, *43*, 942-960. https://doi.org/10.1068/a43401

Cousse, J., Trutnevyte, E., & Hahnel, U. J. J. (2021). Tell me how you feel about geothermal energy: Affect as a revealing factor of the role of seismic risk on public acceptance. *Energy Policy*, *158*, 112547. https://doi.org/10.1016/j.enpol.2021.112547

Cowell, R., Bristow, G., & Munday, M. (2011). Acceptance, acceptability and environmental justice: The role of community benefits in wind energy development. *Journal of Environmental Planning and Management*, *54*(4), 539–557. https://doi.org/10.1080/09640568.2010.521047

Cuppen, E., Ejderyan, O., Pesch, U., Spruit, S., van de Grift, E., Correljé, A., & Taebi, B. (2020). When controversies cascade: Analysing the dynamics of public engagement and conflict in the Netherlands and Switzerland through "controversy spillover". *Energy Research & Social Science*, *68*, 101593. https://doi.org/10.1016/j.erss.2020.101593

Curtius, H. C., Hille, S. L., Berger, C., Hahnel, U. J. J., & Wüstenhagen, R. (2018). Shotgun or snowball approach? Accelerating the diffusion of rooftop solar photovoltaics through peer effects and social norms. *Energy policy*, *118*, 596-602. https://doi.org/10.1016/j.enpol.2018.04.005

De Cremer, D., van Dijke, M., & Mayer, D. M. (2010). Cooperating when "you" and "I" are treated fairly: The moderating role of leader prototypicality. *Journal of Applied Psychology*, *95*(6), 1121–1133. https://doi.org/10.1037/a0020419

De Dominicis, S., Fornara, F., Ganucci Cancellieri, U., Twigger-Ross, C., & Bonaiuto, M. (2015). We are at risk, and so what? Place attachment, environmental risk

perceptions and preventive coping behaviours. *Journal of Environmental Psychology*, *43*, 66–78. https://doi.org/10.1016/j.jenvp.2015.05.010
de Groot, J. I. M., Schweiger, E., & Schubert, I. (2020). Social Influence, Risk and Benefit Perceptions, and the Acceptability of Risky Energy Technologies: An Explanatory Model of Nuclear Power Versus Shale Gas. *Risk Analysis*, *40*(6), 1226–1243. https://doi.org/10.1111/risa.13457
Debbané, A. M., & Keil, R. (2004). Multiple disconnections: environmental justice and urban water in Canada and South Africa. *Space and Polity*, *8*, 209-225. https://doi.org/10.1080/1356257042000273968
Deci, E. L., & Ryan, R. M. (2008). Facilitating optimal motivation and psychological well-being across life's domains. *Canadian Psychology/Psychologie canadienne, 49*(1), 14–23. https://doi.org/10.1037/0708-5591.49.1.14
Deci, E. L., & Ryan, R. M. (1985). The general causality orientations scale: Self-determination in personality. *Journal of research in personality*, *19*, 109-134. https://doi.org/10.1016/0092-6566(85)90023-6
Deci, E. L., & Ryan, R. M. (2000). The" what" and" why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological inquiry*, *11*, 227-268. https://doi.org/10.1207/S15327965PLI1104_01
Della Bosca, H., & Gillespie, J. (2018). The coal story: Generational coal mining communities and strategies of energy transition in Australia. *Energy Policy*, *120*, 734–740. https://doi.org/10.1016/j.enpol.2018.04.032
Department for Business, Energy & Industrial Strategy (2021a). *Transitioning to a net zero energy system: Smart Systems and Flexibility Plan 2021.* This document is available at: https://www.gov.uk/government/publications/transitioning-to-a-net-zero-energy-system-smart-systems-and-flexibility-plan-2021
Department for Business, Energy & Industrial Strategy (2021b). *Energy Trends: December 2021.* This document is available at: https://www.gov.uk/government/statistics/energy-trends-december-2021
Deutsch, M., & Gerard, H. B. (1955). A study of normative and informational social influences upon individual judgment. *The journal of abnormal and social psychology*, *5*, 629-636. https://doi.org/10.1037/h0046408
DeVellis, R. F., & Thorpe, C. T. (2021). *Scale Development: Theory and Applications*. SAGE Publications.
Devine-Wright, P. (2005). Beyond NIMBYism: towards an integrated framework for understanding public perceptions of wind energy. *Wind Energy: An International Journal for Progress and Applications in Wind Power Conversion Technology*, *8*, 125-139. https://doi.org/10.1002/we.124
Devine-Wright, P. (2009). Rethinking NIMBYism: The role of place attachment and place identity in explaining place-protective action. *Journal of Community & Applied Social Psychology*, *19*(6), 426–441. https://doi.org/10.1002/casp.1004
Devine-Wright, P. (2011). Enhancing local distinctiveness fosters public acceptance of tidal energy: A UK case study. *Energy Policy*, *39*(1), 83–93. https://doi.org/10.1016/j.enpol.2010.09.012
Devine-Wright, P., & Batel, S. (2017). My neighbourhood, my country or my planet? The influence of multiple place attachments and climate change concern on social acceptance of energy infrastructure. *Global Environmental Change*, *47*, 110–120. https://doi.org/10.1016/j.gloenvcha.2017.08.003
Devine-Wright, P., & Howes, Y. (2010). Disruption to place attachment and the protection of restorative environments: A wind energy case study. *Journal of environmental psychology*, *30*, 271-280. https://doi.org/10.1016/j.jenvp.2010.01.008

Devine-Wright, P., & Sherry-Brennan, F. (2019). Where do you draw the line? Legitimacy and fairness in constructing community benefit fund boundaries for energy infrastructure projects. *Energy Research & Social Science*, *54*, 166-175. https://doi.org/10.1016/j.erss.2019.04.002

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

Diekmann, K. A., Sondak, H., & Barsness, Z. I. (2007). Does fairness matter more to some than to others? The moderating role of workplace status on the relationship between procedural fairness perceptions and job satisfaction. *Social Justice Research*, *20*, 161-180. https://doi.org/10.1007/s11211-007-0036-x

Diógenes, J. R. F., Claro, J., Rodrigues, J. C., & Loureiro, M. V. (2020). Barriers to onshore wind energy implementation: A systematic review. *Energy Research & Social Science*, *60*, 101337. https://doi.org/10.1016/j.erss.2019.101337

DiPippo, R. *Geothermal Power Plants: Principles, Applications, Case Studies and Environmental Impact* (2012). Waltham, MA. USA: Butterworth-Heinemann, Elsevier Ltd.

Distinto, M., & Priola, V. (2021). On refugees, researchers, viruses, data, and how they affect each other. A post-qualitative approach. *TPM Testing, Psychometric, Methodology in Applied Psychology*, 28, 83–97. https://doi.org/10.4473/TPM28.1.6

Dittmar, H. (1992). Perceived material wealth and first impressions. *British Journal of Social Psychology*, *31*, 379-391. https://doi.org/10.1111/j.2044-8309.1992.tb00980.x

Doosje, B., Branscombe, N. R., Spears, R., & Manstead, A. S. (1998). Guilty by association: When one's group has a negative history. *Journal of personality and social psychology*, *75*, 872. https://doi.org/10.1037/0022-3514.75.4.872

Douglas, M., & Wildavsky, A. (1982). *Risk and culture: An essay on the selection of technological and environmental dangers*. Berkeley, CA: University of California Press.

Dowd, A. M., Boughen, N., Ashworth, P., & Carr-Cornish, S. (2011). Geothermal technology in Australia: Investigating social acceptance. *Energy policy*, *39*, 6301-6307. https://doi.org/10.1016/j.enpol.2011.07.029

Dryhurst, S., Schneider, C. R., Kerr, J., Freeman, A. L., Recchia, G., Van Der Bles, A. M., Spiegelhalter, D., & Van Der Linden, S. (2020). Risk perceptions of COVID-19 around the world. *Journal of Risk Research*, *23*, 994-1006. https://doi.org/10.1080/13669877.2020.1758193

Dubois, A., & Gadde, L. E. (2002). Systematic combining: an abductive approach to case research. *Journal of business research*, *55*, 553-560. https://doi.org/10.1016/S0148-2963(00)00195-8

Dubois, A., & Gadde, L. E. (2014). "Systematic combining"—A decade later. *Journal of Business Research*, *67*(6), 1277-1284. https://doi.org/10.1016/j.jbusres.2013.03.036

Dubois, A., Holzer, S., Xexakis, G., Cousse, J., & Trutnevyte, E. (2019). Informed Citizen Panels on the Swiss Electricity Mix 2035: Longer-Term Evolution of Citizen Preferences and Affect in Two Cities. *Energies*, *12*(22), 4231. https://doi.org/10.3390/en12224231

Dunlap, R. E. V. L., Liere, K. V., Mertig, A., & Jones, R. E. (2000). Measuring endorsement of the new ecological paradigm: A revised NEP scale. *Journal of social issues*, *56*, 425-442. DOI: 10.3200/JOEE.40.1.3-18

Dwyer, P. C., Maki, A., & Rothman, A. J. (2015). Promoting energy conservation behavior in public settings: The influence of social norms and personal responsibility. *Journal of Environmental Psychology*, *41*, 30-34. https://doi.org/10.1016/j.jenvp.2014.11.002

Eid, M., Geiser, C., Koch, T., & Heene, M. (2017). Anomalous results in G-factor models: Explanations and alternatives. *Psychological Methods*, *22*(3), 541–562. https://doi.org/10.1037/met0000083

Eid, M., Krumm, S., Koch, T., & Schulze, J. (2018). Bifactor Models for Predicting Criteria by General and Specific Factors: Problems of Nonidentifiability and Alternative Solutions. *Journal of Intelligence*, *6*(3), 42. https://doi.org/10.3390/jintelligence6030042

Ellemers, N. (1993). The influence of socio-structural variables on identity management strategies. *European review of social psychology*, *4*, 27-57. https://doi.org/10.1080/14792779343000013

Ellemers, N., Wilke, H., & van Knippenberg, A. (1993). Effects of the legitimacy of low group or individual status on individual and collective status-enhancement strategies. *Journal of Personality and Social Psychology, 64*(5), 766–778. https://doi.org/10.1037/0022-3514.64.5.766

Ellemers, N., Spears, R., & Doosje, B. (2002). Self and Social Identity. *Annual Review of Psychology, 53*(1), 161–186. https://doi.org/10.1146/annurev.psych.53.100901.135228

Ellemers, N., Kortekaas, P., & Ouwerkerk, J. W. (1999). Self-categorisation, commitment to the group and group self-esteem as related but distinct aspects of social identity. *European Journal of Social Psychology*, *29*(2–3), 371–389. https://doi.org/10.1002/(SICI)1099-0992(199903/05)29:2/3<371::AID-EJSP932>3.0.CO;2-U

Erbil, A. Ö. (2011). Social acceptance of the clean energy concept: Exploring the clean energy understanding of Istanbul residents. *Renewable and Sustainable Energy Reviews*, *15*, 4498-4506. https://doi.org/10.1016/j.rser.2011.07.101

Ferguson M.A., McDonald R.I., Branscombe N.R. (2016) Global Climate Change: A Social Identity Perspective on Informational and Structural Interventions. In McKeown S., Haji R., Ferguson N. (Eds). *Understanding Peace and Conflict Through Social Identity Theory*. Peace Psychology Book Series. Springer, Cham. https://doi.org/10.1007/978-3-319-29869-6_10

Ferguson, M. A., & Branscombe, N. R. (2010). Collective guilt mediates the effect of beliefs about global warming on willingness to engage in mitigation behavior. *Journal of Environmental Psychology*, *30*, 135-142. https://doi.org/10.1016/j.jenvp.2009.11.010

Ferguson, M.A., McDonald, R.I., Branscombe, N.R. (2016). Global climate change: A social identity perspective on informational and structural interventions. In: N. Ferguson, R. Jaji, S. McKeown (Eds), *Peace psychology book series. Understanding peace and conflict through social identity theory: Contemporary global perspectives*, Springer, Switzerland (2016), pp. 145-164. 10.1007/978-3-319-29869-6_10

Fielding, K. S., & Hornsey, M. J. (2016). A Social Identity Analysis of Climate Change and Environmental Attitudes and Behaviors: Insights and Opportunities. *Frontiers in Psychology*, *7*. https://www.frontiersin.org/article/10.3389/fpsyg.2016.00121

Flake, J. K., Pek, J., & Hehman, E. (2017). Construct Validation in Social and Personality Research: Current Practice and Recommendations. *Social Psychological and Personality Science*, *8*(4), 370–378. https://doi.org/10.1177/1948550617693063

Fornara, F., Carrus, G., Passafaro, P., & Bonnes, M. (2011). Distinguishing the sources of normative influence on proenvironmental behaviors: The role of local norms in household waste recycling. *Group Processes & Intergroup Relations*, *14*, 623-635. https://doi.org/10.1177/1368430211408149
Fornell, C., & Larcker, D. F. (1981). Structural Equation Models with Unobservable Variables and Measurement Error: Algebra and Statistics. *Journal of Marketing Research*, *18*(3), 382–388. https://doi.org/10.1177/002224378101800313
Frey, B. S., & Oberholzer-Gee, F. (1997). The cost of price incentives: An empirical analysis of motivation crowding-out. *The American economic review*, *87*, 746-755. https://www.jstor.org/stable/2951373
Fritsche, I., Barth, M., Jugert, P., Masson, T., & Reese, G. (2018). A Social Identity Model of Pro-Environmental Action (SIMPEA). *Psychological Review*, *125*(2), 245–269. https://doi.org/10.1037/rev0000090
Folger, R., & Martin, C. (1986). Relative deprivation and referent cognitions: Distributive and procedural justice effects. *Journal of Experimental Social Psychology*, *22*(6), 531–546. https://doi.org/10.1016/0022-1031(86)90049-1
Furlong, C., & Vignoles, V. L. (2021). Social identification in collective climate activism: Predicting participation in the environmental movement, extinction rebellion. *Identity*, *21*, 1, 20-35. https://doi.org/10.1080/15283488.2020.1856664
Gabo-Ratio, J. A., & Fujimitsu, Y. (2020). Exploring public engagement and social acceptability of geothermal energy in the Philippines: A case study on the Makiling-Banahaw Geothermal Complex. *Geothermics*, *85*, 101774. https://doi.org/10.1016/j.geothermics.2019.101774
Gaede, J., Jones, C. R., Ganowski, S., & Rowlands, I. H. (2020). Understanding lay-public perceptions of energy storage technologies: Preliminary results of a questionnaire conducted in Canada. *Energy Reports*, *6*, 249-258. https://doi.org/10.1016/j.egyr.2020.03.031
Gelfand, M. J., & Harrington, J. R. (2015). The motivational force of descriptive norms: For whom and when are descriptive norms most predictive of behavior?. *Journal of Cross-Cultural Psychology*, *46*, 1273-1278. https://doi.org/10.1177/0022022115600796
Goldstein, N. J., Cialdini, R. B., & Griskevicius, V. (2008). A room with a viewpoint: Using social norms to motivate environmental conservation in hotels. *Journal of consumer Research*, *35*, 472-482. https://doi.org/10.1086/586910
Grant, P. R., Abrams, D., Robertson, D. W., & Garay, J. (2015). Predicting protests by disadvantaged skilled immigrants: A test of an integrated social identity, relative deprivation, collective efficacy (SIRDE) model. *Social Justice Research*, *28*, 76-101. https://doi.org/10.1007/s11211-014-0229-z
Griffin, R. J., Dunwoody, S., & Neuwirth, K. (1999). Proposed Model of the Relationship of Risk Information Seeking and Processing to the Development of Preventive Behaviors. *Environmental Research*, *80*(2), S230–S245. https://doi.org/10.1006/enrs.1998.3940
Gross, C. (2007). Community perspectives of wind energy in Australia: The application of a justice and community fairness framework to increase social acceptance. *Energy policy*, *35*, 2727-2736. https://doi.org/10.1016/j.enpol.2006.12.013
Gross, M. (2013). Old science fiction, new inspiration: Communicating unknowns in the utilization of geothermal energy. *Science Communication*, *35*, 810-818. https://doi.org/10.1177/1075547012469184
Hansla, A., Gamble, A., Juliusson, A., & Gärling, T. (2008). The relationships between awareness of consequences, environmental concern, and value

orientations. *Journal of environmental psychology*, *28*, 1-9. https://doi.org/10.1016/j.jenvp.2007.08.004
Harth, N. S. (2021). Affect, (group-based) emotions, and climate change action. *Current Opinion in Psychology*, *42*, 140–144. https://doi.org/10.1016/j.copsyc.2021.07.018
Hart, P. S., Stedman, R. C., & McComas, K. A. (2015). How the physical proximity of climate mitigation projects influences the relationship between affect and public support. *Journal of Environmental Psychology*, *43*, 196–202. https://doi.org/10.1016/j.jenvp.2015.07.003
Harth, N. S., Leach, C. W., & Kessler, T. (2013). Guilt, anger, and pride about in-group environmental behaviour: Different emotions predict distinct intentions. *Journal of Environmental Psychology, 34*, 18-26. https://doi.org/10.1016/j.jenvp.2012.12.005
Hässler, T., Ullrich, J., Sebben, S., Shnabel, N., Bernardino, M., Valdenegro, D., Van Laar, C., González, R., Visintin, E. P., Tropp, L. R., Ditlmann, R. K., Abrams, D., Aydin, A. L., Pereira, A., Selvanathan, H. P., von Zimmermann, J., Lantos, N. A., Sainz, M., Glenz, A., . . . Pistella, J. (2021). Need satisfaction in intergroup contact: A multinational study of pathways toward social change. *Journal of Personality and Social Psychology.* Advance online publication. https://doi.org/10.1037/pspi0000365
Hayes, T. (2021). R-squared change in structural equation models with latent variables and missing data. *Behavior Research Methods*, *53*(5), 2127–2157. https://doi.org/10.3758/s13428-020-01532-y
Hennink, M. M., Kaiser, B. N., & Marconi, V. C. (2017). Code saturation versus meaning saturation: how many interviews are enough? *Qualitative health research*, *27*, 591-608. https://doi.org/10.1177/1049732316665344
Hidalgo, M. C., & Hernandez, B. (2001). Place attachment: Conceptual and empirical questions. *Journal of environmental psychology*, *21*, 273-281. https://doi.org/10.1006/jevp.2001.0221
HM Treasury (2021). *Net Zero Review: Analysis exploring the key issues.* This document is available at: https://www.gov.uk/government/publications/net-zero-review-final-report
Hobman, E. V., & Ashworth, P. (2013). Public support for energy sources and related technologies: the impact of simple information provision. *Energy Policy*, *63*, 862-869. https://doi.org/10.1016/j.enpol.2013.09.011
Hogg, M. A. (2000). Subjective Uncertainty Reduction through Self-categorization: A Motivational Theory of Social Identity Processes. *European Review of Social Psychology*, *11*(1), 223–255. https://doi.org/10.1080/14792772043000040
Hogg, M. A. (2007). Uncertainty–identity theory. *Advances in experimental social psychology*, *39*, 69-126.
Hogg, M. A. (2020). Social identity theory. In P. J. Burke (Ed.), *Contemporary Social Psychological Theories* (pp. 112-138). Redwood City: Stanford University Press. https://doi.org/10.1515/9781503605626
Hogg, M. A., & Abrams, D. (1988). *Social identifications: A social psychology of intergroup relations and group processes.* Taylor & Frances/Routledge.
Hogg, M. A., & Smith, J. R. (2007). Attitudes in social context: A social identity perspective. *European Review of Social Psychology*, *18*, 89-131. https://doi.org/10.1080/10463280701592070
Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Huang, R. (2016). RQDA: R-based Qualitative Data Analysis. R package version 0.2-8. URL http://rqda.r-forge.r-project.org/

Huber, P. J. (1967). The behavior of maximum likelihood estimates under nonstandard conditions. In *Proceedings of the fifth berkeley symposium on mathematical statistics and probability*. Berkeley, CA: University of California Press.

Huijts, N. M. (2018). The emotional dimensions of energy projects: Anger, fear, joy and pride about the first hydrogen fuel station in the Netherlands. *Energy Research & Social Science*, *44*, 138-145. https://doi.org/10.1016/j.erss.2018.04.042

Huijts, N. M. A., Molin, E. J. E., & Steg, L. (2012). Psychological factors influencing sustainable energy technology acceptance: A review-based comprehensive framework. *Renewable and Sustainable Energy Reviews*, *16*(1), 525–531. https://doi.org/10.1016/j.rser.2011.08.018

Huijts, N. M., Molin, E. J., & van Wee, B. (2014). Hydrogen fuel station acceptance: A structural equation model based on the technology acceptance framework. *Journal of Environmental Psychology*, *38*, 153-166. https://doi.org/10.1016/j.jenvp.2014.01.008

Hussey, I., & Hughes, S. (2020). Hidden Invalidity Among 15 Commonly Used Measures in Social and Personality Psychology. *Advances in Methods and Practices in Psychological Science*, *3*(2), 166–184. https://doi.org/10.1177/2515245919882903

Idahosa, L. O., & Akotey, J. O. (2021). A social constructionist approach to managing HVAC energy consumption using social norms–A randomised field experiment. *Energy Policy*, *154*, 112293. https://doi.org/10.1016/j.enpol.2021.112293

IPCC (2014). "Climate change 2014: synthesis report," in Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, eds. R. K. Pachauri and L. A. Meyer (Geneva: IPCC), 151.

Jans, L. (2021). Changing environmental behaviour from the bottom up: The formation of pro-environmental social identities. *Journal of Environmental Psychology*, *73*, 101531. https://doi.org/10.1016/j.jenvp.2020.101531

Jans, L., & Fielding, K. (2018). The Role of Group Processes in Environmental Issues, Attitudes, and Behaviours. In *Environmental Psychology* (pp. 228–237). John Wiley & Sons, Ltd. https://doi.org/10.1002/9781119241072.ch23

Jaspal, R., & Breakwell, G. M. (2014). *Identity Process Theory: Identity, Social Action and Social Change*. Cambridge University Press.

Jeanne, P., Rutqvist, J., Rinaldi, A. P., Dobson, P. F., Walters, M., Hartline, C., & Garcia, J. (2015). Seismic and aseismic deformations and impact on reservoir permeability: The case of EGS stimulation at The Geysers, California, USA. *Journal of Geophysical Research: Solid Earth*, *120*(11), 7863–7882. https://doi.org/10.1002/2015JB012142

Jetten, J., Spears, R., & Manstead, A. S. R. (1997). Distinctiveness threat and prototypicality: Combined effects on intergroup discrimination and collective self-esteem. *European Journal of Social Psychology*, *27*(6), 635–657. https://doi.org/10.1002/(SICI)1099-0992(199711/12)27:6<635::AID-EJSP835>3.0.CO;2-#

Jetten, J., Spears, R., & Postmes, T. (2004). Intergroup Distinctiveness and Differentiation: A Meta-Analytic Integration. *Journal of Personality and Social Psychology, 86*(6), 862–879. https://doi.org/10.1037/0022-3514.86.6.862

Johansson, M., & Laike, T. (2007). Intention to respond to local wind turbines: The role of attitudes and visual perception. *Wind Energy*, *10*(5), 435–451. https://doi.org/10.1002/we.232

Jonas, E., McGregor, I., Klackl, J., Agroskin, D., Fritsche, I., Holbrook, C., Nash, K., Proulx, T., Quirin, M. (2014). Threat and defense: From anxiety to approach. In J. M. Olson & M. P. Zanna (Eds.), *Advances in experimental social psychology* (pp. 219-286). Amsterdam, The Netherlands: Elsevier Academic Press. http://dx.doi.org/10.1016/B978-0-12-800052-6.00004-4

Jones, C. R., & Eiser, J. R. (2010). Understanding 'local' opposition to wind development in the UK: How big is a backyard?. *Energy Policy*, *38*, 3106-3117. https://doi.org/10.1016/j.enpol.2010.01.051

Jørgensen, M. L. (2020). Low-carbon but corrupt? Bribery, inappropriateness and unfairness concerns in Danish energy policy. *Energy Research & Social Science*, *70*, 101663. https://doi.org/10.1016/j.erss.2020.101663

Jørgensen, M. L., Anker, H. T., & Lassen, J. (2020). Distributive fairness and local acceptance of wind turbines: The role of compensation schemes. *Energy Policy*, *138*, 111294. https://doi.org/10.1016/j.enpol.2020.111294

Jorgensen, T. D., Kite, B. A., Chen, P.-Y., & Short, S. D. (2018). Permutation randomization methods for testing measurement equivalence and detecting differential item functioning in multiple-group confirmatory factor analysis. *Psychological Methods*, *23*(4), 708–728. https://doi.org/10.1037/met0000152

Jorgensen, T. D., Pornprasertmanit, S., Schoemann, A. M., & Rosseel, Y. (2021). semTools: Useful tools for structural equation modeling. R package version 0.5-5.912. Retrieved from https://CRAN.R-project.org/package=semTools

Jugert, P., Greenaway, K. H., Barth, M., Büchner, R., Eisentraut, S., & Fritsche, I. (2016). Collective efficacy increases pro-environmental intentions through increasing self-efficacy. *Journal of Environmental Psychology*, *48*, 12-23. https://doi.org/10.1016/j.jenvp.2016.08.003

Kachanoff, F. J., Taylor, D. M., Caouette, J., Khullar, T. H., & Wohl, M. J. A. (2019). The chains on all my people are the chains on me: Restrictions to collective autonomy undermine the personal autonomy and psychological well-being of group members. *Journal of Personality and Social Psychology, 116*, 141–165. https://doi.org/10.1037/pspp0000177

Kaiser, F. G., Henn, L., & Marschke, B. (2020). Financial rewards for long-term environmental protection. *Journal of Environmental Psychology*, *68*, 101411. https://doi.org/10.1016/j.jenvp.2020.101411

Kalkbrenner, B. J., & Roosen, J. (2016). Citizens' willingness to participate in local renewable energy projects: The role of community and trust in Germany. *Energy Research & Social Science*, *13*, 60-70. https://doi.org/10.1016/j.erss.2015.12.006

Karimi, F., & Toikka, A. (2014). The Relation between Cultural Structures and Risk Perception: How does Social Acceptance of Carbon Capture and Storage Emerge? *Energy Procedia*, *63*, 7087–7095. https://doi.org/10.1016/j.egypro.2014.11.743

Karimi, F., & Toikka, A. (2018). General public reactions to carbon capture and storage: Does culture matter? *International Journal of Greenhouse Gas Control*, *70*, 193–201. https://doi.org/10.1016/j.ijggc.2018.01.012

Karimi, F., Toikka, A., & Hukkinen, J. I. (2016). Comparative socio-cultural analysis of risk perception of Carbon Capture and Storage in the European Union. *Energy Research & Social Science*, *21*, 114–122. https://doi.org/10.1016/j.erss.2016.06.024

Karytsas S., Polyzou O., Karytsas C. (2019). Social Aspects of Geothermal Energy in Greece. In Manzella A., Allansdottir A., Pellizone A., (Eds), *Geothermal Energy and Society*. Cham: Springer, p. 123–44. https://doi.org/10.1007/978-3-319-78286-7_9

Karytsas, S., & Theodoropoulou, H. (2014). Socioeconomic and demographic factors that influence publics' awareness on the different forms of renewable energy

sources. *Renewable Energy*, *71*, 480-485. https://doi.org/10.1016/j.renene.2014.05.059
Kessler, T., & Mummendey, A. (2002). Sequential or parallel processes? A longitudinal field study concerning determinants of identity-management strategies. *Journal of Personality and Social Psychology*, *82*(1), 75–88. https://doi.org/10.1037//0022-3514.82.1.75
Klaus, G., Ernst, A., & Oswald, L. (2020). Psychological factors influencing laypersons' acceptance of climate engineering, climate change mitigation and business as usual scenarios. *Technology in Society*, *60*, 101222. https://doi.org/10.1016/j.techsoc.2019.101222
Kline, R. B. (2015). *Principles and practice of structural equation modelling* (4th ed.). New York, NY: The Guildford Press.
Knoblauch, T. A. K., Stauffacher, M., & Trutnevyte, E. (2018). Communicating Low-Probability High-Consequence Risk, Uncertainty and Expert Confidence: Induced Seismicity of Deep Geothermal Energy and Shale Gas. *Risk Analysis*, *38*(4), 694–709. https://doi.org/10.1111/risa.12872
Knoblauch, T. A., Trutnevyte, E., & Stauffacher, M. (2019). Siting deep geothermal energy: Acceptance of various risk and benefit scenarios in a Swiss-German cross-national study. *Energy Policy*, *128*, 807-816. https://doi.org/10.1016/j.enpol.2019.01.019
Korcaj, L., Hahnel, U. J., & Spada, H. (2015). Intentions to adopt photovoltaic systems depend on homeowners' expected personal gains and behavior of peers. *Renewable Energy*, *75*, 407-415. https://doi.org/10.1016/j.renene.2014.10.007
Kubota, H., Hondo, H., Hienuki, S., & Kaieda, H. (2013). Determining barriers to developing geothermal power generation in Japan: societal acceptance by stakeholders involved in hot springs. *Energy Policy*, *61*, 1079-1087. https://doi.org/10.1016/j.enpol.2013.05.084
Kunze, C., & Hertel, M. (2017). Contested deep geothermal energy in Germany—The emergence of an environmental protest movement. *Energy research & social science*, *27*, 174-180. https://doi.org/10.1016/j.erss.2016.11.007
Lai, A. E., Tirotto, F. A., Pagliaro, S., & Fornara, F. (2020). Two sides of the same coin: Environmental and health concern pathways toward meat consumption. *Frontiers in Psychology*, *11*. 10.3389/fpsyg.2020.578582
Lai, K. (2018). Estimating standardized SEM parameters given nonnormal data and incorrect model: Methods and comparison. *Structural Equation Modeling: A Multidisciplinary Journal*, *25*(4), 600-620. https://doi.org/10.1080/10705511.2017.1392248
Lai, K. (2019). More robust standard error and confidence interval for sem parameters given incorrect model and nonnormal data. *Structural Equation Modeling: A Multidisciplinary Journal*, *26*, 260–279. https://doi.org/10.1080/10705511.2018.1505522
Landmann, H., & Rohmann, A. (2020). Being moved by protest: Collective efficacy beliefs and injustice appraisals enhance collective action intentions for forest protection via positive and negative emotions. *Journal of Environmental Psychology*, *71*, 101491. https://doi.org/10.1016/j.jenvp.2020.101491
Langer, K., Decker, T., Roosen, J., & Menrad, K. (2018). Factors influencing citizens' acceptance and non acceptance of wind energy in Germany. *Journal of Cleaner Production*, *175*, 133-144. https://doi.org/10.1016/j.jclepro.2017.11.221
Lavergne, K. J., Sharp, E. C., Pelletier, L. G., & Holtby, A. (2010). The role of perceived government style in the facilitation of self-determined and non self-determined motivation for pro-environmental behaviour. *Journal of*

Environmental Psychology, *30*, 169-177. https://doi.org/10.1016/j.jenvp.2009.11.002
Lee, S.-Y., Song, X.-Y., & Tang, N.-S. (2007). Bayesian Methods for Analyzing Structural Equation Models With Covariates, Interaction, and Quadratic Latent Variables. *Structural Equation Modeling: A Multidisciplinary Journal*, *14*(3), 404–434. https://doi.org/10.1080/10705510701301511
Lee, S.-Y., & Song, X.-Y. (2012). *Basic and Advanced Bayesian Structural Equation Modeling: With Applications in the Medical and Behavioral Sciences*. John Wiley & Sons.
Lei, M., & Lomax, R. G. (2005). The Effect of Varying Degrees of Nonnormality in Structural Equation Modeling. *Structural Equation Modeling: A Multidisciplinary Journal*, *12*(1), 1–27. https://doi.org/10.1207/s15328007sem1201_1
Leiserowitz, A. (2006). Climate change risk perception and policy preferences: The role of affect, imagery, and values. *Climatic change*, *77*, 45-72. https://doi.org/10.1007/s10584-006-9059-9
Leung, K., Tong, K.-K., & Lind, E. A. (2007). Realpolitik versus fair process: Moderating effects of group identification on acceptance of political decisions. *Journal of Personality and Social Psychology, 92*(3), 476–489. https://doi.org/10.1037/0022-3514.92.3.476
Levenda, A. M., Behrsin, I., & Disano, F. (2021). Renewable energy for whom? A global systematic review of the environmental justice implications of renewable energy technologies. *Energy Research & Social Science*, *71*, 101837. https://doi.org/10.1016/j.erss.2020.101837
Lewin, P. G. (2019). “Coal is Not Just a Job, It’s a Way of Life”: The Cultural Politics of Coal Production in Central Appalachia. *Social Problems*, *66*(1), 51–68. https://doi.org/10.1093/socpro/spx030
Li, K., Bian, H., Liu, C., Zhang, D., & Yang, Y. (2015). Comparison of geothermal with solar and wind power generation systems. *Renewable and Sustainable Energy Reviews*, *42*, 1464-1474. https://doi.org/10.1016/j.rser.2014.10.049
Liebe, U., & Dobers, G. M. (2019). Decomposing public support for energy policy: what drives acceptance of and intentions to protest against renewable energy expansion in Germany?. *Energy Research & Social Science*, *47*, 247-260. https://doi.org/10.1016/j.erss.2018.09.004
Liebe, U., Bartczak, A., & Meyerhoff, J. (2017). A turbine is not only a turbine: The role of social context and fairness characteristics for the local acceptance of wind power. *Energy Policy*, *107*, 300-308. https://doi.org/10.1016/j.enpol.2017.04.043
Lima, M. L. (2004). On the influence of risk perception on mental health: Living near an incinerator. *Journal of Environmental Psychology*, *24*(1), 71–84. https://doi.org/10.1016/S0272-4944(03)00026-4
Lienhoop, N. (2018). Acceptance of wind energy and the role of financial and procedural participation: An investigation with focus groups and choice experiments. *Energy Policy*, *118*, 97-105. https://doi.org/10.1016/j.enpol.2018.03.063
Lin, G. C., Wen, Z., Marsh, H. W., & Lin, H. S. (2010). Structural equation models of latent interactions: Clarification of orthogonalizing and double-mean-centering strategies. *Structural Equation Modeling*, *17*, 374-391. https://doi.org/10.1080/10705 511.2010.488999
Lin, L.-C., Huang, P.-H., & Weng, L.-J. (2017). Selecting Path Models in SEM: A Comparison of Model Selection Criteria. *Structural Equation Modeling: A Multidisciplinary Journal*, *24*(6), 855–869. https://doi.org/10.1080/10705511.2017.1363652

Lind, E. A., & Tyler, T. R. (1988). *The social psychology of procedural justice*. New York: Plenum Press.

Lind, E. A., Kanfer, R., & Earley, P. C. (1990). Voice, control, and procedural justice: Instrumental and noninstrumental concerns in fairness judgments. *Journal of Personality and Social Psychology, 59*, 952–959. https://doi.org/10.1037/0022-3514.59.5.952

Liobikienė, G., Dagiliūtė, R., & Juknys, R. (2021). The determinants of renewable energy usage intentions using theory of planned behaviour approach. *Renewable Energy*, *170*, 587-594. https://doi.org/10.1016/j.renene.2021.01.152

Lipscomb, M. (2012). Abductive reasoning and qualitative research. *Nursing Philosophy*, *13*(4), 244–256. https://doi.org/10.1111/j.1466-769X.2011.00532.x

Liu, L., Bouman, T., Perlaviciute, G., & Steg, L. (2020a). Effects of competence-and integrity-based trust on public acceptability of renewable energy projects in China and the Netherlands. *Journal of Environmental Psychology*, *67*, 101390.

Liu, L., Bouman, T., Perlaviciute, G., & Steg, L. (2020b). Public participation in decision making, perceived procedural fairness and public acceptability of renewable energy projects. *Energy and Climate Change*, *1*, 100013. https://doi.org/10.1016/j.egycc.2020.100013

Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk as feelings. *Psychological Bulletin*, *127*(2), 267–286. https://doi.org/10.1037/0033-2909.127.2.267

Long, J. S., & Ervin, L. H. (2000). Using Heteroscedasticity Consistent Standard Errors in the Linear Regression Model. *The American Statistician*, *54*(3), 217–224. https://doi.org/10.1080/00031305.2000.10474549

Lu, H., Song, H., & McComas, K. (2021). Seeking information about enhanced geothermal systems: The role of fairness, uncertainty, systematic processing, and information engagement intentions. *Renewable Energy*, *169*, 855-864. https://doi.org/10.1016/j.renene.2021.01.031

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods, 1*, 130–149. doi: 10.1037/1082-989X.1.2.130

MacKinnon, D. P., Lockwood, C. M., & Williams, J. (2004). Confidence Limits for the Indirect Effect: Distribution of the Product and Resampling Methods. *Multivariate Behavioral Research*, *39*(1), 99–128. https://doi.org/10.1207/s15327906mbr3901_4

Mackay, C. M. L., Schmitt, M. T., Lutz, A. E., & Mendel, J. (2021). Recent developments in the social identity approach to the psychology of climate change. *Current Opinion in Psychology*, *42*, 95–101. https://doi.org/10.1016/j.copsyc.2021.04.009

Macknick, J., Newmark, R., Heath, G., & Hallett, K. C. (2011). *A Review of Operational Water Consumption and Withdrawal Factors for Electricity Generating Technologies*. National Renewable Energy Lab. United States. https://dx.doi.org/10.2172/1009674

Madill, A., Jordan, A., & Shirley, C. (2000). Objectivity and reliability in qualitative analysis: Realist, contextualist and radical constructionist epistemologies. *British Journal of Psychology*, *91*(1), 1–20. https://doi.org/10.1348/000712600161646

Mallett, R. K. (2012). Eco-guilt motivates eco-friendly behavior. *Ecopsychology*, *4*, 223-231. http://dx.doi.org/10.1089/eco.2012.0031

Mallett, R. K., Melchiori, K. J., & Strickroth, T. (2013). Self-confrontation via a carbon footprint calculator increases guilt and support for a proenvironmental group. *Ecopsychology*, *5*, 9-16. http://dx.doi.org/10.1089/eco.2012.0067

Malo, M., Malo, F., Bédard, K., & Raymond, J. (2019). Public perception regarding deep geothermal energy and social acceptability in the province of Québec, Canada. In Manzella A., Allansdottir A., Pellizone A., (Eds), *Geothermal Energy and Society*. Cham: Springer, p. 123–44. https://doi.org/10.1007/978-3-319-78286-7_9

Mansfield, C., Van Houtven, G. L., & Huber, J. (2002). Compensating for public harms: why public goods are preferred to money. *Land Economics*, *78*, 368-389. doi: 10.2307/3146896

Manzi, C., Vignoles, V. L., Regalia, C., & Scabini, E. (2006). Cohesion and Enmeshment Revisited: Differentiation, Identity, and Well-Being in Two European Cultures. *Journal of Marriage and Family*, *68*(3), 673–689. https://doi.org/10.1111/j.1741-3737.2006.00282.x

Marques, S., Lima, M. L., Moreira, S., & Reis, J. (2015). Local identity as an amplifier: Procedural justice, local identity and attitudes towards new dam projects. *Journal of Environmental Psychology*, *44*, 63-73. https://doi.org/10.1016/j.jenvp.2015.09.007

Marsh, H. W., Wen, Z., & Hau, K.-T. (2004). Structural equation models of latent interactions: Evaluation of alternative estimation strategies and indicator construction. *Psychological Methods*, *9*(3), 275–300. https://doi.org/10.1037/1082-989X.9.3.275

Marsh, H. W., Wen, Z., Nagengast, B., & Hau, K.-T. (2012). Structural equation models of latent interaction. In R. H. Hoyle (Ed.), *Handbook of structural equation modeling* (pp. 436–458). The Guilford Press.

Marshall, G. R., Hine, D. W., & East, M. J. (2017). Can community-based governance strengthen citizenship in support of climate change adaptation? Testing insights from Self-Determination Theory. *Environmental Science & Policy*, *72*, 1-9. https://doi.org/10.1016/j.envsci.2017.02.010

Masson, T., & Fritsche, I. (2014). Adherence to climate change-related ingroup norms: Do dimensions of group identification matter?. *European Journal of Social Psychology*, *44*, 455-465. https://doi.org/10.1002/ejsp.2036

Masson, T., & Fritsche, I. (2021). We need climate change mitigation and climate change mitigation needs the 'We': a state-of-the-art review of social identity effects motivating climate change action. *Current Opinion in Behavioral Sciences*, *42*, 89-96. https://doi.org/10.1016/j.cobeha.2021.04.006

Masson, T., & Otto, S. (2021). Explaining the difference between the predictive power of value orientations and self-determined motivation for proenvironmental behavior. *Journal of Environmental Psychology*, *73*, 101555. https://doi.org/10.1016/j.jenvp.2021.101555

Masson, T., Jugert, P., & Fritsche, I. (2016). Collective self-fulfilling prophecies: Group identification biases perceptions of environmental group norms among high identifiers. *Social Influence*, *11*(3), 185–198. https://doi.org/10.1080/15534510.2016.1216890

Mayer, D. M., Greenbaum, R. L., Kuenzi, M., & Shteynberg, G. (2009). When do fair procedures not matter? A test of the identity violation effect. *The Journal of Applied Psychology*, *94*(1), 142–161. https://doi.org/10.1037/a0013108

McComas, K. A., Lu, H., Keranen, K. M., Furtney, M. A., & Song, H. (2016). Public perceptions and acceptance of induced earthquakes related to energy development. *Energy Policy*, *99*, 27-32. https://doi.org/10.1016/j.enpol.2016.09.026

McCright, A. M., Dunlap, R. E., & Marquart-Pyatt, S. T. (2016). Political ideology and views about climate change in the European Union. *Environmental Politics*, *25*, 338-358. https://doi.org/10.1080/09644016.2015.1090371

McDonald, R. P. (1999). *Test Theory: A Unified Treatment*. Psychology Press. https://doi.org/10.4324/9781410601087
Meller, C., Schill, E., Bremer, J., Kolditz, O., Bleicher, A., Benighaus, C., Chavot, P., Gross, M., Pellizzone, A., Renn, O., Schilling, F., & Kohl, T. (2018). Acceptability of geothermal installations: A geoethical concept for GeoLaB. *Geothermics*, *73*, 133–145. https://doi.org/10.1016/j.geothermics.2017.07.008
Midden, C. J., & Huijts, N. M. (2009). The role of trust in the affective evaluation of novel risks: The case of CO2 storage. *Risk Analysis: An International Journal*, *29*, 743-751. https://doi.org/10.1111/j.1539-6924.2009.01201.x
Milfont, T. L., Osborne, D., Yogeeswaran, K., & Sibley, C. G. (2020). The role of national identity in collective pro-environmental action. *Journal of Environmental Psychology*, *72*, 101522. https://doi.org/10.1016/j.jenvp.2020.101522
Morgan, D. L. (2010). Reconsidering the Role of Interaction in Analyzing and Reporting Focus Groups. *Qualitative Health Research*, *20*(5), 718–722. https://doi.org/10.1177/1049732310364627
Muldoon, O. T., Acharya, K., Jay, S., Adhikari, K., Pettigrew, J., & Lowe, R. D. (2017). Community identity and collective efficacy: A social cure for traumatic stress in post-earthquake Nepal. *European Journal of Social Psychology*, *47*, 904-915. https://doi.org/10.1002/ejsp.2330
Mullen, E., & Skitka, L. J. (2006). Exploring the psychological underpinnings of the moral mandate effect: Motivated reasoning, group differentiation, or anger? *Journal of Personality and Social Psychology, 90*, 629–643. https://doi.org/10.1037/0022-3514.90.4.629
Mummendey, A., Kessler, T., Klink, A., & Mielke, R. (1999a). Strategies to cope with negative social identity: Predictions by social identity theory and relative deprivation theory. *Journal of Personality and Social Psychology*, *76*(2), 229–245. https://doi.org/10.1037//0022-3514.76.2.229
Mummendey, A., Klink, A., Mielke, R., Wenzel, M., & Blanz, M. (1999b). Socio-structural characteristics of intergroup relations and identity management strategies: Results from a field study in East Germany. *European Journal of Social Psychology*, *29*(2–3), 259–285. https://doi.org/10.1002/(SICI)1099-0992(199903/05)29:2/3<259::AID-EJSP927>3.0.CO;2-F
Murtagh, N., Gatersleben, B., & Uzzell, D. (2012). Self-identity threat and resistance to change: Evidence from regular travel behaviour. *Journal of Environmental Psychology*, *32*(4), 318–326. https://doi.org/10.1016/j.jenvp.2012.05.008
Napier, J. L., & Tyler, T. R. (2008). Does moral conviction really override concerns about procedural justice? A reexamination of the value protection model. *Social justice research*, *21*, 509-528. https://doi.org/10.1007/s11211-008-0083-y
Naumann, S. E., & Bennett, N. (2000). A case for procedural justice climate: Development and test of a multilevel model. *Academy of Management journal*, *43*, 881-889. https://doi.org/10.5465/1556416
Noble, S., McLennan, D., Noble, M., Plunkett, E., Gutacker, N., Silk, M., & Wright, G. (2019). *The English indices of deprivation 2019*. https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019. Retrieved on July 2020.
Nolan, J. M. (2021). Social norm interventions as a tool for pro-climate change. *Current Opinion in Psychology*, 120-125. https://doi.org/10.1016/j.copsyc.2021.06.001
Nolan, J. M., Schultz, P. W., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2008). Normative social influence is underdetected. *Personality and social psychology bulletin*, *34*, 913-923. https://doi.org/10.1177/0146167208316691
Noppers, E. H., Keizer, K., Bockarjova, M., & Steg, L. (2015). The adoption of sustainable innovations: The role of instrumental, environmental, and symbolic

attributes for earlier and later adopters. *Journal of environmental psychology*, *44*, 74-84. https://doi.org/10.1016/j.jenvp.2015.09.002
Nosek, B. A., Alter, G., Banks, G. C., Borsboom, D., Bowman, S. D., Breckler, S. J., Buck, S., Chambers, C. D., Chin, G., Christensen, G., Contestabile, M., Dafoe, A., Eich, E., Freese, J., Glennerster, R., Goroff, D., Green, D. P., Hesse, B., Humphreys, M., … Yarkoni, T. (2015). Promoting an open research culture. *Science*, *348*(6242), 1422–1425. https://doi.org/10.1126/science.aab2374
Nuvolari, A. (2004). Collective invention during the British Industrial Revolution: the case of the Cornish pumping engine. *Cambridge Journal of Economics*, *28*, 347-363. https://doi.org/10.1093/cje/28.3.347
Oakes, P. J. 1987. The salience of social categories. In J. C. Turner, M. A. Hogg, P. J. Oakes, S. D. Reicher, and M. S. Wetherell (Eds.). *Rediscovering the Social Group: A Self-Categorization Theory*. Oxford: Blackwell.Oyserman.
Oakes, P. J. (1994). The Effects of Fit versus Novelty on the Salience of Social Categories: A Response to Biernat and Vescio (1993). *Journal of Experimental Social Psychology*, *30*(4), 390–398. https://doi.org/10.1006/jesp.1994.1019
Oakes, P. J., & Turner, J. C. (1980). Social categorization and intergroup behaviour: Does minimal intergroup discrimination make social identity more positive? *European Journal of Social Psychology, 10*(3), 295–301. https://doi.org/10.1002/ejsp.2420100307
Oakes, P., & Turner, J. C. (1986). Distinctiveness and the salience of social category memberships: Is there an automatic perceptual bias towards novelty? *European Journal of Social Psychology*, *16*(4), 325–344. https://doi.org/10.1002/ejsp.2420160403
Oakes, P. J., & Turner, J. C. (1990). Is Limited Information Processing Capacity the Cause of Social Stereotyping? *European Review of Social Psychology*, *1*(1), 111–135. https://doi.org/10.1080/14792779108401859
Office for National Statistics. (2011). 2011 Census. Retrieved from 28 May, 2021. https://www.ons.gov.uk/census/2011census.
Onwezen, M. C. (2015). I did good, and we did bad: The impact of collective versus private emotions on pro-environmental food consumption. *Food Research International*, *76*, 261-268. https://doi.org/10.1016/j.foodres.2015.03.032
Onwezen, M. C., Bartels, J., & Antonides, G. (2014). Environmentally friendly consumer choices: Cultural differences in the self-regulatory function of anticipated pride and guilt. *Journal of Environmental Psychology*, *40*, 239-248. https://doi.org/10.1016/j.jenvp.2014.07.003
Owuamalam, C. K., Rubin, M., & Spears, R. (2018). Addressing evidential and theoretical inconsistencies in system-justification theory with a social identity model of system attitudes. *Current Directions in Psychological Science, 27*, 91-96. https://doi.org/10.1177/0963721417737136
Paulillo, A., Cotton, L., Law, R., Striolo, A., & Lettieri, P. (2020). Geothermal energy in the UK: The life-cycle environmental impacts of electricity production from the United Downs Deep Geothermal Power project. *Journal of Cleaner Production*, *249*, 119410. https://doi.org/10.1016/j.jclepro.2019.119410
Payera, S. V. (2018). Understanding social acceptance of geothermal energy: Case study for Araucanía region, Chile. *Geothermics*, *72*, 138-144. https://doi.org/10.1016/j.geothermics.2017.10.014
Pelletier, L. G., Tuson, K. M., Green-Demers, I., Noels, K., & Beaton, A. M. (1998). Why are you doing things for the environment? The motivation toward the environment scale (mtes) 1. *Journal of applied social psychology*, *28*, 437-468. https://doi.org/10.1111/j.1559-1816.1998.tb01714.x

Pellizzone, A., Allansdottir, A., De Franco, R., Muttoni, G., & Manzella, A. (2015). Exploring public engagement with geothermal energy in southern Italy: A case study. *Energy Policy*, *85*, 1-11. https://doi.org/10.1016/j.enpol.2015.05.002

Pellizzone, A., Allansdottir, A., De Franco, R., Muttoni, G., & Manzella, A. (2017). Geothermal energy and the public: A case study on deliberative citizens' engagement in central Italy. *Energy Policy*, *101*, 561-570. https://doi.org/10.1016/j.enpol.2016.11.013

Perlaviciute, G., & Steg, L. (2014). Contextual and psychological factors shaping evaluations and acceptability of energy alternatives: integrated review and research agenda. *Renewable and Sustainable Energy Reviews*, *35*, 361-381. https://doi.org/10.1016/j.rser.2014.04.003

Perlaviciute, G., Steg, L., Contzen, N., Roeser, S., & Huijts, N. (2018). Emotional responses to energy projects: Insights for responsible decision making in a sustainable energy transition. *Sustainability*, *10*, 1-12. https://doi.org/10.3390/su10072526

Petrakopoulou, F. (2017). The social perspective on the renewable energy autonomy of geographically isolated communities: evidence from a Mediterranean island. *Sustainability*, *9*, 327. https://doi.org/10.3390/su9030327

Platow, M. J., & van Knippenberg, D. (2001). A social identity analysis of leadership endorsement: The effects of leader ingroup prototypicality and distributive intergroup fairness. *Personality and Social Psychology Bulletin*, *27*, 1508-1519. https://doi.org/10.1177/01461672012711011

Pornprasertmanit, S., Miller, P., Schoemann A., & Jorgensen, T. D. (2021). simsem: SIMulated Structural Equation Modeling. R package version 0.5-16. https://CRAN.R-project.org/package=simsem.

Preacher, K. J., & Selig, J. P. (2012). Advantages of Monte Carlo confidence intervals for indirect effects. *Communication Methods and Measures*, *6*, 77-98. https://doi.org/10.1080/19312458.2012.679848

Proshansky, H. M. (1978). The city and self-identity. *Environment and behavior*, *10*, 147-169. doi: 10.1177/0013916578102002

Proshansky, H. M., Fabian, A. K., & Kaminoff, R. (1983). Place-identity: Physical world socialization of the self. *Journal of environmental psychology*, *3*, 57-83. doi: 10.1016/S0272-4944(83)80021-8

Rabinovich, A., Morton, T. A., Postmes, T., & Verplanken, B. (2012). Collective self and individual choice: The effects of inter-group comparative context on environmental values and behaviour. *British Journal of Social Psychology*, *51*, 551-569. https://doi.org/10.1111/j.2044-8309.2011.02022.x

Rathnaweera, T. D., Wu, W., Ji, Y., & Gamage, R. P. (2020). Understanding injection-induced seismicity in enhanced geothermal systems: From the coupled thermo-hydro-mechanical-chemical process to anthropogenic earthquake prediction. *Earth-Science Reviews*, *205*, 103182. https://doi.org/10.1016/j.earscirev.2020.103182

Rees, J. H., & Bamberg, S. (2014). Climate protection needs societal change: Determinants of intention to participate in collective climate action. *European Journal of Social Psychology*, *44*, 466-473. https://doi.org/10.1002/ejsp.2032

Reichertz, J. (2019). Abduction: The logic of discovery in grounded theory – An updated review. In A. Bryant & K. Charmaz (Eds.), *The Sage handbook of current developments in grounded theory* (pp. 259-281). Thousand Oaks, CA: Sage

Reinecker, J., Gutmanis, J., Foxford, A., Cotton, L., Dalby, C., & Law, R. (2021). Geothermal exploration and reservoir modelling of the united downs deep

geothermal project, Cornwall (UK). *Geothermics*, *97*, 102-226. https://doi.org/10.1016/j.geothermics.2021.102226
Rochyadi-Reetz, M., Arlt, D., Wolling, J., & Bräuer, M. (2019). Explaining the media's framing of renewable energies: an international comparison. *Frontiers in Environmental Science*, *7*, 119. https://doi.org/10.3389/fenvs.2019.00119
Romanach, L., Carr-Cornish, S., & Muriuki, G. (2015). Societal acceptance of an emerging energy technology: How is geothermal energy portrayed in Australian media? *Renewable and Sustainable Energy Reviews*, *42*, 1143-1150. https://doi.org/10.1016/j.rser.2014.10.088
Rönkkö, M., & Cho, E. (2022). An Updated Guideline for Assessing Discriminant Validity. *Organizational Research Methods*, *25*(1), 6–14. https://doi.org/10.1177/1094428120968614
Rosseel, Y. (2012). lavaan: An R Package for Structural Equation Modeling. *Journal of Statistical Software*, 48, 1-36. URL https://www.jstatsoft.org/v48/i02/
Ruiz, C., Marrero, R., & Hernández, B. (2018). Influence of emotions on the acceptance of an oil drilling project. *Environment and Behavior*, *50*, 324-349. https://doi.org/10.1177/0013916517701795
Runciman, W. G. (1966). *Relative Deprivation and Social Justice: A Study of Attitudes to Social Inequality in Twentieth Century England*. London: Routledge.
Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary educational psychology*, *25*, 54-67. https://doi.org/10.1006/ceps.1999.1020
Ryan, R. M., & Deci, E. L. (2017). Self-determination theory: Basic psychological needs in motivation, development, and wellness. New York, NY: Guilford Publishing.
Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, *61*, 101860. https://doi.org/10.1016/j.cedpsych.2020.101860
Sæþórsdóttir, A. D., & Hall, C. M. (2019). Contested development paths and rural communities: Sustainable energy or sustainable tourism in Iceland?. *Sustainability*, *11*, 3642. https://doi.org/10.3390/su11133642
Sani, F., Bowe, M., Herrera, M., Manna, C., Cossa, T., Miao, X., & Zhou, Y. (2007). Perceived collective continuity: Seeing groups as entities that move through time. *European Journal of Social Psychology*, *37*(6), 1118–1134. https://doi.org/10.1002/ejsp.430
Sani, F., Herrera, M., & Bowe, M. (2009). Perceived collective continuity and ingroup identification as defence against death awareness. *Journal of Experimental Social Psychology*, *45*, 242-245. https://doi.org/10.1016/j.jesp.2008.07.019
Sathaye, J., Lucon, O., Rahman, A., Christensen, J., Denton, F., Fujino, J., Heath, G., Mirza, M., Rudnick, H., Schlaepfer, A., Shmakin, A., Angerer, G., Bauer, C., Bazilian, M., Brecha, R., Burgherr, P., Clarke, L., Creutzig, F., Edmonds, J., … Zhang, Y. (2011). Renewable Energy in the Context of Sustainable Development. *Renewable Energy Sources and Climate Change Mitigation*. https://ecommons.udayton.edu/phy_fac_pub/1
Savalei, V., & Rosseel, Y. (2021). Computational Options for Standard Errors and Test Statistics with Incomplete Normal and Nonnormal Data in SEM. *Structural Equation Modeling: A Multidisciplinary Journal*, *0*(0), 1–19. https://doi.org/10.1080/10705511.2021.1877548
Schuitema, G., Steg, L., & van Kruining, M. (2011). When are transport pricing policies fair and acceptable?. *Social Justice Research*, *24*, 66-84. https://doi.org/10.1007/s11211-011-0124-9

Schulte, M., Bamberg, S., Rees, J., & Rollin, P. (2020). Social identity as a key concept for connecting transformative societal change with individual environmental activism. *Journal of Environmental Psychology*, *72*, 101525. https://doi.org/10.1016/j.jenvp.2020.101525

Schultz, W. P., Khazian, A. M., & Zaleski, A. C. (2008). Using normative social influence to promote conservation among hotel guests. *Social influence*, *3*, 4-23. https://doi.org/10.1080/15534510701755614

Schwartz, S.H., 1977. Normative influences on Altruism. In Berkowitz, L. (Ed.), *Advances in experimental social psychology* 10. pp. 221–279. https://doi.org/10.1016/S0065- 2601(08)60358-5

See, K. E. (2009). Reactions to decisions with uncertain consequences: Reliance on perceived fairness versus predicted outcomes depends on knowledge. *Journal of Personality and Social Psychology, 96*, 104–118. https://doi.org/10.1037/a0013266

Sharpe, E. J., Perlaviciute, G., & Steg, L. (2021). Pro-environmental behaviour and support for environmental policy as expressions of pro-environmental motivation. *Journal of Environmental Psychology*, *76*, 101650. https://doi.org/10.1016/j.jenvp.2021.101650

Sherman, S. J. (1980). On the self-erasing nature of errors of prediction. *Journal of Personality and Social Psychology*, *39*, 211–221. doi:10.1037/0022-3514.39.2.211

Shnabel, N., & Ullrich, J. (2013). Increasing intergroup cooperation toward social change by restoring advantaged and disadvantaged groups' positive identities. *Journal of Social and Political Psychology*, 1, 216–238. https://doi.org/10.5964/jspp.v1i1.187

Siegrist, M., & Árvai, J. (2020). Risk perception: Reflections on 40 years of research. *Risk Analysis*, *40*, 2191-2206. https://doi.org/10.1111/risa.13599

Siegrist, M., Connor, M., & Keller, C. (2012). Trust, confidence, procedural fairness, outcome fairness, moral conviction, and the acceptance of GM field experiments. *Risk Analysis: An International Journal*, *32*, 1394-1403. https://doi.org/10.1111/j.1539-6924.2011.01739.x

Siem, B., Von Oettingen, M., Mummendey, A., & Nadler, A. (2013). When status differences are illegitimate, groups' needs diverge: Testing the needs-based model of reconciliation in contexts of status inequality. *European Journal of Social Psychology,* 43, 137–148. https://doi.org/ 10.1002/ejsp.1929

Simcock, N. (2016). Procedural justice and the implementation of community wind energy projects: A case study from South Yorkshire, UK. *Land Use Policy*, *59*, 467-477. https://doi.org/10.1016/j.landusepol.2016.08.034

Skitka, L. J. (2002). Do the means always justify the ends, or do the ends sometimes justify the means? A value protection model of justice reasoning. *Personality and Social Psychology Bulletin*, *28*, 588-597. https://doi.org/10.1177/0146167202288003

Skitka, L. J., & Mullen, E. (2002). Understanding judgments of fairness in a real-world political context: A test of the value protection model of justice reasoning. *Personality and Social Psychology Bulletin*, *28*, 1419-1429. https://doi.org/10.1177/014616702236873

Skitka, L. J., & Mullen, E. (2008). Moral convictions often override concerns about procedural fairness: A reply to Napier and Tyler. *Social justice research*, *21*, 529-546. https://doi.org/10.1007/s11211-008-0085-9

Skitka, L. J., Hanson, B. E., Morgan, G. S., & Wisneski, D. C. (2021). The psychology of moral conviction. *Annual Review of Psychology*, *72*, 347-366. https://doi.org/10.1146/annurev-psych-063020-030612

Slovic, P. (1987). Perception of risk. *Science (New York, N.Y.)*, *236*(4799), 280–285. https://doi.org/10.1126/science.3563507

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2004). Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk, and rationality. *Risk Analysis: An International Journal*, *24*, 311-322. https://doi.org/10.1111/j.0272-4332.2004.00433.x

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2004). Risk as Analysis and Risk as Feelings: Some Thoughts about Affect, Reason, Risk, and Rationality. *Risk Analysis*, *24*(2), 311–322. https://doi.org/10.1111/j.0272-4332.2004.00433.x

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2007). The affect heuristic. *European Journal of Operational Research*, *177*(3), 1333–1352. https://doi.org/10.1016/j.ejor.2005.04.006

Smeekes, A., & Verkuyten, M. (2013). Collective self-continuity, group identification and in-group defense. *Journal of Experimental Social Psychology*, *49*(6), 984–994. https://doi.org/10.1016/j.jesp.2013.06.004

Smeekes, A., & Verkuyten, M. (2014). Perceived group continuity, collective self-continuity, and in-group identification. *Self and Identity*, *13*, 663-680. https://doi.org/10.1080/15298868.2014.898685

Smeekes, A., Verkuyten, M., & Martinovic, B. (2015). Longing for the country's good old days: National nostalgia, autochthony beliefs, and opposition to Muslim expressive rights. *British Journal of Social Psychology*, *54*, 561-580. https://doi.org/10.1111/bjso.12097

Smith, E. R., Seger, C. R., & Mackie, D. M. (2007). Can emotions be truly group level? Evidence regarding four conceptual criteria. *Journal of personality and social psychology*, *93*, 431–446. https://doi.org/10.1037/0022-3514.93.3.431

Smith, H. J., Pettigrew, T. F., Pippin, G. M., & Bialosiewicz, S. (2012). Relative Deprivation: A Theoretical and Meta-Analytic Review. *Personality and Social Psychology Review*, *16*(3), 203–232. https://doi.org/10.1177/1088868311430825

Smith, H. J., Tyler, T. R., Huo, Y. J., Ortiz, D. J., & Lind, E. A. (1998). The self-relevant implications of the group-value model: Group membership, self-worth, and treatment quality. *Journal of experimental social psychology*, *34*, 470-493. https://doi.org/10.1006/jesp.1998.1360

Sovacool, B. K., Heffron, R. J., McCauley, D., & Goldthau, A. (2016). Energy decisions reframed as justice and ethical concerns. *Nature Energy*, *1*, 5, 16024. https://doi.org/10.1038/nenergy.2016.24

Spada, M., Sutra, E., & Burgherr, P. (2021). Comparative accident risk assessment with focus on deep geothermal energy systems in the Organization for Economic Co-operation and Development (OECD) countries. *Geothermics*, *95*, 102142. https://doi.org/10.1016/j.geothermics.2021.102142

Stadelmann-Steffen, I., & Dermont, C. (2021). Acceptance through inclusion? Political and economic participation and the acceptance of local renewable energy projects in Switzerland. *Energy Research & Social Science*, *71*, 101818. https://doi.org/10.1016/j.erss.2020.101818

Stauffacher, M., Muggli, N., Scolobig, A., & Moser, C. (2015). Framing deep geothermal energy in mass media: the case of Switzerland. *Technological Forecasting and Social Change*, *98*, 60-70. https://doi.org/10.1016/j.techfore.2015.05.018

Stedman, R. C., Evensen, D., O'Hara, S., & Humphrey, M. (2016). Comparing the relationship between knowledge and support for hydraulic fracturing between residents of the United States and the United Kingdom. *Energy research & social science*, *20*, 142-148. https://doi.org/10.1016/j.erss.2016.06.017

Steel, B. S., Pierce, J. C., Warner, R. L., & Lovrich, N. P. (2015). Environmental value considerations in public attitudes about alternative energy development in Oregon and Washington. *Environmental management*, *5*, 634-645. DOI: 10.1007/s00267-014-0419-3
Steg, L. (2005). Car use: lust and must. Instrumental, symbolic and affective motives for car use. *Transportation Research Part A: Policy and Practice*, *39*, 147-162. https://doi.org/10.1016/j.tra.2004.07.001
Steg, L., Perlaviciute, G., & van der Werff, E. (2015). Understanding the human dimensions of a sustainable energy transition. *Frontiers in Psychology*, *6*. https://www.frontiersin.org/article/10.3389/fpsyg.2015.00805
Steg, L., Perlaviciute, G., Sovacool, B. K., Bonaiuto, M., Diekmann, A., Filippini, M., ... & Woerdman, E. (2021). A Research Agenda to Better Understand the Human Dimensions of Energy Transitions. *Frontiers in psychology*, *12*, 2421. https://doi.org/10.3389/fpsyg.2021.672776
Stern, P. C. (2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues, 56*, 407–424. https://doi.org/10.1111/0022-4537.00175
Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human ecology review*, 81-97. https://www.jstor.org/stable/24707060
Stürmer, S., & Simon, B. (2004). Collective action: Towards a dual-pathway model. *European Review of Social Psychology*, *15*(1), 59–99. https://doi.org/10.1080/10463280340000117
Suddaby, R. 2006. From the editors: What grounded theory is not. *Academy of Management Journal, 49*, 633–42. https://doi.org/10.5465/amj.2006.22083020
Tajfel, H. (1974). Social identity and intergroup behaviour. *Social science information*, *13*, 65-93. https://doi.org/10.1177/053901847401300204
Tajfel, H. (1975). The exit of social mobility and the voice of social change: Notes on the social psychology of intergroup relations. *Social Science Information*, *14*, 101-118. https://doi.org/10.1177/053901847501400204
Tajfel, H. (1982). Social psychology of intergroup relations. *Annual review of psychology*, *33*, 1-39. https://doi.org/10.1146/annurev.ps.33.020182.000245
Tajfel, H. (1981). Human groups and social categories: Studies in social psychology. Cambridge: Cambridge University Press.
Tajfel, H. & Turner, J.C. (1979). An integrative theory of intergroup conflict. In W. G. Austin & S. Worchel (Eds), *The social psychology of intergroup relations.* (pp. 33-47). Monterey, CA: Brooks Cole.
Tajfel, H., & Fraser, C. (Eds) (1978). *Introducing social psychology: An analysis of individual reaction and response*. Harmondsworth: Penguin. Reprinted in 1987.
Tampakis, S., Tsantopoulos, G., Arabatzis, G., & Rerras, I. (2013). Citizens' views on various forms of energy and their contribution to the environment. *Renewable and Sustainable Energy Reviews*, *20*, 473-482. https://doi.org/10.1016/j.rser.2012.12.027
Tay, L., & Jebb, A. T. (2018). Establishing Construct Continua in Construct Validation: The Process of Continuum Specification. *Advances in Methods and Practices in Psychological Science*, *1*(3), 375–388. https://doi.org/10.1177/2515245918775707
Taylor, L. C. (2018). Reassessing and refining theory in qualitative accounting research. *Qualitative Research in Accounting & Management*. https://doi.org/10.1108/QRAM-09-2017-0090

Temper, L., Avila, S., Del Bene, D., Gobby, J., Kosoy, N., Le Billon, P., ... & Walter, M. (2020). Movements shaping climate futures: A systematic mapping of protests against fossil fuel and low-carbon energy projects. *Environmental Research Letters*, *15*, 123004. https://doi.org/10.1088/1748-9326/abc197

Ter Mors, E., Terwel, B. W., & Daamen, D. D. (2012). The potential of host community compensation in facility siting. *International Journal of Greenhouse Gas Control*, *11*, 130-138. https://doi.org/10.1016/j.ijggc.2012.07.002

Terwel, B. W., Harinck, F., Ellemers, N., & Daamen, D. D. L. (2010). Voice in political decision-making: The effect of group voice on perceived trustworthiness of decision makers and subsequent acceptance of decisions. *Journal of Experimental Psychology: Applied, 16*, 173–186. https://doi.org/10.1037/a0019977

Terwel, B. W., Koudenburg, F. A., & ter Mors, E. (2014). Public Responses to Community Compensation: The Importance of Prior Consultations with Local Residents. *Journal of Community & Applied Social Psychology*, *24*(6), 479–490. https://doi.org/10.1002/casp.2186

Thibaut, J. W., & Walker, L. (1975). *Procedural justice: A psychological analysis*. L. Erlbaum Associates.

Thøgersen, J. (2006). Norms for environmentally responsible behaviour: An extended taxonomy. *Journal of environmental Psychology*, *26*, 247-261. https://doi.org/10.1016/j.jenvp.2006.09.004

Thomas, E. F., Amiot, C. E., Louis, W. R., & Goddard, A. (2017). Collective self-determination: How the agent of help promotes pride, well-being, and support for intergroup helping. *Personality and Social Psychology Bulletin*, *43*, 662-677. https://doi.org/10.1177/0146167217695553

Thomas, E. F., Mavor, K. I., & McGarty, C. (2012). Social identities facilitate and encapsulate action-relevant constructs: A test of the social identity model of collective action. *Group Processes & Intergroup Relations*, *15*, 75-88. https://doi.org/10.1177/1368430211413619

Thomas, E. F., McGarty, C., & Mavor, K. I. (2009). Aligning identities, emotions, and beliefs to create commitment to sustainable social and political action. *Personality and Social Psychology Review*, *13*, 194-218. https://doi.org/10.1177/1088868309341563

Thomas, W. E., Brown, R., Easterbrook, M. J., Vignoles, V. L., Manzi, C., D'Angelo, C., & Holt, J. J. (2017). Social Identification in Sports Teams: The Role of Personal, Social, and Collective Identity Motives. *Personality and Social Psychology Bulletin*, *43*(4), 508–523. https://doi.org/10.1177/0146167216689051

Timmermans, S., & Tavory, I. (2012). Theory construction in qualitative research: From grounded theory to abductive analysis. *Sociological theory*, *30*, 167-186. https://doi.org/10.1177/0735275112457914

Timmermans, S., & Tavory, I. (2014). *Abductive Analysis: Theorizing Qualitative Research*. University of Chicago Press.

Tunçgenç, B., El Zein, M., Sulik, J., Newson, M., Zhao, Y., Dezecache, G., & Deroy, O. (2021). Social influence matters: We follow pandemic guidelines most when our close circle does. *British Journal of Psychology*. https://doi.org/10.1111/bjop.12491

Turner, J. C. (1975). Social comparison and social identity: Some prospects for intergroup behaviour. *European Journal of Social Psychology*, *5*(1), 1–34. https://doi.org/10.1002/ejsp.2420050102

Turner, J. C. (1982). Towards a cognitive redefinition of the social group. *Social identity and intergroup relations*, 15-40.

Turner, J. C. (2010). Towards a cognitive redefinition of the social group. In T. Postmes & N. R. Branscombe (Eds.), *Rediscovering social identity* (pp. 210–234). Psychology Press.

Turner, J. C., Hogg, M. A., Oakes, P. J., Reicher, S. D., & Wetherell, M. S. (1987). *Rediscovering the social group: A self-categorization theory*. Basil Blackwell.

Turner, J. C., Oakes, P. J., Haslam, S. A., & McGarty, C. (1994). Self and collective: Cognition and social context. *Personality and social psychology bulletin*, *20*, 454-463. https://doi.org/10.1177/0146167294205002

Twigger-Ross, C., Bonaiuto, M., & Breakwell, G. (2003). Identity theories and environmental psychology. In M. Bonnes, M. (Ed.) *Psychological Theories for Environmental Issues* (pp. 203-229). Routledge.

Tyler, G., Bidwell, D., Smythe, T., & Trandafir, S. (2022). Preferences for community benefits for offshore wind development projects: A case study of the Outer Banks of North Carolina, U.S. *Journal of Environmental Policy & Planning*, *24*(1), 39–55. https://doi.org/10.1080/1523908X.2021.1940896

Tyler, T. R. (2000). Social justice: Outcome and procedure. *International journal of psychology*, *35*, 117-125. https://doi.org/10.1080/002075900399411

Tyler, T. R. (2006). Psychological Perspectives on Legitimacy and Legitimation. *Annual Review of Psychology*, *57*(1), 375–400. https://doi.org/10.1146/annurev.psych.57.102904.190038

Tyler, T. R., & Blader, S. L. (2002). Autonomous vs. comparative status: Must we be better than others to feel good about ourselves?. *Organizational Behavior and Human Decision Processes*, *89*, 813-838. https://doi.org/10.1016/S0749-5978(02)00031-6

Tyler, T. R., & Blader, S. L. (2003). The Group Engagement Model: Procedural Justice, Social Identity, and Cooperative Behavior. *Personality and Social Psychology Review*, *7*(4), 349–361. https://doi.org/10.1207/S15327957PSPR0704_07

Tyler, T. R., & Lind, E. A. (1992). A relational model of authority in groups. *Advances in experimental social psychology*, *25*, 115-191. https://doi.org/10.1016/S0065-2601(08)60283-X

Tyler, T. R., Boeckmann, R. J., Smith, H. J., & Huo, Y. J. (1997). *Social justice in a diverse society*. Bolder, CO: Westview Press. https://doi.org/10.4324/9780429306310

Tyler, T. R., Rasinski, K. A., & Spodick, N. (1985). Influence of voice on satisfaction with leaders: Exploring the meaning of process control. *Journal of Personality and Social Psychology, 48*, 72-81. https://doi.org/10.1037/0022-3514.48.1.72

Tyler, T., Degoey, P., & Smith, H. (1996). Understanding why the justice of group procedures matters: A test of the psychological dynamics of the group-value model. *Journal of Personality and Social Psychology, 70*, 913–930. https://doi.org/10.1037/0022-3514.70.5.913

Tyler, T., Lind, E. A., Ohbuchi, K. I., Sugawara, I., & Huo, Y. J. (1998). Conflict with outsiders: Disputing within and across cultural boundaries. *Personality and Social Psychology Bulletin*, *24*, 137-146. https://doi.org/10.1177/0146167298242003

Uji, A., Prakash, A., & Song, J. (2021). Does the "NIMBY syndrome" undermine public support for nuclear power in Japan? *Energy Policy*, *148*, 111944. https://doi.org/10.1016/j.enpol.2020.111944

Ullrich, J., Christ, O., & van Dick, R. (2009). Substitutes for procedural fairness: Prototypical leaders are endorsed whether they are fair or not. *Journal of Applied Psychology*, *94*, 1, 235 244. https://doi.org/10.1037/a0012936

Urbanska, K., Pehrson, S., & Turner, R. N. (2019). Authority fairness for all? Intergroup status and expectations of procedural justice and resource

distribution. *Journal of Social and Political Psychology*, *7*, 766-789. https://doi.org/10.5964/jspp.v7i2.974
van Bommel, N., & Höffken, J. I. (2021). Energy justice within, between and beyond European community energy initiatives: A review. *Energy Research & Social Science*, *79*, 102157. https://doi.org/10.1016/j.erss.2021.102157
van den Bos, K., & Lind, E. A. (2002). Uncertainty management by means of fairness judgments. In *Advances in experimental social psychology* (Vol. 34, pp. 1-60). Academic Press. https://doi.org/10.1016/S0065-2601(02)80003-X
van den Bos, K., & Miedema, J. (2000). Toward understanding why fairness matters: The influence of mortality salience on reactions to procedural fairness. *Journal of Personality and Social Psychology, 79*, 355–366. https://doi.org/10.1037/0022-3514.79.3.355
van den Bos, K., Wilke, H. A. M., & Lind, E. A. (1998). When do we need procedural fairness? The role of trust in authority. *Journal of Personality and Social Psychology, 75*, 1449–1458. https://doi.org/10.1037/0022-3514.75.6.1449
Van der Werff, E., Steg, L., & Keizer, K. (2014). I Am What I Am, by Looking Past the Present: The Influence of Biospheric Values and Past Behavior on Environmental Self-Identity. *Environment and Behavior*, *46*(5), 626–657. https://doi.org/10.1177/0013916512475209
van Dijke, M., & Verboon, P. (2010). Trust in authorities as a boundary condition to procedural fairness effects on tax compliance. *Journal of Economic Psychology*, *31*, 80-91. https://doi.org/10.1016/j.joep.2009.10.005
van Prooijen, A. M. (2019). Public trust in energy suppliers' communicated motives for investing in wind power. *Journal of Environmental Psychology*, *61*, 115–124. https://doi.org/10.1016/j.jenvp.2019.01.004
van Prooijen, J.-W. (2009). Procedural justice as autonomy regulation. *Journal of Personality and Social Psychology*, *96*(6), 1166–1180. https://doi.org/10.1037/a0014153
van Prooijen, J.-W., van den Bos, K., & Wilke, H. A. M. (2002). Procedural justice and status: Status salience as antecedent of procedural fairness effects. *Journal of Personality and Social Psychology, 83*, 1353–1361. https://doi.org/10.1037/0022-3514.83.6.1353
van Wijk, J., Fischhendler, I., Rosen, G., & Herman, L. (2021). Penny wise or pound foolish? Compensation schemes and the attainment of community acceptance in renewable energy. *Energy Research & Social Science*, *81*, 102260. https://doi.org/10.1016/j.erss.2021.102260
van Zomeren, M. (2014). Synthesizing individualistic and collectivistic perspectives on environmental and collective action through a relational perspective. *Theory & Psychology*, *24*, 775-794. https://doi.org/10.1177/0959354314548617
Van Zomeren, M., Leach, C. W., & Spears, R. (2010). Does group efficacy increase group identification? Resolving their paradoxical relationship. *Journal of Experimental Social Psychology*, *46*, 1055-1060. https://doi.org/10.1016/j.jesp.2010.05.006
van Zomeren, M., Leach, C. W., & Spears, R. (2012). Protesters as "Passionate Economists": A Dynamic Dual Pathway Model of Approach Coping With Collective Disadvantage. *Personality and Social Psychology Review*, *16*(2), 180–199. https://doi.org/10.1177/1088868311430835
van Zomeren, M., Postmes, T., & Spears, R. (2008). Toward an integrative social identity model of collective action: A quantitative research synthesis of three socio-psychological perspectives. *Psychological Bulletin*, *134*(4), 504–535. https://doi.org/10.1037/0033-2909.134.4.504

van Zomeren, M., Spears, R., Fischer, A. H., & Leach, C. W. (2004). Put Your Money Where Your Mouth Is! Explaining Collective Action Tendencies Through Group-Based Anger and Group Efficacy. *Journal of Personality and Social Psychology, 87*, 649–664. https://doi.org/10.1037/0022-3514.87.5.649

Venables, D., Pidgeon, N. F., Parkhill, K. A., Henwood, K. L., & Simmons, P. (2012). Living with nuclear power: Sense of place, proximity, and risk perceptions in local host communities. *Journal of Environmental Psychology*, *32*(4), 371–383. https://doi.org/10.1016/j.jenvp.2012.06.003

Venus, M., Stam, D., & van Knippenberg, D. (2019). Visions of Change as Visions of Continuity. *Academy of Management Journal*, *62*(3), 667–690. https://doi.org/10.5465/amj.2015.1196

Vignoles, V. L. (2011). Identity Motives. In S. J. Schwartz, K. Luyckx, & V. L. Vignoles (Eds.), *Handbook of Identity Theory and Research* (pp. 403–432). Springer. https://doi.org/10.1007/978-1-4419-7988-9_18

Vignoles, V. L., Regalia, C., Manzi, C., Golledge, J., & Scabini, E. (2006). Beyond self-esteem: Influence of multiple motives on identity construction. *Journal of Personality and Social Psychology*, *90*(2), 308–333. https://doi.org/10.1037/0022-3514.90.2.308

Visschers, V. H. M., & Siegrist, M. (2013). How a Nuclear Power Plant Accident Influences Acceptance of Nuclear Power: Results of a Longitudinal Study Before and After the Fukushima Disaster. *Risk Analysis*, *33*(2), 333–347. https://doi.org/10.1111/j.1539-6924.2012.01861.x

Visschers, V. H., & Siegrist, M. (2012). Fair play in energy policy decisions: Procedural fairness, outcome fairness and acceptance of the decision to rebuild nuclear power plants. *Energy policy*, *46*, 292-300. https://doi.org/10.1016/j.enpol.2012.03.062

Vlassenroot, S., Molin, E., Kavadias, D., Marchau, V., Brookhuis, K., & Witlox, F. (2011). What drives the Acceptability of Intelligent Speed Assistance (ISA)? *European Journal of Transport and Infrastructure Research*, *11*(2), Article 2. https://doi.org/10.18757/ejtir.2011.11.2.2925

Vrieling, L., Perlaviciute, G., & Steg, L. (2021). Afraid, angry or powerless? Effects of perceived risks and trust in responsible parties on emotions towards gasquakes in the Netherlands. *Energy Research & Social Science*, *76*, 102063. https://doi.org/10.1016/j.erss.2021.102063

Vuichard, P., Broughel, A., Wüstenhagen, R., Tabi, A., & Knauf, J. (2022). Keep it local and bird-friendly: Exploring the social acceptance of wind energy in Switzerland, Estonia, and Ukraine. *Energy Research & Social Science*, *88*, 102508. https://doi.org/10.1016/j.erss.2022.102508

Walker, B. J. A., Russel, D., & Kurz, T. (2017). Community Benefits or Community Bribes? An Experimental Analysis of Strategies for Managing Community Perceptions of Bribery Surrounding the Siting of Renewable Energy Projects. *Environment and Behavior*, *49*(1), 59–83. https://doi.org/10.1177/0013916515605562

Walker, B. J. A., Wiersma, B., & Bailey, E. (2014). Community benefits, framing and the social acceptance of offshore wind farms: An experimental study in England. *Energy Research & Social Science*, *3*, 46–54. https://doi.org/10.1016/j.erss.2014.07.003

Walker, C., & Baxter, J. (2017). Procedural justice in Canadian wind energy development: a comparison of community-based and technocratic siting processes. *Energy research & social science*, *29*, 160-169. https://doi.org/10.1016/j.erss.2017.05.016

Wang, M., Gong, Y., Wang, S., Li, Y., & Sun, Y. (2021). Promoting support for carbon capture and storage with social norms: Evidence from a randomized controlled

trial in China. *Energy Research & Social Science*, *74*, 101979. https://doi.org/10.1016/j.erss.2021.101979
Webb, D., Soutar, G. N., Mazzarol, T., & Saldaris, P. (2013). Self-determination theory and consumer behavioural change: Evidence from a household energy-saving behaviour study. *Journal of Environmental Psychology*, *35*, 59-66. https://doi.org/10.1016/j.jenvp.2013.04.003
Weinstein, N., & Ryan, R. M. (2010). When helping helps: Autonomous motivation for prosocial behavior and its influence on well-being for the helper and recipient. *Journal of Personality and Social Psychology, 98*, 222–244. https://doi.org/10.1037/a0016984
White, H. (1982). Maximum likelihood estimation of misspecified models. *Econometrica*, 1–25. https://doi.org/10.2307/1912526
White, K. M., Smith, J. R., Terry, D. J., Greenslade, J. H., & McKimmie, B. M. (2009). Social influence in the theory of planned behaviour: The role of descriptive, injunctive, and in-group norms. *British journal of social psychology*, *48*, 135-158. https://doi.org/10.1348/014466608X295207
Whitehouse, R. (2018, 16 May). 'Failed' £42m wave hub could damage the future of renewable energy. *CornwallLive*. https://www.cornwalllive.com/news/cornwall-news/failed-42m-wave-hub-could-1575317
Whitfield, S. C., Rosa, E. A., Dan, A., & Dietz, T. (2009). The future of nuclear power: Value orientations and risk perception. *Risk Analysis: An International Journal*, *29*, 425-437.
Whitmarsh, L., Xenias, D., & Jones, C. R. (2019). Framing effects on public support for carbon capture and storage. *Palgrave Communications*, *5*(1), 1–10. https://doi.org/10.1057/s41599-019-0217-x
Wiesenfeld, B. M., Swann Jr, W. B., Brockner, J., & Bartel, C. A. (2007). Is more fairness always preferred? Self-esteem moderates reactions to procedural justice. *Academy of Management Journal*, *50*, 1235-1253. https://doi.org/10.5465/amj.2007.20159922
Wilding, S., Conner, M., Sandberg, T., Prestwich, A., Lawton, R., Wood, C., Miles, E., Godin, G., & Sheeran, P. (2016). The question-behaviour effect: a theoretical and methodological review and meta-analysis. *European Review of Social Psychology*, *27*, 196-230. https://doi.org/10.1080/10463283.2016.1245940
Wilson, R. S., Zwickle, A., & Walpole, H. (2019). Developing a Broadly Applicable Measure of Risk Perception. *Risk Analysis*, *39*(4), 777–791. https://doi.org/10.1111/risa.13207
Wittenberg, I., Blöbaum, A., & Matthies, E. (2018). Environmental motivations for energy use in PV households: Proposal of a modified norm activation model for the specific context of PV households. *Journal of Environmental Psychology*, *55*, 110-120. https://doi.org/10.1016/j.jenvp.2018.01.002
Wohl, M. J., Giguère, B., Branscombe, N. R., & McVicar, D. N. (2011). One day we might be no more: Collective angst and protective action from potential distinctiveness loss. *European Journal of Social Psychology*, *41*, 289-300. https://doi.org/10.1002/ejsp.773
Wolf, E. J., Harrington, K. M., Clark, S. L., & Miller, M. W. (2013). Sample Size Requirements for Structural Equation Models: An Evaluation of Power, Bias, and Solution Propriety. *Educational and Psychological Measurement*, *73*(6), 913–934. https://doi.org/10.1177/0013164413495237
Wolsink, M. (2006). Invalid theory impedes our understanding: a critique on the persistence of the language of NIMBY. *Transactions of the Institute of British Geographers*, *31*(1), 85-91. https://doi.org/10.1111/j.1475-5661.2006.00191.x

Wolsink, M., & Devilee, J. (2009). The motives for accepting or rejecting waste infrastructure facilities. Shifting the focus from the planners' perspective to fairness and community commitment. *Journal of environmental planning and management*, *52*, 217-236. https://doi.org/10.1080/09640560802666552
Wu, Y., Wen, Z., Marsh, H. W., & Hau, K. T. (2013). A comparison of strategies for forming product indicators for unequal numbers of items in structural equation models of latent interactions. *Structural equation modeling: A multidisciplinary journal*, *20*(4), 551-567. https://doi.org/10.1080/10705511.2013.824772
Wüstenhagen, R., Wolsink, M., & Bürer, M. J. (2007). Social acceptance of renewable energy innovation: An introduction to the concept. *Energy policy*, *35*, 2683-2691. https://doi.org/10.1016/j.enpol.2006.12.001
Yang, J., Mossholder, K. W., & Peng, T. K. (2007). Procedural justice climate and group power distance: An examination of cross-level interaction effects. *Journal of Applied Psychology, 92*, 681-692. https://doi.org/10.1037/0021-9010.92.3.681
Yasukawa, K., Kubota, H., Soma, N., & Noda, T. (2018). Integration of natural and social environment in the implementation of geothermal projects. *Geothermics*, *73*, 111-123. https://doi.org/10.1016/j.geothermics.2017.09.011
Zang, A., Oye, V., Jousset, P., Deichmann, N., Gritto, R., McGarr, A., Majer, R., & Bruhn, D. (2014). Analysis of induced seismicity in geothermal reservoirs–An overview. *Geothermics*, *52*, 6-21. https://doi.org/10.1016/j.geothermics.2014.06.005
Zanocco, C., Flora, J., Rajagopal, R., & Boudet, H. (2021). When the lights go out: Californians' experience with wildfire-related public safety power shutoffs increases intention to adopt solar and storage. *Energy Research & Social Science*, *79*, 102183. https://doi.org/10.1016/j.erss.2021.102183
Zhang, X., Noor, R., & Savalei, V. (2016). Examining the Effect of Reverse Worded Items on the Factor Structure of the Need for Cognition Scale. *PLOS ONE*, *11*(6), e0157795. https://doi.org/10.1371/journal.pone.0157795

Appendices

Appendix A – Study 4

Multi-group and CFAs power analyses

Multi-group analyses only considered the two novel constructs of support and threat of identity motives. The multi-group confirmatory analysis sample size was based on the calculation of root mean square error of approximation (RMSEA). For the structural model, the sample size was based on Monte Carlo experiment simulations. The same participants were used for both the multi-group and the structural model. Given that the latter is a more complex model and would require a higher number of participants, the results of the Monte Carlo simulation led the sample size decision. Therefore, the sample size estimation for the multi-group model was only performed for thoroughness, as a further indication of the appropriate sample size for that specific analysis.

Confirmatory factor analysis: population RMSEA (prior)

In order to test the equivalence of the factor meanings across groups (i.e., measurement invariance), a multi-group confirmatory factor analysis (MGCFA) was planned. In this analysis, the two novel constructs of support and threat of identity motives were tested across the Welsh and Scottish samples. The required sample size for the multi-group confirmatory analysis was investigated using the population RMSEA approach (MacCallum et al., 1996). The population RMSEA analysis was performed with the R package *semTools* (Jorgensen et al., 2021). The following arguments were specified: *rmsea0* = .05, *rmseaA* = .01, *df* = 53, *power* = 0.80, *alpha* = 0.5. Degrees of freedom were calculated assuming a scenario of two factors with six observed variables. The proposed sample size was 258 participants per group, one group of Scottish people and one group of Welsh people (N = 516) (Figure 1A).

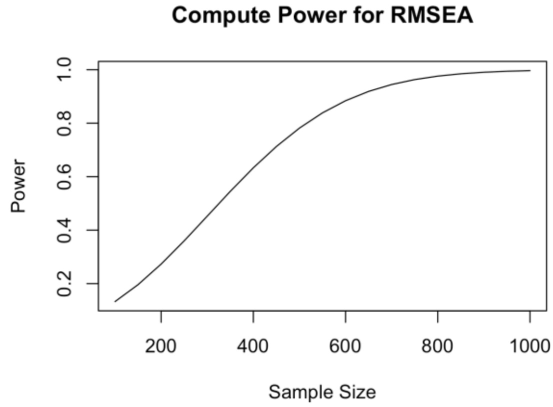

Figure 1A. Plots power of RMSEA over a range of sample sizes

Post-hoc power analysis: CFAs and model comparisons

Since the pre-registered factor structures could not be accepted, as explained later, this section reports the results of the power analyses based on the actual factor structure used. This analyses only involve the CFAs models. The Monte Carlo simulation power analysis of the structural model was, instead, still reliable as the model tested is largely consistent with the model simulated.

These analyses were carried out using the function *findRMSEApower* (for single and multi-group CFAs), and the function *findRMSEApowernested* (for the model comparisons analysis) of the package *semTools* (version 0.5-5.912). Results indicated that all CFA models achieved power > .80. Sufficient power was also achieved for the comparison between the second-order and the bifactor model, which is consistent with sample size recommendations of Chen et al. (2006).

Further details of the population parameters for the Monte Carlo simulation power analysis

The interaction effect was computed as the product term explained in the following equation:

$$\eta = \gamma_1\xi_1 + \gamma_2\xi_2 + \gamma_3\xi_1\xi_2 + \zeta$$

where the endogenous latent variable η is the result of the first order effects γ_1 (exogenous/independent variable) and γ_2 (exogenous/moderator variable) and the γ_3 being the interaction effect (the product term between γ_1 and γ_2). This means that six pairs of product indicators were added into the regression line as a new latent variable. This procedure follows double-mean centering (Lin et. al., 2010) and match-paired approaches (Marsh, Wen, & Hau, 2004). Therefore, each mean of the indicators was centered, as well as the resulting product indicators.

Appendix B – Study 4

Items group-level identity motives

The words Scottish and Scotland were Welsh and Wales when recruiting participants from Wales. See section 5.3.1. for information about the questions order.
The final items used for the identity motives are in **bold**.

Numerical indices

DIS-R refers to Appendix C when commenting:
Details of item selection – current study plan;
Details of items selection results based on item correspondence with the construct, factor loadings and residual correlations.

EFA-A refers to Appendix C when commenting:
Results of exploratory factor analysis: all items;
Figure 1C.

EFA-R refers to section 5.5.4 when commenting:
Figure 13. "EFA with items of the final factors structure".

Table 1B/a. Group-level identity motives (SUPPORT – CONTINUITY)

DIS-R	EFA-A	EFA-R	
1	1		I can see how the geothermal technology is congruent with Scotland's previous energy industries
2	2	1	**I think that the geothermal technology may contribute to preserve Scotland's traditions**
3	3	2	**I perceive a sense of continuity between the past energy technologies in Scotland and the future prospect use of geothermal energy technology in Scotland**
4	4	3	**Despite societal changes, the geothermal energy technology may help to preserve the Scottish culture and identity over time**
5	5		When thinking about previous traditional energy sources, I consider the implementation of geothermal technology a consistent evolution of the energy systems in Scotland

Table 1B/b. Group-level identity motives (SUPPORT – DISTINCTIVNESS)

DIS-R	EFA-A	EFA-R	
1	6		Geothermal technology would be something unique for Scotland
2	7	4	**Geothermal technology would be one more thing to put Scotland on the map**
3	8	5	**Geothermal technology would make my country (Scotland) positively different from others**
4	9	6	**Geothermal technology would make Scotland stand out from the rest of the UK**
5	10		Geothermal technology would enhance the distinctiveness of Scotland

Table 1B/c. Group-level identity motives (SUPPORT – SELF-ESTEEM)

DIS-R	EFA-A	EFA-R	
1	11	7	**I think people in Scotland would be proud of the development of geothermal technology**
2	12		I think that the geothermal technology in Scotland could be an example of novelty and progress in the energy field to other countries
3	13	8	**Using the geothermal technology would make Scotland feel closer to my ideal country**
4	14	9	**In general, I think people from elsewhere would think positively about the implementation of the geothermal technology in Scotland**
5	15		Talking about the geothermal technology can be among the interesting things to tell about Scotland when speaking with people living elsewhere

Table 1B/d. Group-level identity motives (THREAT – CONTINUITY)

DIS-R	EFA-A	EFA-R	
1	16	10	**The geothermal technology does NOT fit with the historical past of Scotland**
2	17		I am NOT comfortable with the idea of implementing additional energy technologies in Scotland
3	18	11	**I don't see why we should implement the geothermal technology while we could keep using the ones we have been using so far**
4	19	12	Hosting geothermal technology in Scotland prevents me from looking positively into Scotland's future*
5	20		**Instead of implementing the geothermal technology, people should work on the improvement of the current energy technologies that we already have in Scotland**

Table 1B/e. Group-level identity motives (THREAT – DISTINCTIVNESS)

DIS-R	EFA-A	EFA-R	
1	21		The implementation of geothermal energy would make us (Scottish people) less distinct from the rest of UK
2	22	13	**The implementation of the geothermal technology would make Scotland less unique**
3	23		Some of the unique features of Scotland may be undermined by the geothermal technology
4	24		Other types of energy technology may be better in representing Scotland than the geothermal technology
5	25	14	**I believe that the implementation of geothermal technology in Scotland would create undesirable similarities between Scotland and the rest of the UK**
6	26	15	**I think that the geothermal technology would undermine some aspects that differentiate Scotland from the rest of the UK**

Table 1B/f. Group-level identity motives (THREAT – SELF-ESTEEM)

DIS-R	EFA-A	EFA-R	
1	27	16	**The geothermal technology may devalue some aspects of my country (Scotland)**
2	28		The implementation of the geothermal technology in Scotland may put Scottish people in a disadvantage position compared to those living elsewhere in the UK
3	29	17	**I think the geothermal technology may undermine the image of Scotland**
4	30	18	**I may be embarrassed, and in some way ashamed, by telling people living elsewhere that Scotland hosts the geothermal technology**
5	31		Regarding the global transition toward renewable energy technology, Scotland would not be doing better than others if the geothermal technology would be implemented

Appendix C – Study 4

Item development and factor structures

Pilot study

A small pilot study was carried out to ensure participants' understanding of the items. In this phase, 40 participants from Scotland were recruited within Prolific. Participants were presented with items concerning the new constructs. Apart from measuring their level of agreement as in the actual survey, they were also asked, in an open question, to indicate if the items were clear and easy to understand and to indicate whether they faced any problems when completing the survey. For what concerns the open questions, these participants mainly indicated items about *threat toward self-esteem* to be hard to understand. Consistently, the correlation matrix showed that items within this factor weakly correlated with each other. Problematic items were then improved, reformulated, and a further sample of 20 participants was recruited. This set of items were judged as easy to understand and the bivariate correlations confirmed a good base for further testing.

Details of items selection – pre-registered study plan

Items within each factor were focused on a specific aspect from which *support* and *threat* of each identity motive could emerge in the context of energy technology implementation. For example, Item 1 of the factor *support toward continuity motives* focused on the consistency between the novel geothermal technology and past energy industries, while Item 2 of the same factor put more emphasis on the positive role of the geothermal technology in preserving group traditions. In this sense, both aspects reflected the construct of continuity but the specific meaning of each item was different. The goal was to offer a parsimonious six-item observed measure for each of the new latent constructs (support and threat toward identity motives). To address this goal, the pre-registration indicated two first-order factors composed by two items of each sub-dimension of group-level continuity, self-esteem, and distinctiveness motive. Therefore, support toward identity motives should have included two items from the continuity motive, two items from the self-esteem motive, and two items from the distinctiveness motive. The same procedure was planned for threat toward identity motives. In fact, in a different research context (Bagci et al., 2020), it has been shown that items of social identity need of esteem, meaning, belonging, continuity, and efficacy loaded well on a single first-order factor.

The pre-registered plan could not be implemented based on CFA model fit indices. All possible combinations were tested for thoroughness; however, the present results did not replicate the one-factor structure of Bagci's study. This was probably due to the different research context and different items used.

Only recently, after the present pre-registration was submitted, Breakwell et al. (2021) validated the "Identity Resilience Index", a second-order construct formed by four first-order identity dimensions (self-esteem, self-efficacy, continuity, and distinctiveness). Identity resilience was defined as reflecting "the individual's capacity to maintain a stable sense of identity in the face of change" (p. 2). The conceptualisation of the current study of identity motives is certainly different as I refer to a specific applied context. However, Breakwell's study underscores the importance of examining different factors structures more thoroughly when investigating different identity motives.

Details of item selection – current study plan

An iterative approach was used to reduce the number of items per factor. Based on Breakwell's identity motive factor structures, the goal was to retain three items per factor to pursue both parsimony and to avoid empirical under-identification (Kline, 2015). Approaches to item selection can be divided into macro-categories: homogeneity optimisation and content optimisation. A content optimisation was the preferred choice as bivariate correlations suggested a good base for homogeneity of items within each factor, actually supporting some degree of redundancy between some pairs of items (see Bandalos, 2021; Boyle 1991). To do this, a multivariate approach was adopted: items were evaluated not only in relation to their own factor, but also to all the other factors. The iterative approach was applied to the Scottish sample. Once the factor structures were finalised, the same factor structures were tested again in the Welsh sample.

Some key items had a high correspondence with the construct meaning. For other items, there was no theoretical reason to prefer one item over the other within the same factor, therefore a data-driven approach was used. Key items were Items 3 and 4 for support toward continuity motives. Items 3 and 4 were equally important for the support toward distinctness motives, Item 1 for support toward self-esteem motives, Item 1 for threat toward continuity motives, Item 2 and 5 for the threat toward distinctness motives, Item 1 and 4 for the threat toward self-esteem motives (see Appendix B, column DIS-R).

First, an exploratory factor analysis based on *oblimin* rotation was carried out using all items. Number of factors to extract was set to 6.

Second, a confirmatory factor analysis that included all items of the six factors was tested. This step aimed at the identification of the weakest items (based on the magnitude of loadings). When the weakest item showed the strongest theoretically correspondence but still achieving a sufficient loading (i.e., $\geq .5$), the second weakest item was dropped.

Third, the new CFA model's matrix of residual correlations was inspected (i.e., the standardised matrix of the differences between observed and predicted covariances). As mentioned before, the positive and negative identity motive factors can be conceptualised as a continuum where the two extremes represent high support and high threat respectively. Therefore, the way in which items of these constructs were written, along with the same meaning associated with them, respectively with a positive and negative valence, may create a substantial ground for correlated residuals between items of these factors (e.g., Bandalos, 2021). For this reason, both residuals within item factors, and residuals between items of all factors were examined. Apart from carrying out the good practice to inspect the model *local fit* as suggested by many authors (e.g., Kline, 2015; Brown, 2015), this step aimed at reducing the number of items to reach a less complex model. Priority was given to the sum of the highest correlated residuals; if two items of the same factor showed a similar amount of total residuals, the item with the highest loadings between the two was chosen.

Fourth, results were further revised in light of convergent and discriminant validity, see below.

Details of criteria for scale validity

In terms of the discriminant validity (i.e., whether the six scales were empirically distinct), the empirical evidence was examined in light of the theory explaining the constructs of interest. Rather than relying on simple cut-off points (i.e., "yes" or "no"), I evaluated the extent to which novel constructs were empirically different from each other and how the difference was theoretically appropriated. I expected the novel constructs to be meaningfully associated to each other, as these represent different aspects of a two theoretically plausible second order constructs of *threat* and *support* toward social identity motives. At the same time, these constructs should still provide unique variance of their distinctive contribution. To do this, I followed Rönkkö and Cho (2022) who stressed the importance of shifting from a cut-off to a classification system in the assessment of discriminant validity. The authors pointed out that "A large correlation does not always mean a discriminant validity problem if one is expected based on theory or prior empirical observations" (p. 33). Based on Monte Carlo simulations, the authors compared two novel techniques named "CI_{CFA} (cut)" and "χ^2 (cut)" to a series of common discriminant validity techniques (e.g., based on the average variance extracted, omega indices, MTMM matrices, and HTMT ratio). Results of their simulation study demonstrated that the novel techniques outperformed the common techniques, and particularly highlighted the usefulness of the "CI_{CFA} (cut)" for practical purposes. This technique is based on the covariance/correlation matrix among factors tested in a classic confirmatory analysis model. According to the recommended classification system, the upper bound (UL) limit of the confidence interval of covariance between each pair of factors should be interpreted as follows: if UL < .8 *no problem*, if UL ranges from ≤ .8 to < .9 *marginal problem*; if UL ranges from ≤ .9 and <.1 *moderate problem*; if UL ≤ 1 *severe problem*.

Details of items selection results

Results of exploratory factor analysis: all items

Results of the exploratory factor analysis showed that items of the support toward group-level identity motives loaded on the expected factors. Items of the threat toward group-level identity motives indicated not negligible cross-loadings (i.e., > .4), especially between the continuity and the self-esteem motives (see Figure 1C). Importantly, most of the key items loaded > .4 on their respective factor.

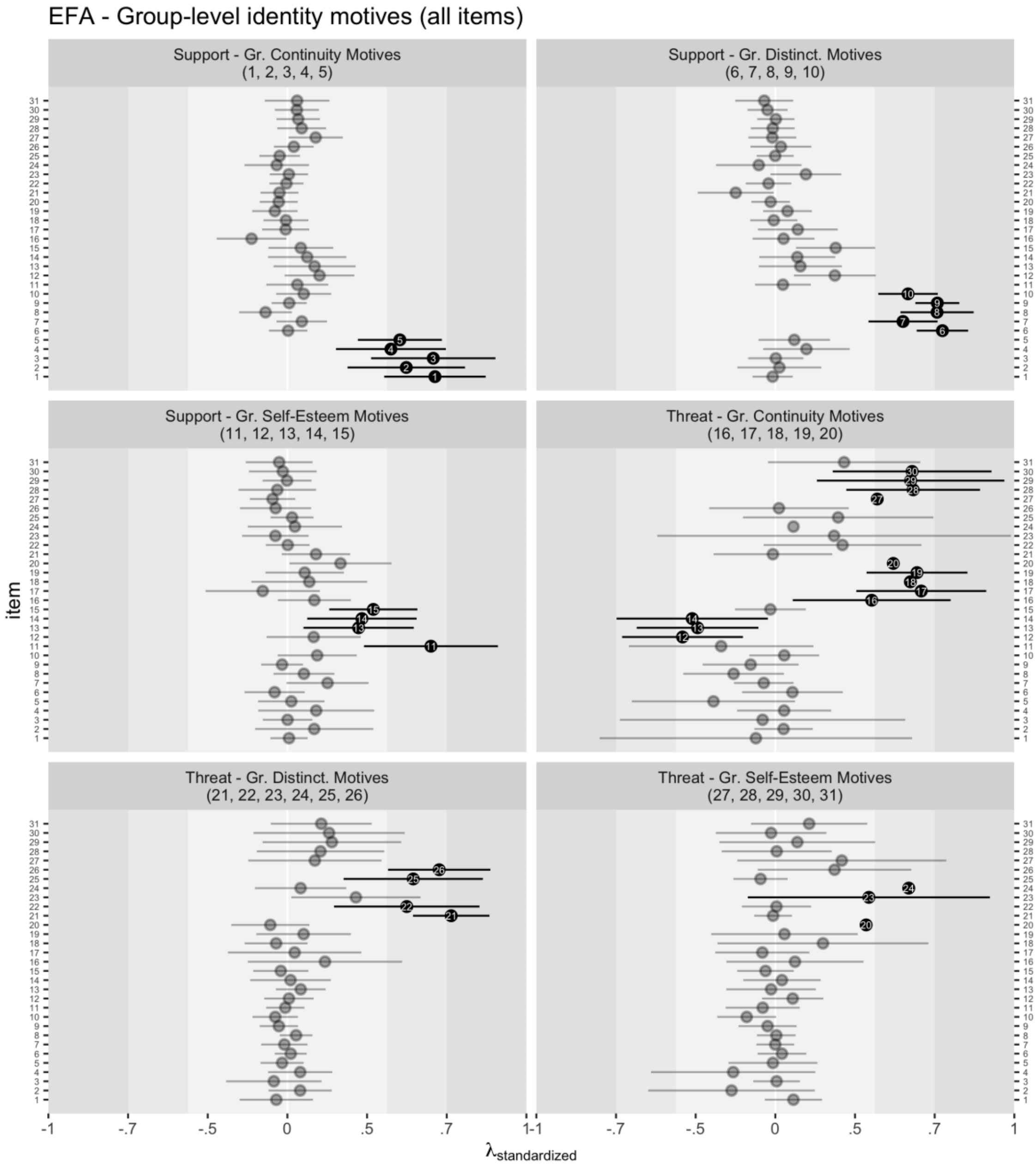

Figure 1C. Preliminary exploratory factor analysis. All items are included. *Note.* For numerical indices of this graph, see Appendix B. *Note 2.* Loadings ≥ +/- .4 are numbered.

Details of items selection results based on item correspondence with the construct, factor loadings and residual correlations.

The confirmatory factor analysis including all items of the six factors was tested. The model fitted the data not sufficiently well (χ^2_{419} 950.567, $p < .001$; SRMR = .070; RMSEA= .070, 90% CI [.064, .076]; CFI= .903; TLI= .892). The following items were dropped based on factor loadings and level of item correspondence with the construct meaning: Item 1 for the support toward continuity motives, Item 1 for the support toward distinctness motives, Item 5 for support toward self-esteem motives, Item 5 for threat toward continuity motives, Item 4 for the threat toward distinctness motives, and Item 5 for the threat toward self-esteem motives (see Appendix B). In sum, only one item was both a key item for the construct meaning and also had the weakest loading among the other items of the same factor (i.e., Item 1 of the threat toward continuity motives, loading = .665). This item was retained and the second weakest item was provisionally dropped (i.e., Item 5, loading = .713). The new resulting model was fitted and it showed a sufficient fit to the data (χ^2_{260} 536.532, $p < .001$; SRMR = .056; RMSEA= .065, 90% CI [.057, .073]; CFI= .937; TLI= .927).

The last phase of item selection followed four criteria: minimising residual correlations, preserving key items, maintaining content and discriminant validity. These different goals were mostly in line with each other. In fact, 5/7 items were dropped based on the highest sum of correlated residuals, while also meeting the other criteria. The factor *support toward distinctiveness motives* presented a conflict between highest sum of residuals and key items that were required to be retained. Differences in the sum of residuals between key items and other items were minimal (i.e., .042 more in the key item 4) so Item 5 of this factor was dropped instead. Subsequent analyses showed that the discriminant validity of the *threat toward continuity motives* was substantially better when including again Item 5 of this factor and dropping Item 4 instead (Item 5 was initially dropped after factor loading inspection). In the final model, Item 5 of this factor was retained, and Item 4 was dropped.

Details of the results of the scale validity

Results of the discriminant validity based on the CI upper limits of the covariance between the latent constructs suggested that 12/15 pairs of factors could be classified as "no problem" according to the previously discussed classification system (i.e., < .8). The upper bound correlation between support toward distinctiveness motives and self-esteem motives was classified as "marginal problem" (r = .856). The upper bound correlation between threat toward continuity motives and self-esteem motives was classified as "marginal problem" (i.e., r = .868). Finally, the upper bound correlation between threat toward distinctiveness motives and self-esteem motives was classified as "moderate problem" (i.e., .907). This last upper bound correlation needs further consideration in light of the nested model comparison discussed in the thesis. The comparisons clearly indicated the superiority of a three-factor structure of the *threat social identity motives* over a one factor structure. Moreover, the model comparisons also indicated the plausibility of a second-order factor, which is consistent with the explanation of the less distinct structure among *threat social identity motives* factors. Therefore, discriminant validity was accepted as sufficiently appropriate. Consistently, Tay and Jebb (2018) claimed that "Constructs are often assumed to be distinguished by their degree of orthogonality. However, two constructs may be part of a common continuum but inhabit different levels on it" (p. 377).

The construct validity was further examined by verifying the strength of the correlations between the novel latent variables and the more established construct of "social identity violation" (Mayer et al., 2009). To perform this analysis, the construct social identity violation was included in the CFA model. Results showed a good and significant strength (p < .001) between social identity violation and threat toward continuity motives (r = .72), threat toward distinctiveness motives (r = .82), and threat toward self-esteem motives (r = .84). The correlations between social identity violation and support toward continuity motives (r = -.20), distinctiveness motives (r = -.38), and self-esteem motives (r = -.57) were less strong but significant as well (p < .001). However, these weaker associations are may be due to the opposite valence associated with these constructs, rather than a different underlying construct meaning. In fact, latent correlations between each factor of threat and support toward identity motives showed similar strength-level correlations, ranging from -.16 to -.65. Therefore, construct validity was supported.

Appendix D – Study 4

Results of the measurement invariance across gender

Since indicators used to measure the novel latent constructs had the same meaning across the two populations investigated, invariance was also tested for gender, i.e. those who identified as "Female" or "Male". Non-binary gender or "prefer to not declare" subgroups were excluded from this analysis due to limited number of observations (N = 4). The two samples, Scottish and Welsh, were merged and the gender equivalence was tested.

Following the same procedure as for the measurement invariance across populations, a series of nested models were compared across gender. The multigroup configural model fit well (χ^2_{240} 380.786, $p < .001$; SRMR = .045; RMSEA= .050, 90% CI [.040, .059]; CFI= .974; TLI= .967).

Results of the invariance test indicated that the chi-square difference between all levels of invariance was not significant (see Tables 1D, 2D, and 3D). Therefore, measurement invariance was also supported across gender.

Table 1D. Nested model comparison – Robust (MLR) Chi-Squared Difference Test

MI level	*df*	AIC	BIC	*χ2*	*Δ χ2*	Δ *df*	*p value*
Configural	240	31326	31932	482.23			
Weak	252	31320	31873	499.65	121.219	12	.4359
Strong	264	31303	31804	507.52	77.052	12	.8077
Residual	282	31295	31717	535.29	147.851	18	.6767

Note. Invariance across gender.

Table 2D. Model fit indices – Robust estimator (MLR)

	χ2	*df*	*p value*	RMSEA	CFI
Configural	380.786	240	< .001	.050	.974
Weak	392.028	252	< .001	.049	.974
Strong	401.824	264	< .001	.047	.975
Residual	411.035	282	< .001	.045	.975

	TLI	SRMR	AIC	BIC
Configural	.967	.045	31.326.082	31.931.935
Weak	.968	.048	31.319.496	31.872.667
Strong	.970	.049	31.303.372	31.803.860
Residual	.973	.049	31.295.137	31.716.600

Note. Invariance across gender.

Table 3D. Non-significant differences in fit indices

	df	RMSEA	CFI	TLI	SRMR	AIC	BIC
Weak - Config.	12	-.001	.000	.002	.004	-6.585	-59.268
Strong - Weak	12	-.002	.001	.002	.000	-16.124	-68.807
Resid. - Strong	18	-.002	.001	.003	.000	-8.235	-87.260

Note. Invariance across gender.

Appendix E – Study 4

Table 1E. Fit indices of the CFA models.

	df	**χ^2**	**RMSEA CI Lower**	**RMSEA**	**RMSEA CI Upper**	**SRMR**	**CFI**	**TLI**
Model 1	284	754.402	.054	.059	.064	.050	.932	.922
Model 2	284	723.617	.052	.058	.063	.047	.943	.935
Model 3	284	718.668	.053	.058	.063	.047	.939	.930
Model 4	175	420.556	.048	.055	.061	.045	.950	.940
Model 5	175	396.654	.046	.053	.060	.037	.961	.953
Model 6	175	399.199	.047	.054	.061	.042	.956	.948
Model 7	260	607.836	.047	.053	.058	.048	.951	.943
Model 8	260	588.866	.046	.051	.057	.041	.959	.952
Model 9	260	591.280	.047	.053	.058	.045	.955	.948
Model 10	284	708.215	.050	.055	.060	.055	.936	.926
Model 11	284	695.380	.049	.054	.059	.051	.946	.938
Model 12	284	695.930	.050	.055	.060	.054	.941	.933

Note. All *p-values* corresponding to the χ^2 were significant (< .001).

Table 2E. Parameter estimates of the confirmatory factor analysis of Model 1.

Latent Factor	Indicator	*B*	SE	Z	*β*
Perc. Risks	Risk_1	1.376	0.048	28.706	0.853
Perc. Risks	Risk_2	1.395	0.052	26.709	0.900
Perc. Risks	Risk_3	1.385	0.048	28.989	0.878
Perc. Risks	Risk_4	1.191	0.054	22.087	0.825
Perc. Risks	Risk_5	1.284	0.051	25.216	0.816
Perc. Risks	Risk_6	1.089	0.056	19.540	0.754
Thr. - Cont. Mot.	Thr.Con_1	0.885	0.074	11.879	0.587
Thr. - Cont. Mot.	Thr.Con_3	1.114	0.060	18.500	0.763
Thr. - Cont. Mot.	Thr.Con_5	1.178	0.058	20.460	0.800
Sup. - Cont. Mot.	Sup.Con_2	1.281	0.051	25.017	0.871
Sup. - Cont. Mot.	Sup.Con_3	0.859	0.062	13.898	0.620
Sup. - Cont. Mot.	Sup.Con_4	1.297	0.054	23.828	0.860
Perm. of Gr. B.	Perm_1	1.530	0.062	24.594	0.810
Perm. of Gr. B.	Perm_2	1.217	0.075	16.295	0.714
Perm. of Gr. B.	Perm_3	1.322	0.074	17.902	0.674
Perm. of Gr. B.	Perm_4	1.313	0.073	18.002	0.728
Perm. of Gr. B.	Perm_5	0.979	0.076	12.834	0.493
Coll. Act. Ag.	Coll.Ac_1	1.017	0.079	12.904	0.783
Coll. Act. Ag.	Coll.Ac_2	1.142	0.072	15.854	0.713
Coll. Act. Ag.	Coll.Ac_3	1.501	0.066	22.653	0.847
Coll. Act. Ag.	Coll.Ac_4	1.287	0.072	17.895	0.793
Coll. Act. Ag.	Coll.Ac_5	1.235	0.071	17.327	0.760
Coll. Act. Ag.	Coll.Ac_6	0.939	0.077	12.169	0.729
Interac. term	InterC_1	2.094	0.184	11.408	0.842
Interac. term	InterC_2	1.443	0.220	6.565	0.613
Interac. term	InterC_3	2.202	0.211	10.448	0.786

B = non-standardized estimate; *SE* = standard error; Z= test statistic; *β* = standardized estimate. All *p*-values corresponding to the z-statistic were significant < .001).

Table 3E. Parameter estimates of the confirmatory factor analysis of Model 2.

Latent Factor	Indicator	*B*	SE	Z	*β*
Perc. Risks	Risk_1	1.376	0.048	28.531	0.853
Perc. Risks	Risk_2	1.393	0.053	26.273	0.899
Perc. Risks	Risk_3	1.384	0.048	28.539	0.877
Perc. Risks	Risk_4	1.195	0.054	21.959	0.828
Perc. Risks	Risk_5	1.286	0.051	25.220	0.817
Perc. Risks	Risk_6	1.086	0.056	19.397	0.752
Thr. - Est. Mot.	Thr.Est_1	1.303	0.059	22.186	0.797
Thr. - Est. Mot.	Thr.Est_3	1.243	0.062	20.036	0.893
Thr. - Est. Mot.	Thr.Est_4	0.962	0.067	14.354	0.814
Sup. - Est. Mot.	Sup.Est_1	1.244	0.054	22.885	0.890
Sup. - Est. Mot.	Sup.Est_3	1.203	0.054	22.105	0.765
Sup. - Est. Mot.	Sup.Est_4	1.103	0.062	17.684	0.817
Perm. of Gr. B.	Perm_1	1.526	0.062	24.468	0.808
Perm. of Gr. B.	Perm_2	1.216	0.075	16.267	0.713
Perm. of Gr. B.	Perm_3	1.319	0.074	17.925	0.672
Perm. of Gr. B.	Perm_4	1.323	0.071	18.504	0.733
Perm. of Gr. B.	Perm_5	0.978	0.076	12.828	0.493
Coll. Act. Ag.	Coll.Ac_1	1.016	0.079	12.816	0.782
Coll. Act. Ag.	Coll.Ac_2	1.139	0.072	15.776	0.711
Coll. Act. Ag.	Coll.Ac_3	1.503	0.066	22.900	0.848
Coll. Act. Ag.	Coll.Ac_4	1.287	0.072	17.892	0.793
Coll. Act. Ag.	Coll.Ac_5	1.238	0.071	17.422	0.762
Coll. Act. Ag.	Coll.Ac_6	0.937	0.077	12.116	0.727
Interac. term	InterE_1	2.292	0.241	9.517	0.899
Interac. term	InterE_2	2.103	0.203	10.360	0.778
Interac. term	InterE_3	2.019	0.254	7.937	0.800

B = non-standardized estimate; *SE* = standard error; Z= test statistic; *β* = standardized estimate.
All *p*-values corresponding to the z-statistic were significant (< .001).

Table 4E. Parameter estimates of the confirmatory factor analysis of Model 3.

Latent Factor	Indicator	*B*	SE	Z	*β*
Perc. Risks	Risk_1	1.378	0.048	28.626	0.854
Perc. Risks	Risk_2	1.395	0.052	26.595	0.900
Perc. Risks	Risk_3	1.387	0.048	28.877	0.879
Perc. Risks	Risk_4	1.194	0.054	22.077	0.827
Perc. Risks	Risk_5	1.277	0.051	25.047	0.811
Perc. Risks	Risk_6	1.086	0.056	19.507	0.752
Thr. - Dis. Mot.	Thr.Dis_2	1.000	0.059	16.922	0.802
Thr. - Dis. Mot.	Thr.Dis_5	1.074	0.061	17.624	0.816
Thr. - Dis. Mot.	Thr.Dis_6	1.227	0.055	22.395	0.852
Sup. - Dis. Mot.	Sup.Dis_2	1.208	0.058	20.944	0.839
Sup. - Dis. Mot.	Sup.Dis_3	1.224	0.056	21.911	0.884
Sup. - Dis. Mot.	Sup.Dis_4	1.158	0.064	18.127	0.839
Perm. of Gr. B.	Perm_1	1.533	0.062	24.856	0.811
Perm. of Gr. B.	Perm_2	1.214	0.075	16.264	0.712
Perm. of Gr. B.	Perm_3	1.329	0.073	18.111	0.677
Perm. of Gr. B.	Perm_4	1.311	0.074	17.837	0.727
Perm. of Gr. B.	Perm_5	0.971	0.077	12.646	0.489
Coll. Act. Ag.	Coll.Ac_1	1.019	0.079	12.909	0.784
Coll. Act. Ag.	Coll.Ac_2	1.142	0.071	16.042	0.713
Coll. Act. Ag.	Coll.Ac_3	1.499	0.065	22.913	0.846
Coll. Act. Ag.	Coll.Ac_4	1.285	0.071	18.045	0.792
Coll. Act. Ag.	Coll.Ac_5	1.233	0.070	17.496	0.759
Coll. Act. Ag.	Coll.Ac_6	0.943	0.077	12.251	0.732
Interac. term	InterD_1	2.249	0.227	9.917	0.892
Interac. term	InterD_2	1.837	0.213	8.609	0.750
Interac. term	InterD_3	1.822	0.262	6.968	0.718

B = non-standardized estimate; *SE* = standard error; Z= test statistic; *β* = standardized estimate. All *p*-values corresponding to the z-statistic were significant (< .001).

Table 5E. Parameter estimates of the confirmatory factor analysis of Model 4.

Latent Factor	Indicator	*B*	SE	Z	*β*
Perc. Risks	Risk_1	1.376	0.048	28.666	0.853
Perc. Risks	Risk_2	1.396	0.052	26.703	0.901
Perc. Risks	Risk_3	1.385	0.048	29.009	0.878
Perc. Risks	Risk_4	1.191	0.054	22.131	0.825
Perc. Risks	Risk_5	1.281	0.051	25.166	0.814
Perc. Risks	Risk_6	1.089	0.056	19.468	0.754
Thr. - Cont. Mot.	Thr.Con_1	0.885	0.075	11.864	0.587
Thr. - Cont. Mot.	Thr.Con_3	1.112	0.061	18.374	0.762
Thr. - Cont. Mot.	Thr.Con_5	1.179	0.058	20.424	0.800
Sup. - Cont. Mot.	Sup.Con_2	1.283	0.051	25.099	0.873
Sup. - Cont. Mot.	Sup.Con_3	0.860	0.062	13.929	0.620
Sup. - Cont. Mot.	Sup.Con_4	1.295	0.055	23.702	0.859
Perm. of Gr. B.	Perm_1	1.530	0.062	24.612	0.810
Perm. of Gr. B.	Perm_2	1.219	0.075	16.349	0.715
Perm. of Gr. B.	Perm_3	1.320	0.074	17.816	0.673
Perm. of Gr. B.	Perm_4	1.314	0.073	18.057	0.728
Perm. of Gr. B.	Perm_5	0.978	0.076	12.828	0.493
Intention to Prot.	Coll.Ac_1	1.228	0.066	18.705	0.945
Interac. term	InterC_1	2.096	0.185	11.347	0.843
Interac. term	InterC_2	1.443	0.220	6.558	0.613
Interac. term	InterC_3	2.200	0.211	10.413	0.786

B = non-standardized estimate; *SE* = standard error; Z= test statistic; *β* = standardized estimate.
All *p*-values corresponding to the z-statistic were significant (< .001).

Table 6E. Parameter estimates of the confirmatory factor analysis of Model 5.

Latent Factor	Indicator	*B*	SE	Z	*β*
Perc. Risks	Risk_1	1.376	0.048	28.475	0.852
Perc. Risks	Risk_2	1.394	0.053	26.224	0.899
Perc. Risks	Risk_3	1.384	0.049	28.482	0.878
Perc. Risks	Risk_4	1.196	0.054	21.948	0.829
Perc. Risks	Risk_5	1.284	0.051	25.163	0.815
Perc. Risks	Risk_6	1.086	0.056	19.335	0.752
Thr. - Est. Mot.	Thr.Est_1	1.304	0.059	22.085	0.797
Thr. - Est. Mot.	Thr.Est_3	1.242	0.062	19.926	0.891
Thr. - Est. Mot.	Thr.Est_4	0.963	0.067	14.352	0.815
Sup. - Est. Mot.	Sup.Est_1	1.245	0.054	22.956	0.890
Sup. - Est. Mot.	Sup.Est_3	1.203	0.054	22.106	0.766
Sup. - Est. Mot.	Sup.Est_4	1.102	0.062	17.671	0.816
Perm. of Gr. B.	Perm_1	1.526	0.062	24.499	0.808
Perm. of Gr. B.	Perm_2	1.218	0.075	16.326	0.714
Perm. of Gr. B.	Perm_3	1.317	0.074	17.843	0.671
Perm. of Gr. B.	Perm_4	1.323	0.071	18.563	0.733
Perm. of Gr. B.	Perm_5	0.977	0.076	12.817	0.492
Intention to Prot.	Coll.Ac_1	1.228	0.066	18.705	0.945
Interac. term	InterE_1	2.288	0.241	9.490	0.897
Interac. term	InterE_2	2.105	0.202	10.404	0.779
Interac. term	InterE_3	2.022	0.254	7.966	0.802

B = non-standardized estimate; *SE* = standard error; Z= test statistic; *β* = standardized estimate. All *p*-values corresponding to the z-statistic were significant (< .001).

Table 7E. Parameter estimates of the confirmatory factor analysis of Model 6.

Latent Factor	Indicator	*B*	SE	Z	*β*
Perc. Risks	Risk_1	1.378	0.048	28.556	0.854
Perc. Risks	Risk_2	1.396	0.053	26.545	0.901
Perc. Risks	Risk_3	1.387	0.048	28.812	0.880
Perc. Risks	Risk_4	1.195	0.054	22.103	0.828
Perc. Risks	Risk_5	1.274	0.051	24.993	0.809
Perc. Risks	Risk_6	1.086	0.056	19.428	0.752
Thr. - Dis. Mot.	Thr.Dis_2	0.999	0.059	16.913	0.801
Thr. - Dis. Mot.	Thr.Dis_5	1.076	0.061	17.646	0.817
Thr. - Dis. Mot.	Thr.Dis_6	1.226	0.055	22.410	0.851
Sup. - Dis. Mot.	Sup.Dis_2	1.209	0.058	20.952	0.839
Sup. - Dis. Mot.	Sup.Dis_3	1.223	0.056	21.935	0.883
Sup. - Dis. Mot.	Sup.Dis_4	1.158	0.064	18.118	0.839
Perm. of Gr. B.	Perm_1	1.534	0.062	24.898	0.812
Perm. of Gr. B.	Perm_2	1.216	0.074	16.327	0.713
Perm. of Gr. B.	Perm_3	1.326	0.074	18.031	0.676
Perm. of Gr. B.	Perm_4	1.311	0.073	17.888	0.727
Perm. of Gr. B.	Perm_5	0.969	0.077	12.614	0.488
Intention to Prot.	Coll.Ac_1	1.228	0.066	18.705	0.945
Interac. term	intD1	2.249	0.227	9.894	0.892
Interac. term	intD2	1.836	0.214	8.587	0.750
Interac. term	intD3	1.824	0.261	6.979	0.719

B = non-standardized estimate; *SE* = standard error; Z= test statistic; *β* = standardized estimate.
All *p*-values corresponding to the z-statistic were significant (< .001).

Table 8E. Parameter estimates of the confirmatory factor analysis of Model 7.

Latent Factor	Indicator	*B*	SE	Z	*β*
Perc. Risks	Risk_1	1.373	0.048	28.603	0.851
Perc. Risks	Risk_2	1.395	0.052	26.845	0.900
Perc. Risks	Risk_3	1.381	0.048	28.843	0.876
Perc. Risks	Risk_4	1.194	0.054	22.184	0.827
Perc. Risks	Risk_5	1.287	0.051	25.302	0.818
Perc. Risks	Risk_6	1.091	0.056	19.451	0.755
Thr. - Cont. Mot.	Thr.Con_1	0.870	0.072	12.094	0.577
Thr. - Cont. Mot.	Thr.Con_3	1.128	0.059	19.140	0.773
Thr. - Cont. Mot.	Thr.Con_5	1.175	0.057	20.758	0.797
Sup. - Cont. Mot.	Sup.Con_2	1.264	0.051	24.995	0.860
Sup. - Cont. Mot.	Sup.Con_3	0.866	0.062	13.965	0.625
Sup. - Cont. Mot.	Sup.Con_4	1.310	0.053	24.762	0.869
Perm. of Gr. B.	Perm_1	1.528	0.062	24.500	0.809
Perm. of Gr. B.	Perm_2	1.216	0.075	16.247	0.713
Perm. of Gr. B.	Perm_3	1.324	0.074	18.009	0.675
Perm. of Gr. B.	Perm_4	1.313	0.073	18.077	0.728
Perm. of Gr. B.	Perm_5	0.984	0.076	12.888	0.496
Social Accept.	Accep_1	1.108	0.056	19.657	0.811
Social Accept.	Accep_2	1.195	0.055	21.568	0.876
Social Accept.	Accep_3	1.255	0.059	21.188	0.724
Social Accept.	Accep_4	1.378	0.047	29.013	0.921
Social Accept.	Accep_5	1.109	0.059	18.734	0.643
Interac. term	InterC_1	2.122	0.183	11.562	0.853
Interac. term	InterC_2	1.428	0.221	6.460	0.607
Interac. term	InterC_3	2.182	0.213	10.250	0.779

B = non-standardized estimate; *SE* = standard error; Z= test statistic; *β* = standardized estimate. All *p*-values corresponding to the z-statistic were significant (< .001).

Table 9E. Parameter estimates of the confirmatory factor analysis of Model 8.

Latent Factor	Indicator	*B*	SE	Z	*β*
Perc. Risks	Risk_1	1.373	0.048	28.453	0.851
Perc. Risks	Risk_2	1.392	0.053	26.308	0.898
Perc. Risks	Risk_3	1.379	0.049	28.268	0.874
Perc. Risks	Risk_4	1.199	0.054	22.023	0.830
Perc. Risks	Risk_5	1.291	0.051	25.345	0.820
Perc. Risks	Risk_6	1.089	0.056	19.334	0.753
Thr. - Est. Mot.	Thr.Est_1	1.296	0.060	21.587	0.793
Thr. - Est. Mot.	Thr.Est_3	1.254	0.062	20.306	0.900
Thr. - Est. Mot.	Thr.Est_4	0.958	0.067	14.394	0.811
Sup. - Est. Mot.	Sup.Est_1	1.226	0.055	22.361	0.877
Sup. - Est. Mot.	Sup.Est_3	1.215	0.054	22.445	0.773
Sup. - Est. Mot.	Sup.Est_4	1.113	0.061	18.400	0.824
Perm. of Gr. B.	Perm_1	1.524	0.062	24.390	0.806
Perm. of Gr. B.	Perm_2	1.214	0.075	16.201	0.712
Perm. of Gr. B.	Perm_3	1.322	0.073	18.066	0.674
Perm. of Gr. B.	Perm_4	1.323	0.071	18.566	0.733
Perm. of Gr. B.	Perm_5	0.984	0.076	12.884	0.495
Social Accept.	Accep_1	1.096	0.057	19.320	0.802
Social Accept.	Accep_2	1.195	0.055	21.587	0.876
Social Accept.	Accep_3	1.258	0.059	21.239	0.726
Social Accept.	Accep_4	1.384	0.048	29.007	0.925
Social Accept.	Accep_5	1.107	0.059	18.759	0.642
Interac. term	InterE_1	2.284	0.241	9.464	0.896
Interac. term	InterE_2	2.107	0.203	10.360	0.779
Interac. term	InterE_3	2.025	0.255	7.941	0.803

B = non-standardized estimate; *SE* = standard error; Z= test statistic; *β* = standardized estimate. All *p*-values corresponding to the z-statistic were significant (< .001).

Table 10E. Parameter estimates of the confirmatory factor analysis of Model 9.

Latent Factor	Indicator	*B*	SE	Z	*β*
Perc. Risks	Risk_1	1.373	0.048	28.561	0.851
Perc. Risks	Risk_2	1.393	0.052	26.621	0.899
Perc. Risks	Risk_3	1.380	0.048	28.577	0.875
Perc. Risks	Risk_4	1.199	0.054	22.203	0.831
Perc. Risks	Risk_5	1.285	0.051	25.253	0.816
Perc. Risks	Risk_6	1.092	0.056	19.534	0.755
Thr. - Dis. Mot.	Thr.Dis_2	1.001	0.059	17.001	0.802
Thr. - Dis. Mot.	Thr.Dis_5	1.074	0.061	17.551	0.816
Thr. - Dis. Mot.	Thr.Dis_6	1.226	0.055	22.104	0.852
Sup. - Dis. Mot.	Sup.Dis_2	1.218	0.056	21.576	0.845
Sup. - Dis. Mot.	Sup.Dis_3	1.221	0.055	22.294	0.881
Sup. - Dis. Mot.	Sup.Dis_4	1.152	0.063	18.238	0.835
Perm. of Gr. B.	Perm_1	1.531	0.062	24.801	0.810
Perm. of Gr. B.	Perm_2	1.213	0.075	16.238	0.712
Perm. of Gr. B.	Perm_3	1.332	0.073	18.249	0.679
Perm. of Gr. B.	Perm_4	1.311	0.073	17.911	0.726
Perm. of Gr. B.	Perm_5	0.974	0.077	12.684	0.491
Social Accept.	Accep_1	1.105	0.056	19.648	0.808
Social Accept.	Accep_2	1.206	0.055	22.060	0.884
Social Accept.	Accep_3	1.246	0.060	20.653	0.719
Social Accept.	Accep_4	1.374	0.048	28.603	0.918
Social Accept.	Accep_5	1.111	0.059	18.709	0.644
Interac. term	InterD_1	2.248	0.231	9.742	0.892
Interac. term	InterD_2	1.838	0.213	8.637	0.750
Interac. term	InterD_3	1.824	0.262	6.949	0.719

B = non-standardized estimate; *SE* = standard error; Z= test statistic; *β* = standardized estimate. All *p*-values corresponding to the z-statistic were significant (< .001).

Table 11E. Parameter estimates of the confirmatory factor analysis of Model 10.

Latent Factor	Indicator	*B*	SE	Z	*β*
Perc. Risks	Risk_1	1.374	0.048	28.498	0.851
Perc. Risks	Risk_2	1.395	0.053	26.537	0.900
Perc. Risks	Risk_3	1.383	0.048	28.688	0.877
Perc. Risks	Risk_4	1.191	0.054	21.989	0.825
Perc. Risks	Risk_5	1.285	0.051	25.182	0.817
Perc. Risks	Risk_6	1.092	0.056	19.395	0.756
Thr. - Cont. Mot.	Thr.Con_1	0.893	0.073	12.169	0.593
Thr. - Cont. Mot.	Thr.Con_3	1.117	0.060	18.566	0.765
Thr. - Cont. Mot.	Thr.Con_5	1.169	0.058	20.092	0.793
Sup. - Cont. Mot.	Sup.Con_2	1.248	0.051	24.295	0.849
Sup. - Cont. Mot.	Sup.Con_3	0.863	0.062	13.825	0.623
Sup. - Cont. Mot.	Sup.Con_4	1.327	0.054	24.753	0.880
Perm. of Gr. B.	Perm_1	1.531	0.062	24.638	0.810
Perm. of Gr. B.	Perm_2	1.215	0.075	16.255	0.713
Perm. of Gr. B.	Perm_3	1.325	0.073	18.045	0.675
Perm. of Gr. B.	Perm_4	1.311	0.073	18.014	0.727
Perm. of Gr. B.	Perm_5	0.981	0.076	12.866	0.494
Coll. Act. Fa.	Coll.Fav_1	0.980	0.056	17.565	0.662
Coll. Act. Fa.	Coll.Fav_2	1.282	0.068	18.759	0.689
Coll. Act. Fa.	Coll.Fav_3	1.568	0.061	25.903	0.802
Coll. Act. Fa.	Coll.Fav_4	1.369	0.066	20.642	0.726
Coll. Act. Fa.	Coll.Fav_5	1.300	0.061	21.208	0.756
Coll. Act. Fa.	Coll.Fav_6	1.052	0.064	16.341	0.672
Interac. term	InterC_1	2.083	0.184	11.351	0.838
Interac. term	InterC_2	1.445	0.219	6.583	0.614
Interac. term	InterC_3	2.213	0.213	10.384	0.790

B = non-standardized estimate; *SE* = standard error; Z= test statistic; *β* = standardized estimate.
All *p*-values corresponding to the z-statistic were significant (< .001).

Table 12E. Parameter estimates of the confirmatory factor analysis of Model 11.

Latent Factor	Indicator	*B*	SE	Z	*β*
Perc. Risks	Risk_1	1.374	0.048	28.363	0.851
Perc. Risks	Risk_2	1.393	0.053	26.040	0.899
Perc. Risks	Risk_3	1.382	0.049	28.151	0.876
Perc. Risks	Risk_4	1.197	0.055	21.803	0.829
Perc. Risks	Risk_5	1.288	0.051	25.182	0.818
Perc. Risks	Risk_6	1.089	0.057	19.262	0.753
Thr. - Est. Mot.	Thr.Est_1	1.302	0.060	21.804	0.796
Thr. - Est. Mot.	Thr.Est_3	1.247	0.062	20.036	0.895
Thr. - Est. Mot.	Thr.Est_4	0.959	0.067	14.344	0.812
Sup. - Est. Mot.	Sup.Est_1	1.232	0.054	22.633	0.882
Sup. - Est. Mot.	Sup.Est_3	1.218	0.054	22.529	0.775
Sup. - Est. Mot.	Sup.Est_4	1.104	0.062	17.944	0.817
Perm. of Gr. B.	Perm_1	1.526	0.062	24.563	0.808
Perm. of Gr. B.	Perm_2	1.214	0.075	16.243	0.712
Perm. of Gr. B.	Perm_3	1.321	0.073	18.073	0.674
Perm. of Gr. B.	Perm_4	1.321	0.071	18.514	0.732
Perm. of Gr. B.	Perm_5	0.980	0.076	12.858	0.493
Coll. Act. Fa.	Coll.Fav_1	0.975	0.056	17.382	0.659
Coll. Act. Fa.	Coll.Fav_2	1.264	0.069	18.305	0.679
Coll. Act. Fa.	Coll.Fav_3	1.588	0.059	26.860	0.812
Coll. Act. Fa.	Coll.Fav_4	1.366	0.067	20.453	0.724
Coll. Act. Fa.	Coll.Fav_5	1.310	0.060	21.705	0.761
Coll. Act. Fa.	Coll.Fav_6	1.036	0.064	16.071	0.662
Interac. term	InterE_1	2.282	0.241	9.468	0.895
Interac. term	InterE_2	2.109	0.203	10.387	0.780
Interac. term	InterE_3	2.025	0.255	7.952	0.803

B = non-standardized estimate; *SE* = standard error; Z= test statistic; *β* = standardized estimate.
All *p*-values corresponding to the z-statistic were significant (< .001).

Table 13E. Parameter estimates of the confirmatory factor analysis of Model 12.

Latent Factor	Indicator	*B*	SE	Z	*β*
Perc. Risks	Risk_1	1.375	0.048	28.417	0.852
Perc. Risks	Risk_2	1.394	0.053	26.342	0.900
Perc. Risks	Risk_3	1.384	0.049	28.417	0.877
Perc. Risks	Risk_4	1.197	0.054	21.979	0.829
Perc. Risks	Risk_5	1.280	0.051	25.041	0.813
Perc. Risks	Risk_6	1.090	0.056	19.368	0.754
Thr. - Dis. Mot.	Thr.Dis_2	1.000	0.059	16.918	0.801
Thr. - Dis. Mot.	Thr.Dis_5	1.074	0.061	17.593	0.816
Thr. - Dis. Mot.	Thr.Dis_6	1.227	0.055	22.265	0.852
Sup. - Dis. Mot.	Sup.Dis_2	1.217	0.057	21.231	0.845
Sup. - Dis. Mot.	Sup.Dis_3	1.221	0.055	22.131	0.882
Sup. - Dis. Mot.	Sup.Dis_4	1.153	0.063	18.187	0.835
Perm. of Gr. B.	Perm_1	1.534	0.062	24.902	0.812
Perm. of Gr. B.	Perm_2	1.213	0.075	16.258	0.712
Perm. of Gr. B.	Perm_3	1.330	0.073	18.219	0.678
Perm. of Gr. B.	Perm_4	1.310	0.073	17.870	0.726
Perm. of Gr. B.	Perm_5	0.972	0.077	12.660	0.489
Coll. Act. Fa.	Coll.Fav_1	0.971	0.056	17.255	0.657
Coll. Act. Fa.	Coll.Fav_2	1.266	0.069	18.302	0.681
Coll. Act. Fa.	Coll.Fav_3	1.592	0.060	26.667	0.814
Coll. Act. Fa.	Coll.Fav_4	1.370	0.067	20.515	0.726
Coll. Act. Fa.	Coll.Fav_5	1.306	0.061	21.398	0.759
Coll. Act. Fa.	Coll.Fav_6	1.034	0.065	16.024	0.660
Interac. term	InterD_1	2.254	0.230	9.807	0.894
Interac. term	InterD_2	1.831	0.213	8.599	0.747
Interac. term	InterD_3	1.824	0.263	6.923	0.719

B = non-standardized estimate; *SE* = standard error; Z= test statistic; *β* = standardized estimate.
All *p*-values corresponding to the z-statistic were significant (< .001).

Appendix F – Study 4

Table 1F. Monte Carlo Confidence Interval – Indirect effects (Model 1-6).

Model 1-6				
	Estimate	**CI Lower**	**CI Upper**	***p value***
Model 1	.002	-.007	.017	.615
Model 2	.004	-.005	.017	.446
Model 3	.007	-.009	.025	.327
Model 4	0.004	-.012	.021	.562
Model 5	0.006	-.008	.025	.401
Model 6	0.016	.001	.038	.066

Note. This table refers to "*Results of the H3 path in the intention to act against and the intention to protest*" in the thesis (section 5.6.2.).

Table 2F. SEM Model fit indices for R^2 analysis.
This refers to Table 27 in the thesis, section 5.6.3. "*Model comparisons via direct matrix calculation of $R^2_{Reduced}$*".

	df	χ^2	**RMSEA CI Lower**	**RMSEA**	**RMSEA CI Upper**	**SRMR**	**CFI**	**TLI**
Model 13	128	405.823	0.060	0.068	0.075	0.052	0.949	0.940
Model 14	128	382.974	0.059	0.067	0.074	0.046	0.956	0.948
Model 15	128	370.080	0.058	0.065	0.073	0.044	0.957	0.948
Model 16	59	148.988	0.045	0.057	0.068	0.045	0.975	0.967
Model 17	59	138.393	0.044	0.056	0.068	0.030	0.980	0.974
Model 18	59	121.537	0.037	0.050	0.062	0.032	0.983	0.978
Model 19	112	257.434	0.044	0.052	0.061	0.045	0.974	0.968
Model 20	112	241.457	0.041	0.050	0.058	0.032	0.979	0.975
Model 21	112	235.873	0.040	0.049	0.058	0.036	0.979	0.974
Model 22	128	384.145	0.056	0.063	0.070	0.062	0.951	0.942
Model 23	128	377.414	0.055	0.062	0.069	0.058	0.959	0.951
Model 24	128	362.054	0.054	0.061	0.068	0.059	0.958	0.950

p-value of all $\chi^2 = < .001$

Table 3F. Monte Carlo Confidence Interval – Indirect effects (Model 7-12).

Models 7-12				
	Estimate	**CI Lower**	**CI Upper**	***p value***
Model 7	-.003	-.016	.009	.577
Model 8	-.004	-.020	.005	.444
Model 9	-.011	-.034	.004	.188
Model 10	.001	-.005	.009	.756
Model 11	.001	-.006	.009	.689
Model 12	.004	-.010	.021	.615

Note. This table refers to "*Results of the H3 path in the intention to act against and the intention to protest*" in the thesis (section 5.6.2.).

Appendix G – Deviations from pre-registration and OSF files

Deviations from the pre-registration of Study 2, 3, and 4.

The present summary contains all the deviations from the pre-registration that were made in the present work. Each change is also presented, and better explained, in the relevant sections of each study. The goal of this section is to offer a list of all changes made in order to give a unified overview of these deviations.

Study Information

Hypotheses

1. Study 2 and Study 3 were initially pre-registered as a unique model. For this reason, the hypotheses were described as part of a unique model. After pre-registering, it was decided to split the model into two parts. Therefore, the two sub-models were analysed separately. This decision was based on the necessity to simplify the model complexity. In fact, when planning the present research work, I underestimated the sample size limits for such large models due to my lack of expertise in treating latent variables when I started my PhD course.
2. While the content of the hypotheses in Study 2, 3 and 4 remained the same as in the pre-registered hypotheses, the form has changed. In fact, the hypotheses have been reworded for clarity.

Sampling Plan

Data collection procedures

3. For Study 2 and Study 3, participants were supposed to be recruited via personal and on-line invitation. However, recruitment was concluded only via on-line invitation. Personal invitation consisted of knocking on people's doors asking if they would like to participate in a research project about their opinion on geothermal energy in Cornwall. However, the bad weather in Cornwall occurring during the recruitment annual period made the personal invitation phase unfeasible.

Sample size plan

4. The sample size of Study 2 and Study 3 was supposed to be decided after recruiting the first 100 participants, to then run a Monte Carlo simulation power analysis using the estimates from this small sample. However, the main endogenous variable was highly skewed in this first small sample, with very

little variability. Therefore, I decided to rely on other parameters such as rules of thumb and post-doc power analysis based on RMSEA population.

Analysis Plan

Statistical models

5. The pre-registration of Study 2 and Study 3 only mentioned a maximum likelihood estimator. However, I used an estimator with robust standard errors to account for non-normal distributed data.
6. In Study 2 and Study 3 all the reverse-coded items were dropped due to their poor statistical proprieties.
7. Items from the collective *not* self-determined motivations were dropped to further simplify the model complexity (Study 3).
8. Since the variable descriptive social norms contained 2 out of 4 reverse-coded items, the two remaining items were constrained to be equal to avoid identification problems (Study 2).
9. In order to reduce correlate residuals, 6 out of 12 items were used to form the variables group-based positive and negative emotions (Study 2).
10. In the pre-registration, the following correlated residuals imposed within the models were not mentioned:

    - between positive and negative group-based emotions (Study 2)
    - between the third and fourth item of ingroup identification (Study 2)
    - between the first and second item of the procedural justice climate (Study 3)

11. The pre-registered SIMPEA model (Study 2) did not fit the data. An alternative model, exploratory instead, is proposed.
12. A follow-up exploratory analysis was added in Study 3 to help with the results interpretation.
13. The novel constructs considered in Study 4 were pre-registered as a two-first order factors structure. These factor structures could not be supported. The final model consisted of a six-first order factors structure.
14. Changing the factor structures in Study 4 implied adaptations in the structural models. Rather than testing four structural models as declared in the pre-

registration (i.e., one for each of the outcome variables), the actual analyses included a total of 12 models.

15. The role group relative deprivation in Study 4 was vaguely mention in the pre-registration without specifications. The actual analysis has included this variable to better understand the role of the permeability of the group boundaries.

OSF files

Pre-registration Study 2 and Study 3
https://osf.io/sa5x8/?view_only=dc93d2587a1e42c8ba728f2d2b285257

Pre-registration Study 4:
https://osf.io/fyz7x/?view_only=e02642000b164aac9d68cdcf685616b1

Dataset and R scripts – Study 2, 3, and 4:
https://osf.io/wkx72/?view_only=cef2b5e28ac540cabb43977d36ba292c