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PSYCHOLOGICAL SELF-PROTECTION IN THE FACE OF CLIMATE CHANGE

A Need-Based Empirical Investigation of the Spectrum of Climate Denial

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Manuscript 1: Wullenkord, M. C. (2020). Climate change through the lens of Self-Determination Theory: How considering basic psychological needs may bring environmental psychology forward. *Umweltpsychologie, 24*(2), 110–129.

Manuscript 2: Wullenkord, M. C., & Reese, G. (2021). Avoidance, rationalization, and denial: Defensive self-protection in the face of climate change negatively predicts pro-environmental behavior. *Journal of Environmental Psychology, 77*(101683).
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Manuscript 3: Wullenkord, M. C. (under review). Looking the other way: Basic psychological need satisfaction negatively predicts defensive self-protection in the face of the climate crisis. *Journal of Environmental Psychology.*

Manuscript 4: Wullenkord, M. C., Tröger, J., Hamann, K. R. S., Loy, L. S., & Reese, G. (2021). Anxiety and climate change: A validation of the Climate Anxiety Scale in a German-speaking quota sample and an investigation of psychological correlates. *Climatic Change, 168*(3). https://doi.org/10.1007/s10584-021-03234-6

Manuscript 5: Wullenkord, M. C. (2021). From denial of facts to rationalization and avoidance: Ideology, needs, and gender predict the spectrum of climate denial and self-protection. *PsyArXiv.* https://doi.org/10.31234/osf.io/w49t8

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Please note that all supplementary materials can be found in the digital attachment accompanying this dissertation.

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IV Abstract

Climate change is an existential threat to human survival, the social organization of society, and the stability of ecosystems. It is thereby profoundly frightening. In the face of threat, people often want to protect themselves instead of engaging in mitigating behaviors. When psychological resources are insufficient to cope, people often respond with different forms of denial. In this dissertation, I contribute original knowledge to the understanding of the multifaceted phenomenon of climate denial from a psychological perspective.

There are four major gaps in the literature on climate denial: First, the spectrum of climate denial as a self-protective response to the climate crisis has not received attention within psychology. Second, basic psychological need satisfaction, a fundamental indicator of human functioning and the ability to cope with threat, has not been investigated as a predictor of climate denial. Third, relations of the spectrum of climate denial to climate-relevant emotions, specifically climate anxiety, have not been examined empirically. Forth, it has not been investigated how the spectrum of climate denial relates to established predictors of climate denial, namely right-wing ideological convictions and male gender. To address those gaps, I investigate what the spectrum of climate denial looks like in the German context and how it relates to basic psychological need satisfaction and frustration, pro-environmental behavior, climate anxiety, ideological conviction, and gender.

Five manuscripts reveal that climate denial exists on a spectrum in the German context, ranging from the distortion of facts (interpretive climate denial, specifically *denial of personal and global outcome severity*) to the denial of the implications of climate change (implicatory climate denial, specifically *avoidance*, *denial of guilt*, and *rationalization of one's own involvement*). Across analyses, low basic psychological need satisfaction predicted the spectrum of climate denial, which was negatively related to pro-environmental behavior. Climate denial was generally negatively related to climate anxiety, except for a positive association of avoidance and climate anxiety. Right-wing ideological conviction was the strongest predictor of climate denial across the spectrum. However, low need satisfaction and male gender were additional weaker predictors of implicatory climate denial.

These findings suggest that the spectrum of climate denial serves many psychological functions. Climate denial is possibly both a self-protective strategy to downregulate emotions and to protect oneself from loss of privilege. In short, it represents a barrier to climate action that may only be resolved once people have sufficient psychological resources to face the threat of climate change and cope with their underlying self-protective, emotional responses.

V Zusammenfassung (German Abstract)

Der Klimawandel stellt eine existenzielle Bedrohung für das menschliche Überleben, die soziale Organisation der Gesellschaft und die Stabilität der Ökosysteme dar. Er ist daher zutiefst beängstigend. Im Angesicht von Bedrohungen wollen sich Menschen häufig schützen, anstatt sich proaktiv zu verhalten. Wenn psychologische Ressourcen zur Bewältigung nicht ausreichen, reagieren Menschen oft mit verschiedenen Formen der Leugnung. Diese Dissertation leistet einen Beitrag zum Verständnis des vielschichtigen Phänomens der Klimawandelleugnung aus psychologischer Sicht.

Es gibt vier Forschungslücken in der Literatur zur Klimawandelleugnung: Erstens hat das Spektrum der Klimawandelleugnung als Selbst-schützende Reaktion auf die Klimakrise innerhalb der Psychologie bisher keine Beachtung gefunden. Zweitens wurde psychologische Grundbedürfnisbefriedigung, ein fundamentaler Indikator für menschliches Funktionieren und die Fähigkeit, mit Bedrohungen umzugehen, bisher nicht als Prädiktor für Klimawandelleugnung untersucht. Drittens sind Beziehungen des Spektrums der Klimawandelleugnung zu klimarelevanten Emotionen, insbesondere der Klimaangst, bisher nicht empirisch untersucht worden. Viertens wurde bisher nicht untersucht, wie sich das Spektrum der Klimawandelleugnung zu etablierten Prädiktoren der Klimawandelleugnung, d.h. rechtsideologischen Überzeugungen und männlichem Geschlecht, verhält. Um diese Lücken zu schließen, untersuche ich, wie sich das Spektrum der Klimawandelleugnung im deutschen Kontext manifestiert und wie es mit psychologischer Grundbedürfnisbefriedigung und -frustration, umweltfreundlichem Verhalten, Klimaangst, ideologischer Überzeugung und Geschlecht zusammenhängt.

Fünf Manuskripte zeigen, dass Klimawandelleugnung im deutschen Kontext auf einem Spektrum existiert, das von der Verzerrung von Fakten (interpretative Leugnung, insbesondere *Leugnung der persönlichen und globalen Folgenschwere*) bis zur Leugnung von Implikationen reicht (implikatorische Leugnung, insbesondere *Vermeidung*, *Leugnung von Schuld* und *Rationalisierung der eigenen Beteiligung*). Über alle Analysen hinweg war niedrige psychologische Grundbedürfnisbefriedigung Prädiktor für das Spektrum der Klimawandelleugnung, das wiederum mit umweltfreundlichem Verhalten assoziiert war. Klimawandelleugnung stand generell in einem negativen Zusammenhang mit Klimaangst, mit Ausnahme einer positiven Assoziation von Vermeidung und Klimaangst. Rechtsideologische Überzeugung war der stärkste Prädiktor für Klimawandelleugnung über das gesamte Spektrum hinweg. Niedrige Bedürfnisbefriedigung und männliches Geschlecht waren weitere, aber schwächere Prädiktoren für imp-

likatorische Leugnung.

Diese Ergebnisse legen nahe, dass das Spektrum der Klimawandelleugnung viele psychologische Funktionen erfüllt. Klimawandelleugnung ist möglicherweise sowohl eine Selbst-schützende Strategie, um Emotionen herunter zu regulieren, als auch um sich vor dem Verlust von Privilegien zu schützen. Kurz gesagt stellt Klimawandelleugnung eine Barriere für Klimaschutzmaßnahmen dar, die möglicherweise erst dann überwunden wird, wenn Menschen über ausreichende psychologische Ressourcen verfügen, um sich der Bedrohung durch den Klimawandel zu stellen und mit zugrundeliegenden Selbst-schützenden, emotionalen Reaktionen umzugehen.

1 Introduction

"At first when I heard about climate change, I was a climate denier. I didn't think it was happening. Because if there really was an existential crisis like that, that would threaten our civilization, we wouldn't be focusing on anything else."
— *Greta Thunberg*

Why do we fail to act as though we are in the midst of an existential crisis? Why do we not face it and why do we deny climate change instead? I wrote this dissertation out of a desire to understand these questions. As Greta implies, many of us simply do not think that the climate crisis could be happening, that it could really be as bad as it is, or that it could have psychological, moral, or political implications for us personally. Over the years, environmental psychology research has identified a plethora of factors that explain why people engage in pro-environmental behaviors (i.e., behaviors aimed at minimizing negative impact on the environment). These factors include problem awareness, perceived behavioral control, or social norms (see for example Bamberg & Möser, 2007 for an overview). However, they are not always sufficient to explain lack of engagement or insufficient engagement. Consistently, most prominent environmental-psychological models (e.g., theory of planned behavior, Ajzen, 1985; norm activation model, Schwartz, 1977, Schwartz & Howard, 1981; value belief norm theory, Stern, 2000; but see for example protection motivation theory, R. W. Rogers, 1983) omit something crucial: The fact that climate change is extremely scary and difficult to bear emotionally. Instead, people desire to protect themselves and turn away from the problem of climate change if psychological resources are insufficient to cope (Lertzman, 2015; Norgaard, 2006a, 2006b). Thus, it is important to recognize that responses to environmental crises such as climate change have at least two different faces: First, people need to cope with the traumatic nature of severe environmental and consequent societal change. Second, people need to translate those feelings into action to avert catastrophic outcomes. As such, environmental problems have a component pertaining to mental health and a component pertaining to behavioral responses. I argue that both are equally important and deserve equal attention because they are inherently intertwined (see for example Landmann, 2020). Understanding what helps

people cope with climate-related emotions proactively and what different strategies people use to protect themselves, is thus crucial to understand climate action.

This dissertation aims at enhancing the understanding of the complex phenomenon of climate denial as a self-protective response to the climate crisis and barrier to climate action. To this end, I apply self-determination theory – a humanistic, dialectical theory of human motivation explaining defensiveness as a result of basic psychological need frustration – to the climate context in five manuscripts. In the following sections, I will outline in how far climate denial can be understood as a climate-relevant defensive, self-protective strategy, what types of climate denial exist, and how they may relate to basic psychological need satisfaction and frustration, climate anxiety, ideology, and gender. I will then summarize the identified gaps in the literature and derive the research questions that guided this work. After a short overview over the individual manuscripts, I will move on to discussing the theoretical contributions of this dissertation, its practical implications and limitations, and conclude with possible directions for future research. So what exactly is climate denial?

1.1 Climate Denial as Self-Protection

Climate denial and its consequences are dangerous barriers to climate action. Climate change is the most pressing crisis of our times (Masson-Delmotte et al., 2018). It has devastating consequences if we do not fundamentally reshape our society to create a fossil-free, socially and ecologically just world. In fact, two thirds of the German population acknowledge this and report high pro-environmental attitudes (BMU & UBA, 2019). Nonetheless, these attitudes do not sufficiently translate into social action and appropriate, high-impact pro-environmental behaviors (Moser & Kleinhückelkotten, 2018). Climate denial may explain part of this gap between attitudes and behavior (Norgaard, 2011; Stich & Wagner, 2012).

Denial is a reaction to threat or other stressors that fulfills the function of protecting the self[1] (Moos & Schaefer, 1993), by not recognizing, ignoring, or normalizing the stressor (Cohen,

[1]Please note that throughout the manuscripts, I changed the terminology to refer to climate denial. In some manuscripts, I refer to climate denial by its psychological function as climate-relevant defensive, self-protective strategies or simply self-protection. These terms can be understood as equivalent to the term climate denial as used in this synopsis.

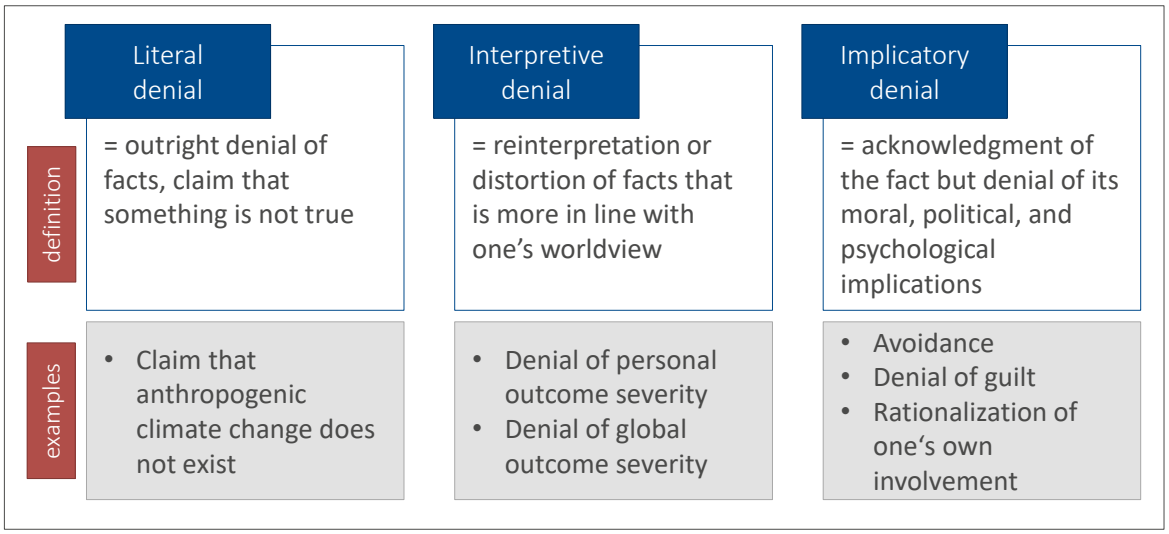
2001). Next to the impact on ecosystems, there are several reasons for why climate change is a threat to many people. To name a few, climate change is an existential threat, potentially endangering human survival if the global community does not follow the Paris Agreement (Smith et al., 2014). Climate change already poses risks for loss of livelihood, mass migration, and civil war (IOM & UN-OHRLLS, 2019). Not less importantly, climate change has fundamental social implications that can feel very threatening, for instance if they involve giving up privilege, ideas, or values (Norgaard, 2019; Stoll-Kleemann & O'Riordan, 2020). Those who are the most privileged in our society (often high-income, middle-aged, white men in countries in the Global North) will be relatively disadvantaged in a socio-ecological transformation because they would have to give up their privileges (Dunlap & Jacques, 2013; Norgaard, 2019). Conservative men are also the ones who tend to deny climate change the most (Jylhä et al., 2016; McCright & Dunlap, 2011; Nelson, 2020). However, the denial often does not take the shape of a denial of facts per se. Often, it manifests as a rejection of the socio-political system that produced the examination of these facts (i.e., climate science and its implications, Norgaard, 2019). In the face of threat, denial does not always equal denial.

Cohen (2001) distinguishes between three forms of denial (see Figure 1): Literal, interpretive, and implicatory denial. Literal denial is the denial of facts, the denial that something is true. The term *climate denial* is most often used in its literal sense – the denial of the fact that anthropogenic climate change exists. But because denial fulfills the function of protecting the self, it can exist in subtler forms. Interpretive denial is the reinterpretation or distortion of facts that is more in line with one's worldview (Cohen, 2001). One may accept that anthropogenic climate change exists but deny that it will have consequences – either for oneself or globally. Lastly, implicatory denial is the acknowledgment of the fact but denial of its moral, political, and psychological implications (Cohen, 2001). In the context of climate change, this is the denial of guilt, rationalization of one's own involvement, and the mere avoidance of its reality in everyday life. Several researchers describe this type of denial as a state of disavowal, of simultaneous (conscious) *knowing but not* (emotional) *knowing* of reality (Ager, 2008; Haseley, 2019; Lertzman, 2015; Norgaard, 2011; Weintrobe, 2013). This is reflected in people living

their lives being aware of climate change but acting in everyday life as though it does not exist (similar to what Greta Thunberg describes in the opening quote). Considering this spectrum of denial, it is presumably not only high-income, middle-aged, white men in the Global North who deny climate change. But why do people use denial if they should know better?

Figure 1

The Spectrum of Denial According to Cohen (2001)



Note. Examples for interpretive and implicatory denial emerged in Manuscript 2 and correspond to the subscales of the *Climate Self-Protection Scale*.

Proactive coping with threats requires sufficient psychological resources (Hunecke, 2013). When those resources are insufficient, people self-protect (Vansteenkiste & Ryan, 2013). Denying that climate change even exists, that it may have consequences globally or for oneself, or that it has moral implications can be understood as self-protection (Norgaard, 2006a): To protect the self from the uncomfortable emotions climate change causes, the identity conflicts it may provoke, and generally to maintain positive self-esteem. Using different terms, Cohen's types of denial have been described in the empirical psychological literature on climate change (e.g., as climate scepticism, Poortinga et al., 2011; de-emphasizing the seriousness of climate change, Ojala, 2015; distancing, Ojala, 2013b; displacement of responsibility, Stoll-Kleemann et al., 2001).

However, a comprehensive nomological network, clear terminology, and according instrument to assess them are lacking. How this research can be systematized by considering the self-protective function climate denial serves will be the content of the next section.

1.2 Basic Psychological Need Satisfaction as a Predictor of Climate Denial

One general predictor of self-protection in the face of threat is the frustration of basic psychological needs, according to self-determination theory (Deci & Ryan, 2000; Ryan & Deci, 2017). Self-determination theory is a humanistic, dialectical theory of human motivation. It proposes that humans have basic psychological needs, defined as "innate psychological nutriments that are essential for ongoing psychological growth, integrity, and well-being" (Deci & Ryan, 2000, p. 229). These consist of the needs for autonomy, competence, and relatedness. People experience satisfaction of autonomy when they can freely choose what to pursue and thereby realize authentic and meaningful interests and values that are aligned with their integrated self. Competence entails the experience of mastery or effectance when realizing optimally challenging plans, goals, or aspirations. The need for relatedness is satisfied when one experiences a sense of belonging to a group and/or a community, and has intimate, safe, and comforting relations with others. Different contexts satisfy those needs more or less well (*context-specific* need satisfaction, e.g., within the environmental domain, in the family home, etc.). The need satisfaction one experiences *across* contexts (i.e., the sum of context-specific need satisfaction) comprises people's *general* need satisfaction. According to self-determination theory and empirical findings, the satisfaction of basic psychological needs leads to well-being and psychological health (e.g., Reis et al., 2000; Wray-Lake et al., 2019), autonomous (i.e., self-determined and thereby self-maintaining) motivation (Deci & Ryan, 1980), the ability to cope with threats (Hodgins et al., 2010; Sheldon et al., 2016), and performance (Sheldon & Filak, 2008). In turn, the frustration of those needs leads to extrinsic motivation and/or amotivation (Ryan & Deci, 2017; Sheldon & Filak, 2008), defensiveness and self-protection (Benita, Kehat, et al., 2019; Hodgins et al., 2006; Vansteenkiste & Ryan, 2013), incongruent behavior (Di

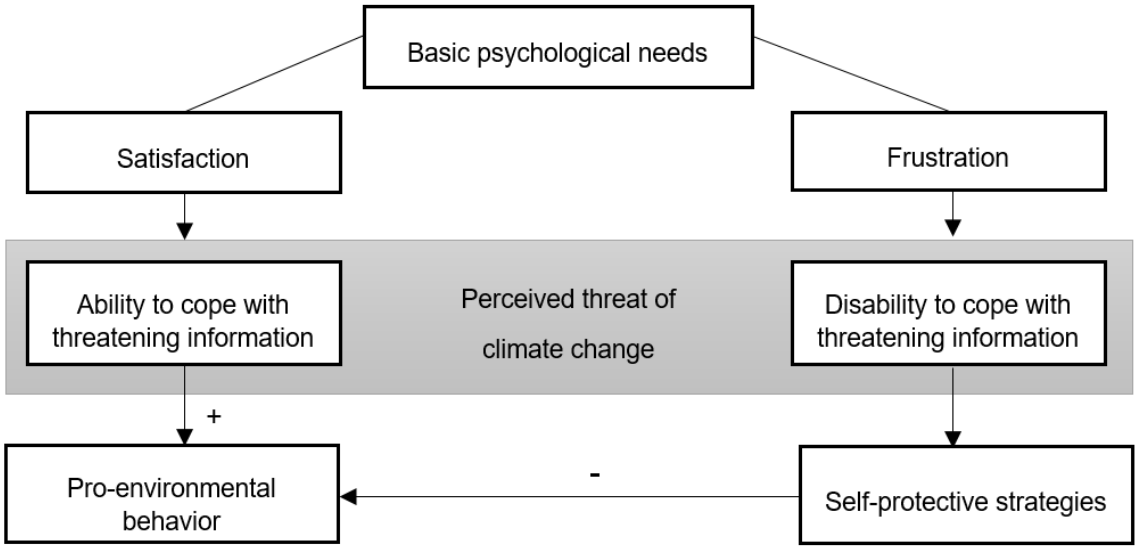
Domenico et al., 2013; Sheldon et al., 1997), and suppressive emotion regulation (i.e., avoiding or suppressing emotions in order to avoid the uncomfortable emotional experience, as in the case of denial, Benita, Benish-Weisman et al., 2019; Brenning et al., 2021; Roth et al., 2019). Simply put, need frustrated people have less psychological resources to cope proactively with threat.

Given that need frustration generally leads to defensiveness, self-protection, and suppressive emotion regulation, it should also be a predictor of climate denial. Figure 2 (taken from Manuscript 1) displays hypothesized relations of basic psychological need satisfaction with different outcome variables in the climate context. In the environmental domain, basic psychological need satisfaction is related to pro-environmental behavior. For instance, people whose basic psychological needs are satisfied have smaller ecological footprints (Cooke et al., 2016), consume clothing more sustainably (Taljaard & Sonnenberg, 2019), report higher sufficiency orientation[2] (Tröger et al., 2021), and have more self-determined motivation for pro-environmental behavior (Grønhøj & Thøgersen, 2017; Kaplan & Madjar, 2015; Osbaldiston & Sheldon, 2003; Pelletier et al., 1998), especially for difficult or uncomfortable behaviors (Aitken et al., 2016; Green-Demers et al., 1997). Based on self-determination theory and these empirical findings, it is reasonable to expect that both environment-specific and general basic psychological need frustration are related to climate-relevant self-protection and thereby climate denial, and an absence of pro-environmental behavior. In fact, people used more self-protective strategies to justify their inconsistent environmentally damaging actions when they had non-autonomous environmental motivation (likely related to need frustration, Lavergne & Pelletier, 2015) and their sense of self was threatened (Lavergne & Pelletier, 2016). However, these relations remain largely uninvestigated. Need-frustrated people also tend to suppress their emotions. Thus, considering the links between climate-related emotions and climate denial should reveal another important dimension of the functionality of climate denial.

[2]Sufficiency is a sustainability strategy aimed at orienting consumption of resources on human needs – to stay within ecological limits whilst fostering social justice. A sufficiency orientation is the attitude towards sufficiency as a sustainability strategy and behavioral intention to act accordingly.

Figure 2

Working Model Depicting the Interrelations of Basic Psychological Needs Satisfaction and Frustration, Pro-Environmental Behavior, and Self-Protective Strategies as a Reaction to Climate Change.



Note. While the satisfaction of basic psychological needs enables the ability to cope with threat proactively and thus, leads to more pro-environmental behavior (left), the frustration of those needs hinders the ability to cope with threat proactively. It thus leads to self-protective strategies such as climate denial (right) and, ultimately less pro-environmental behavior (taken from Manuscript 1).

1.3 The Spectrum of Climate Denial and Climate Anxiety

People ultimately use climate denial as a way of regulating emotions, to protect themselves by numbing the disturbing, uncomfortable emotional experience associated with climate change (see Jonas et al., 2014; Weintrobe, 2013). Another term for this process is controlled (or suppressive) emotion regulation, the diminishing of emotional experiences using avoidance, suppression, or re-appraisal (Roth et al., 2019). If this self-protective process is successful, the emotions may not be consciously felt. People in controlling environments (i.e., environments characterized by pressure, contingency, and autonomy-frustration) become more defensive when trying to suppress their emotions (Benita, Kehat, et al., 2019). In the climate context, Wein-

trobe (2013) describes denial as a repressed manifestation of anxiety that masks the anxiety. Simply put, the anxiety is not accessible to conscious recollection. She argues that ultimately, denial is anxiety-provoking because the cause of the anxiety is not addressed. This requires even more denial to numb the anxiety(a "vicious spiral", p. 39). Kapeller and Jäger (2020) found similar relations between climate denial and climate anxiety in a simulation study using agent-based modelling. Thus, climate denial and anxiety should be negatively related.

Nevertheless, I established earlier that denial does not always equal denial. Different types of climate denial likely relate differently to climate anxiety. The acknowledgement that climate change is a problem with devastating consequences seems to be a necessary condition for the conscious experience of climate anxiety (Weintrobe, 2013). Thus, rationalizing one's own involvement with the climate crisis or avoidance of information about it in everyday life should be less successful strategies to numb the anxious experience (Salander & Windahl, 1999) because these strategies involve acknowledgment of climate change as a problem. Nevertheless, climate denial and climate anxiety have not explicitly been examined in an empirical psychological study and the underlying process of emotion regulation remains unclear. What has been examined extensively, however, are the roles of ideological conviction and gender for literal and interpretive climate denial.

1.4 The Spectrum of Climate Denial, Ideological Convictions, and Gender

Right-wing ideological conviction is the best established predictor of literal and interpretive climate denial (e.g., Feygina et al., 2010; Jylhä et al., 2016; McCright & Dunlap, 2011; Milfont et al., 2021). An ideology can be understood as a more or less coherent belief system. It thereby functions as an attitudinal lens that shapes people's perceptions and appraisals of the world (Jost et al., 2008). Most commonly, research considered right-wing authoritarianism (Altemeyer, 1981; Stanley et al., 2017), social-dominance orientation (Jylhä et al., 2016; Pratto et al., 1994), human dominance over nature (Jylhä & Akrami, 2015; Milfont et al., 2013), system justification (Feygina et al., 2010; Jost & Banaji, 1994), and political left-right orientation

(Norgaard, 2019) as predictors of climate denial. People use literal and interpretive climate denial who prefer conservative norms and values, obedience to authorities, and law and order (right-wing authoritarianism); who support group-based social hierarchies and believe their social group is worth more than low-status groups (social dominance orientation); who believe that humans are superior to nature and have the right to exploit it (human dominance over nature); who want to maintain and justify the status quo (system justification); and who report right-wing political orientation. Given this ideological backdrop, it is likely that climate denial serves the function to protect from loss of privilege (Dunlap & Jacques, 2013; Norgaard, 2019). Norgaard (2019) further proposes that climate denial exists on a political spectrum, with literal and interpretive climate denial on the right of the political spectrum and implicatory climate denial on the left of the political spectrum. Yet, studies are missing that investigate whether ideological conviction also predicts implicatory climate denial and if there are distinct profiles of climate denial.

Another established predictor of literal and interpretive climate denial is male gender (Hultman & Pulé, 2018; Jylhä et al., 2016; McCright & Dunlap, 2011; Nelson, 2020). European climate change contrarian think tanks that promote climate denial as part of the "denial machine" (Oreskes & Conway, 2012) are dominated by men (Almiron et al., forthcoming). Several authors have argued that male climate denial may serve to protect male privilege through an expression of system-justifying ideologies (see Jylhä et al., 2016). Relations to implicatory climate denial, however, have not explicitly been investigated, to my knowledge. Even though there are established predictors of literal and interpretive climate denial, it is unclear how they relate to implicatory climate denial. Essentially, the literature is fragmented but it suggests that climate denial may fulfill the functions of protecting the self from uncomfortable emotional experiences, and from loss of privilege when psychological resources are insufficient to cope in more proactive ways. In the following, I will present how this dissertation addresses all the presented gaps in the literature.

2 The Present Research

My original contribution to knowledge with this dissertation is to synthesize the literature on and understand the complex phenomenon of climate denial from a psychological perspective. To summarize, there are four major gaps in the (psychological) literature on climate denial: First, there is no comprehensive, systematic measure of the spectrum of climate denial and generally defensive, self-protective strategies that people may use to protect themselves when coping with the climate crisis. Second, indicators of fundamental human functioning such as basic psychological need satisfaction have not been investigated in relation to the spectrum of climate denial. Third, relations of climate-relevant emotions with the spectrum of climate denial have not empirically been investigated. Forth, it is unclear whether there are distinct profiles of climate denial and how the spectrum of climate denial relates to established predictors of literal climate denial. This dissertation seeks, thus, to answer the following research questions (RQ):

1. What does the spectrum of climate denial look like in the German context?
2. How do the satisfaction and frustration of basic psychological needs relate to the spectrum of climate denial and pro-environmental behavior?
3. How does the spectrum of climate denial relate to climate-relevant emotions and established predictors of literal and interpretive climate denial?

The manuscripts that comprise the body of this dissertation aim to fill those gaps and answer those research questions.

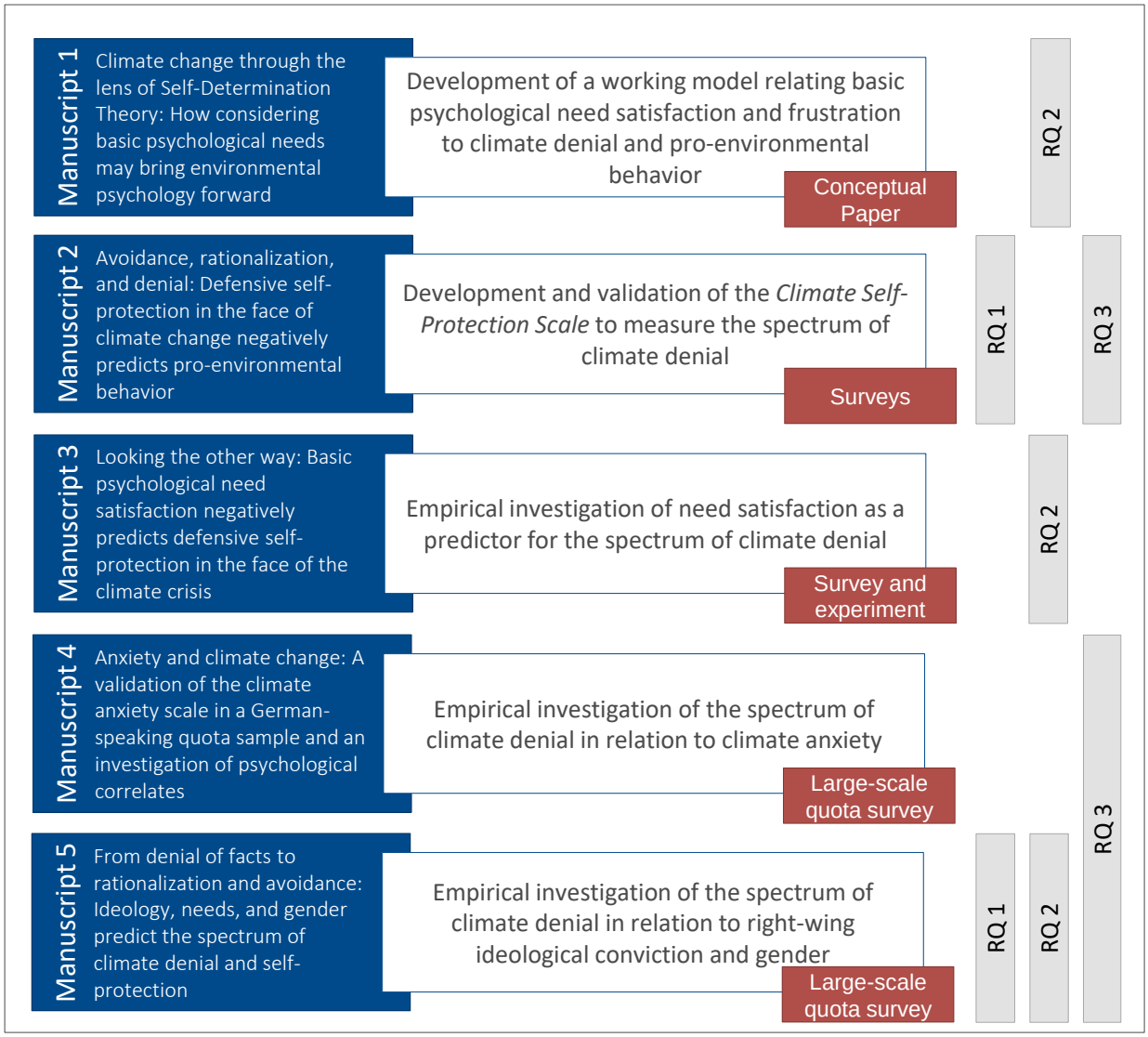
2.1 Structure and Outline of the Manuscripts

In five manuscripts, I introduce a working model on the relations of climate denial with basic psychological need satisfaction (Manuscript 1) and evaluate its merit (Manuscripts 2-5). To make the spectrum of climate denial measurable, I developed and validated the *Climate Self-Protection Scale* (CSPS, Manuscript 2). I then investigated how its subscales relate to a

climate-relevant emotion, namely climate anxiety (Manuscript 4), and to established predictors of literal and interpretive climate denial (Manuscript 5). Figure 3 illustrates the methodological approaches of the manuscripts and which research questions they answer.

Figure 3

Overview over the Manuscripts



Note. RQ = research question.

2.2 Manuscript 1: Development of a Working Model

In Manuscript 1, I argued for how the understanding of human responses to the climate crisis can be enhanced if we consider basic psychological need satisfaction as a predictor of climate denial and pro-environmental behavior (RQ2). Models in environmental psychology explaining pro-environmental behavior, behavior change, and reactions to climate change have generally not included basic indicators of fundamental human functioning (e.g., theory of planned behavior, Ajzen, 1985; norm activation model, Schwartz, 1977, Schwartz & Howard, 1981; value belief norm theory, Stern, 2000). Thus, there is no comprehensive model explaining climate denial as a self-protective response to the threat of climate change. Some theories such as Lazarus' transactional theory of coping (Lazarus, 1991), Festinger's theory of cognitive dissonance (1957), or Bandura's theory of selective moral disengagement (2007) may be adapted to explain self-protection without a focus on behavior. Given the absence of a model that includes both climate denial and pro-environmental behavior as outcome variables and that considers fundamental human functioning as their predictors, I drew on self-determination theory (Deci & Ryan, 2000; Ryan & Deci, 2017) to propose such a simplified model (see Figure 2).

Grounded on the theoretical propositions in self-determination theory and the empirical literature on basic psychological need satisfaction, environmental motivation and behavior, I proposed the following relations: The satisfaction of basic psychological needs fosters the ability to cope with threat proactively and thus, leads to more pro-environmental behavior. In turn, the frustration of basic psychological needs inhibits the ability to cope with threat proactively and leads to self-protection that manifests as different forms of climate denial. In Manuscripts 3 to 5, I investigated these propositions empirically. As climate denial should be a barrier to pro-environmental behavior, Manuscript 2 focused on those relations and how climate denial can be measured.

2.3 Manuscript 2: Development and Validation of the Climate Self-Protection Scale

In Manuscript 2, I developed and validated the CSPS. I first outlined how different climate-relevant self-protective strategies have been operationalized in psychology. These strategies can be understood as different forms of climate denial. However, they have not been integrated into a nomological network and I found no comprehensive measure of the different types of climate denial. I therefore aimed for 1) developing the CSPS, a measure of defensive, climate-relevant self-protective strategies that can be construed as different types of climate denial; 2) validating the CSPS and its underlying structure; and 3) investigating its subscales' relations with various indicators of pro-environmentalism, political orientation, and socio-demographic variables (RQ1). To this end, I conducted two studies.

In Study 1, I developed the CSPS. N=354 German participants responded to a pool of items that I derived from an extensive literature search of psychological and sociological studies on defensive, self-protective strategies and coping in the environmental domain. Exploratory main axis analysis revealed that items loaded onto five factors, corresponding to five self-protective strategies or types of denial (see Figure 1): 1) *Rationalization of own involvement*, the claim that one cannot do anything to mitigate climate change; 2) *Avoidance*, ignoring of information about climate change in everyday life; 3) *Denial of personal outcome severity*, the claim that climate change will not have such negative consequences for oneself; 4) *Denial of global outcome severity*, the claim that global climate change will not be as severe as predicted; and 5) *Denial of guilt*, the claim that one does not need to have a guilty conscience about climate change. Confirming the proposition that denial leads to inactivity (Cohen, 2001), those strategies were negatively associated with self-reported pro-environmental behavior. Men and people with right-wing political orientation generally reported stronger agreement with the statements than women and people with left-wing political orientation.

Using confirmatory factor analysis in Study 2 (N=453 Germans), I validated the underlying structure of the CSPS. The strategies *denial of personal and global outcome severity* corresponded to a secondary factor representing interpretive climate denial. *Rationalization of*

own involvement, avoidance, and *denial of guilt* corresponded to a secondary factor representing implicatory climate denial. Again, men and people with right-wing political orientation reported stronger climate denial. A path model showed that all scales corresponding to interpretive climate denial negatively predicted environmental awareness. All scales corresponding to implicatory climate denial negatively and environmental awareness positively predicted environmental motivation. Rationalization of own involvement and denial of global outcome severity negatively, and environmental motivation positively predicted pro-environmental behavior. Denial of guilt negatively and environmental motivation positively predicted willingness to donate to an environmental organization. In sum, the two studies of Manuscript 2 yielded a reliable and valid measure of different types of climate denial that I could use in further research to investigate relations with basic psychological need satisfaction (RQ2).

2.4 Manuscript 3: Basic Psychological Needs and the Spectrum of Climate Denial

Manuscript 3 is the first to empirically evaluate relations between basic psychological need satisfaction and climate denial, in two studies (RQ2). More specifically, Study 1 (N=453 Germans) aimed at investigating both general and environmental basic psychological need satisfaction and frustration as predictors of climate denial. As predicted, path analysis indicated that low need satisfaction was related to stronger climate denial, and high need satisfaction was related to more autonomous environmental motivation and pro-environmental behavior.

Study 2 (N=392 Germans) built on Study 1 and used an experimental between-subjects design to vary self-esteem threat and investigate its effects on climate denial. I assessed climate denial both explicitly using the CSPS and implicitly using two single category implicit association tests (Greenwald et al., 1998; Karpinski & Steinman, 2006). Again, low need satisfaction predicted explicitly measured climate denial but interestingly, only for men as revealed by regression analysis. For women, climate denial did not vary with basic psychological need satisfaction. Replicating results of Manuscript 2, right-wing political orientation was related to stronger climate denial. Self-esteem threat did not influence climate denial. In sum, the two

studies in Manuscript 3 found first evidence for the association between low basic psychological need satisfaction and stronger climate denial.

2.5 Manuscript 4: Climate Anxiety and the Spectrum of Climate Denial

Given that climate denial generally fulfills the function of protecting the self from threat and to avoid unpleasant emotions, relations with climate change-related emotions are particularly interesting to consider (RQ3). To this end, I investigated the spectrum of climate denial in connection with climate anxiety in Manuscript 4[3]. I used a large German-speaking quota sample stratified for age and gender (N=1011). To represent the spectrum of climate denial more completely (Cohen, 2001; Norgaard, 2019), I also included items assessing literal climate denial. Participants who reported higher climate anxiety generally reported less climate denial, except for denial of personal outcome severity, which was unrelated. Furthermore, people who reported more climate anxiety also avoided climate change more. Those reporting higher climate anxiety also had significantly stronger pro-environmental intentions and support for climate-protective policies. Manuscript 4 thus provides first insights into the relations of the spectrum of climate denial with climate-relevant emotions.

2.6 Manuscript 5: Ideology, Needs, Gender, and the Spectrum of Denial

Drawing on the same sample as Manuscript 4, I investigated the spectrum of climate denial for distinct profiles in Manuscript 5 (RQ1). To this end, I used latent profile analysis, a person-centered statistical approach. Furthermore, I investigated the spectrum of climate denial with respect to right-wing ideological conviction and male gender as established predictors of literal and interpretive climate denial (RQ3), and examined relations with basic psychological need satisfaction (RQ2), using structural equation modelling. Even though participants differed in

[3]Please note that this was a validation study of a German translation of the Climate Anxiety Scale that includes further correlates of climate anxiety that are not the main focus of this dissertation.

the extent to which they denied climate change overall, there was no evidence for distinct profiles. Right-wing ideological conviction emerged as the strongest predictor of climate denial across the spectrum but especially of literal and interpretive climate denial. Low need satisfaction and male gender additionally predicted implicatory climate denial. Manuscript 5 thus showed how this dissertation connects to previous research on more established predictors of climate denial, and shows basic psychological need satisfaction to be relevant for implicatory climate denial beyond right-wing ideological conviction.

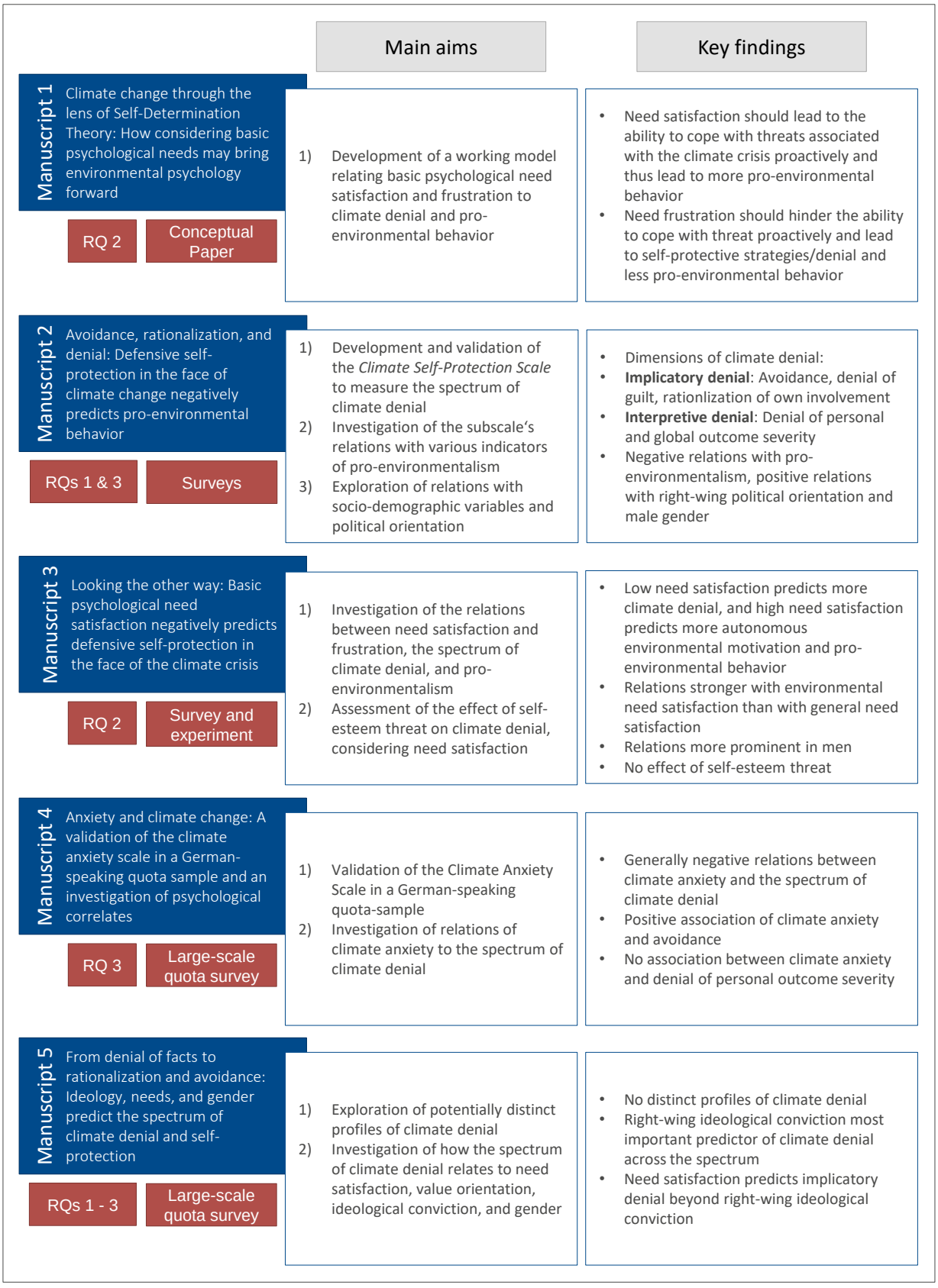
3 Discussion

Climate denial in all its complexities is a widely present barrier to climate action. Its prevalence may indicate that people are lacking psychological resources to cope with the climate crisis in more proactive ways. Understanding its underlying workings is crucial to overcome climate denial and enable people to cope in less destructive ways. In this dissertation, I aimed to contribute to a greater understanding of the spectrum of climate denial from a psychological perspective. To this end, five manuscripts demonstrated that climate denial is a multifaceted phenomenon that exists on a spectrum (Manuscript 2) and is related to low basic psychological need satisfaction (Manuscripts 1, 3, & 5).

Figure 4 summerizes the main aims and key findings of the manuscripts. Manuscript 1 showed that it is theoretically sound to expect basic psychological need satisfaction to enable proactive coping with the threats associated with climate change, resulting in pro-environmental behavior. In turn, I showed that basic psychological need frustration is related to an inability to cope with the threats associated with climate change, resulting in self-protective responses in the form of climate denial, which ultimately represent a barrier to pro-environmental behavior. In Manuscript 2, I developed and validated the CSPS that assesses the spectrum of climate denial on five subscales. These correspond to interpretive climate denial (denial of personal and global outcome severity) and implicatory climate denial (avoidance, denial of guilt, rationalization of one's own involvement).

Figure 4

Main Aims and Key Findings of the Manuscripts



Note. RQ = research question.

These types of climate denial were generally negatively related to pro-environmental outcomes but relations were not always straightforward. Manuscript 3 revealed first empirical support for the relations proposed in Manuscript 1: People with low general and especially environmental need satisfaction also reported stronger climate denial.

In turn, high need satisfaction predicted autonomous environmental motivation and pro-environmental behavior. Experimentally varying self-esteem threat did not have an effect on either implicitly or explicitly measured climate denial. Interestingly, basic psychological need satisfaction and gender interacted to predict climate denial: Men with low need satisfaction reported more climate denial while this relation was absent for women. Climate anxiety was generally negatively related to the spectrum of climate denial, with two notable exceptions: People reporting higher climate anxiety also reported more avoidance, and climate anxiety appeared unrelated to the denial of the personal outcome severity of climate change (Manuscript 4). When investigating the spectrum of climate denial in relation to both established predictors of literal and interpretive climate denial, namely right-wing ideological convictions and male gender, and in relation to basic psychological need satisfaction, right-wing ideological conviction emerged as the strongest predictor of climate denial across the spectrum. Basic psychological need satisfaction appeared as a weak but significant additional predictor of implicatory climate denial (Manuscript 5). In the following, I will discuss the theoretical contributions of this dissertation, outline some of its practical implications, critically consider limitations, and suggest directions for future research.

3.1 The Manifestation of the Spectrum of Climate Denial in the German Context

Manuscript 2 revealed that climate denial exists on a spectrum in the German context. Given the previous lack of a comprehensive nomological network, this dissertation represents an important step towards understanding how multifaceted and complex climate denial is, even if it may seem absent in the German context at first glance (i.e., there is relatively little literal climate denial, Steentjes et al., 2017, Stoll-Kleemann & O'Riordan, 2020). Some of the five

types of climate denial I identified resemble psychological concepts that have not previously been integrated with regard to climate denial.

The psychological literature on interpretive climate denial is quite straightforward, even if it does not use this term, to my knowledge. For example, Sparks (2010; see also Opotow & Weiss, 2000) previously described denial of outcome severity of climate change. This is closely related to the types *denial of personal outcome severity* and *denial of global outcome severity*. Furthermore, the literature on climate denial oftentimes assesses a mixture of literal and interpretive climate denial (e.g., Jylhä et al., 2016), without explicitly distinguishing between them.

The psychological literature on implicatory climate denial is less straightforward. Denial of psychological, political, or moral implications of climate change may be closely related to strategies of selective moral disengagement (Bandura, 2007; Opotow & Weiss, 2000; Stoll-Kleemann & O'Riordan, 2020). More specifically, Sparks' (2010) denial of self-involvement resembles the factor *rationalization of own involvement*. Norgaard's (2006a) perspectival selectivity is related to the factor *avoidance*. Lastly, perceived feelings of guilt have been extensively described in the environmental psychology literature (e.g., Harth et al., 2013; Tagkaloglou & Kasser, 2018). Taken as a whole, climate denial is a widely-present, multifaceted phenomenon in the German context. What functions does it serve?

3.2 Relations Between Need Satisfaction, Climate Denial, and Pro-Environmental Behavior

People with low need satisfaction use more climate denial and engage in less pro-environmental behavior. This dissertation is the first work to investigate how basic psychological need satisfaction as defined in self-determination theory helps explain different types of climate denial. In general, the empirical work in this dissertation supports the theoretical propositions made in self-determination theory (Deci & Ryan, 2000; Ryan & Deci, 2017). It partly replicates the previous literature on basic psychological need satisfaction, autonomous environmental motivation, and pro-environmental behavior (e.g., Aitken et al., 2016; Cooke et al., 2016; Kaplan &

Madjar, 2015; Lavergne et al., 2010) and replicates literature on need frustration and defensiveness (Hodgins et al., 2006, 2010; Vansteenkiste & Ryan, 2013). Thus, it provides first evidence for those relations to explain human responses to the climate crisis, as proposed in Manuscript 1, especially implicatory climate denial (i.e., avoidance and rationalization of own involvement). Here, I will discuss one notable finding pertaining to the difference of need frustration and need satisfaction.

I expected need frustration to predict climate denial most strongly (see Manuscript 1). This was based both on self-determination theory and literature on the differences between lack of need satisfaction and active thwarting of needs (Bartholomew et al., 2011; Vansteenkiste & Ryan, 2013). However, when not using a composite score of basic psychological need satisfaction but investigating need satisfaction and frustration on six separate subscales (autonomy satisfaction and frustration, competence satisfaction and frustration, and relatedness satisfaction and frustration), this picture did not emerge. Rather, it was lack of basic psychological need satisfaction that predicted climate denial. While this is an unexpected finding, there are several potential explanations: Research building on and informing self-determination theory in deductive and inductive empirical processes has traditionally considered "obvious" ill-being outcomes such as loneliness or depression (e.g., Bartholomew et al., 2011). Given that climate denial is also socially constructed and does not only serve psychological functions (i.e., it has a different nature than the "obvious" ill-being outcomes; Hultman et al., 2019; Norgaard, 2019; Zerubavel, 2006), severity of need frustration may not linearly relate to climate denial. Analyses based on the general linear model may thus have been unable to uncover potential distinct profiles of need frustration and climate denial. Furthermore, people experiencing severe need frustration often also experience severe depression (Heissel et al., 2018). Severely depressed people often do not display what is called the optimism bias (Korn et al., 2014) – the overly optimistic expectation that one is unlikely to experience adversity, even when given counter-evidence. If climate denial, just as the optimism bias, fulfills the function of protecting the self, people with severe need frustration may not engage with it. To disentangle these relations further and map the functionality of the different types of climate denial, person-centered analyses

(such as latent profile analysis) of samples experiencing different severity of basic psychological need frustration are needed. Beyond need frustration, what do relations to climate anxiety, ideology, and gender reveal about the functionality of climate denial?

3.3 Associations of Climate Denial with Climate Anxiety and Established Predictors of Literal Denial

To create a broader understanding of the complexities of the spectrum of climate denial, I also investigated its relations with climate anxiety and more established predictors of literal and interpretive climate denial, namely ideological conviction and gender. I will discuss the three aspects in the following sections.

3.3.1 Climate Anxiety and the Spectrum of Climate Denial

This dissertation is the first empirical work on the connections of climate anxiety and the spectrum of climate denial in a German-speaking quota sample. As expected, climate anxiety and climate denial were generally negatively related, with the exception of a positive relation of climate anxiety with avoidance and an absence of a relation with denial of personal outcome severity. My findings replicate the literature on climate denial and climate anxiety that assumes the denial to be a self-protective type of emotion regulation (Kapeller & Jäger, 2020; Weintrobe, 2013). They also replicate the literature on anxiety and avoidance (Epstein, 1972). Nevertheless, based on this cross-sectional data, it is unclear whether the climate anxiety was successfully numbed or masked by engaging in different types of climate denial, or whether the experience of anxiety was in fact never present. To shed light on these underlying relations, longitudinal designs investigating emotion regulation and its manifestations in the climate context are needed.

3.3.2 Right-Wing Ideological Conviction and the Spectrum of Climate Denial

Those reporting right-wing political orientation consistently reported more climate denial across the spectrum. Manuscript 5 identified right-wing ideological conviction, the latent con-

struct emerging from the combination of social-dominance orientation, human dominance over nature, and right-wing authoritarianism, as the strongest predictor of climate denial across the spectrum. The relations were especially strong for interpretive and literal climate denial. This replicates the established finding that right-wing ideological conviction predicts literal and interpretive climate denial (Feygina et al., 2010; Jylhä et al., 2016; McCright & Dunlap, 2011) but is a new finding regarding implicatory climate denial. It also slightly disconfirms Norgaard's (2019) analysis of the political spectrum of climate denial. She proposed that implicatory climate denial is a phenomenon of the political left, at least in the US context. Nevertheless, Hornsey et al. (2018) found weaker links between ideology and literal/interpretive climate denial in countries other than the US. This may in part be due to systematic climate denial being an Anglo-American project of right-wing conservative thinktanks (Jacques, in press). Consistent with this, my work suggests that implicatory climate denial in the German context may fulfill different functions for different people: For some, it may be a form of self-protection from the threat of the disturbing emotional experiences related to the awareness of the climate crisis. For others, it may be a form of self-protection from the threat of societal change as a result of climate change and the resulting potential loss of privilege. For some, it may be both. Given that climate denial has evolved in recent years from more literal and interpretive to more implicatory types (Forchtner, 2021; Stoll-Kleemann & O'Riordan, 2020), these different functionalities may be convoluted and manifest in seemingly identical types of climate denial. Simply put, the same type of denial may fulfill different psychological functions. Do these relations extend to gender-based privilege?

3.3.3 Gender and the Spectrum of Climate Denial

Generally, men engaged in stronger climate denial than women, except for avoidance, which was a more female phenomenon. This replicates the established finding that literal and interpretive climate denial are generally male phenomena that likely serve the function to protect from loss of male privilege (Hultman & Pulé, 2018; Jylhä et al., 2016; McCright & Dunlap, 2011; Nelson, 2020). Interestingly, Study 2 in Manuscript 3 revealed an interaction effect of

basic psychological need satisfaction and gender on climate denial. Men who reported low need satisfaction also reported more overall climate denial and denial on most subscales of the CSPS. Men who reported high need satisfaction reported lowest levels of climate denial. For women, need satisfaction was unrelated to climate denial and levels of climate denial were generally low. This finding may be interpreted as further evidence for the "male denial effect": For men, denying climate change may be a form of self-protection and protection of male privilege. This may be especially triggered when basic psychological needs are frustrated and psychological resources to cope with the climate crisis are few. For women, who also consistently engage in more environmentalism (Bloodhart & Swim, 2020; Gifford & Nilsson, 2014; Stoll-Kleemann & Schmidt, 2017), denying climate change cannot fulfill the same function of protecting gender-based privilege and may thus be less related to basic psychological need satisfaction. In general, climate denial seems to serve the psychological functions of protecting the self from uncomfortable emotions and loss of privilege when psychological resources are scarce. This has tangible implications.

3.4 Practical Implications for Societal Actors

If we want people to act, we need to meet their basic psychological needs – and thereby provide them with psychological resources that render climate denial superfluous. Manuscripts 3 and 5 showed that those who experienced less basic psychological need satisfaction also reported more climate denial. Study 1 in Manuscript 3 is particularly interesting in this regard: Even though relations were stronger with context-specific need satisfaction (i.e., need satisfaction in the environmental context), the same relations emerged when considering *general* need satisfaction. General need satisfaction is, at first glance, unrelated to the *specific* crisis of climate change. Even though causal links have not yet been explored (but see section 3.6 for suggestions for future research), the empirical studies in Manuscripts 3 and 5 suggest that people with high basic psychological need satisfaction may be better equipped to cope proactively with the climate crisis and do not need to protect themselves to the same extent. Meeting people's basic psychological needs generally, in all aspects of life (i.e., irrespective of the specific

climate context), may enable people to cope with the climate crisis. Reversely, if people's needs are not met, people are not well equipped to cope with the specific crisis of climate change and search for ways to protect themselves instead, which stands in the way of urgently needed climate action. This finding has societal implications beyond individual health and well-being.

It is not sufficient to consider human psychology only at the level of the individual. Individuals are embedded in social contexts and cannot be understood without considering their social worlds (Ryan & Deci, 2017). Consistent with this, self-determination theory is a dialectical theory. It proposes need satisfaction to be a function of the social context (Ryan & Deci, 2017): Social contexts can be shaped in ways that enable people to satisfy their basic psychological needs, which in turn enables them to shape their contexts in need-satisfying ways. Thus, to promote climate action and drive a socio-ecological transformation, social contexts across all levels of societal organization need to be shaped in human-friendly, need-satisfying ways. While this sounds like a big task, and it certainly is, this is also associated with plenty of opportunities. In the following sections, I outline what this could look like for different societal actors.

3.4.1 Individuals

While the need to transform societies may seem overwhelming, each individual can help make contexts more need-satisfying and help themselves and others obtain psychological resources to proactively cope with the climate crisis. To make those suggestions more tangible, I will first outline how, generally, basic psychological needs can be satisfied and frustrated. According to self-determination theory (Deci & Ryan, 2000; Ryan & Deci, 2017; see Teixeira et al., 2000 for an overview), autonomy-satisfying situations may be characterized by an absence of pressure, provision of meaningful choice, promotion of interest, empathy with resistance, obstacles, and different perspectives, interest in the other, autonomy-supportive language, and provision of rationales for requested behavior. Autonomy-frustrating situations, in turn, may be characterized by external pressure, punishments, goal imposition, controlling rewards, ego-involvement, and evaluative surveillance. The need for competence is satisfied when activities

are designed in a way that mastery is the dominant experience, when positive informational, not evaluative feedback and informational rewards are provided, when people are not compared with each other, and when challenges are optimally difficult (i.e., not too easy, which results in boredom, and not too difficult, which results in feelings of overwhelm). Rewards that include a contingency, however, undermine competence satisfaction. Lastly, the need for relatedness gets satisfied when respect is conveyed for individuals, individuals perceive themselves to be valued and significant, experience care and concern when facing challenges, when situations are characterized by warmth and inclusion, and opportunities to contribute or give are provided. Individuals may not always have the power to directly change the contexts they are embedded in, especially the more pervasive contexts. Nevertheless, this list of opportunities reveals one important tool: Autonomy-supportive (i.e., need-satisfying) communication.

Autonomy-supportive communication, and specifically non-violent communication (Rosenberg, 1999), can be a tool to use in everyday life to counteract defensiveness and give room for emotions and needs (Ryan & Deci, 2017). It is a need-based mode of communication that aims to increase harmony between communication partners through the satisfaction of needs. It is based on Carl Roger's humanistic, person-centered approach (C. R. Rogers, 1951) and generally follows four steps: 1) Non-evaluative observation of the situation, 2) acknowledgment of the accompanying emotions, 3) identification of underlying needs, and 4) expression of action-oriented requests to meet the underlying needs. Non-violent communication is widely applied in a variety of different contexts and found to be successful at increasing empathy and reducing defensiveness (e.g., McMahon & Pederson, 2020; Suarez et al., 2014). When used in the climate context, it may reduce climate denial because it may fulfill its psychological functions by acknowledging emotions and satisfying needs. Such communication approaches may also be used by groups or other societal actors, such as NGOs.

3.4.2 NGOs

This dissertation and the body of research on the connection of basic psychological need satisfaction and pro-environmentalism also have implications for NGOs and practitioners in

the field, who either design campaigns or run environmental groups. Manuscript 3 revealed that both general and environmental need satisfaction contribute to autonomous environmental motivation. The latter mirrors a host of former research studies (e.g., Quested et al., 2018; Reznickova & Zepeda, 2016). When NGOs want their campaigns to be successful in fostering autonomous environmental motivation, prevent people from getting defensive, and want participants to engage in groups long-term, they also need to meet people's basic psychological needs – both in the immediate context, but also recognizing the seemingly unrelated general satisfaction of basic psychological needs. For example, when designing a campaign, practitioners could ensure that people understand the meaning behind the campaign and foster their ability to make informed decisions by providing a rationale (autonomy). They could ensure that the content of the campaign presents an optimal challenge for most people (competence) and ensure that most people will not experience social exclusion as a result of their actions (relatedness). Furthermore, Pavey et al. (2011) suggest to incorporate relatedness primes in interventions to foster pro-social behavior. Regarding group processes in environmental NGOs, basic psychological needs could be met by establishing flat hierarchies, giving people the choice to do what they want and the opportunity to contribute meaningfully (autonomy). Further, NGOs could ensure that the group feels capable of achieving its goals (competence), and foster a general sense of belonging in the group and a warm and respectful tone (relatedness). Given that the influence of NGOs is limited, I will now turn to the implication for more powerful actors, namely policy makers.

3.4.3 Policy Makers

Policy makers may have the greatest power to pass both need-satisfying and pro-environmental legislation. They thereby have the power to create social contexts that prevent defensiveness and enable people to act pro-environmentally. Basic psychological need satisfaction may be especially relevant for the acceptance of pro-environmental policy measures (see Martela et al., 2021). Lavergne et al. (2010) showed that when citizens perceived their governments to be autonomy-supportive in their implementation of environmental legislation, citizens were more

autonomously motivated and behaved in more pro-environmental ways. Importantly, the detrimental effect when governments were perceived as controlling (i.e., autonomy-frustrating) was stronger than the positive effect when governments were perceived as autonomy-supportive. Thus, one of the most effective and economic ways to prevent defensiveness in the environmental context may be if policy makers avoid appearing controlling and instead use need-satisfying communication of policy measures that shows that they take people's concerns seriously. To enhance interpretation of these implications and the findings of this dissertation as a whole, I will now turn to its limitations.

3.5 Limitations of the Dissertation

This dissertation has several strengths, including the merits of large-sample research, advanced statistical methods, and its commitment to open science. Nevertheless, some limitations of the dissertation as a whole deserve comment, namely issues around its methodological approach and generalizability. I discuss study-specific limitations in the respective manuscripts and will not discuss them here in detail.

3.5.1 General Methodological Approach

Even though I employed methods appropriate for a first empirical psychological examination of the spectrum of climate denial, the present research could be enriched methodologically. Its methodological approach is purely quantitative and cross-sectional, it is mainly correlational, and it relies mainly on self-report.

The investigation of highly complex phenomena such as climate denial requires a multitude of scientific perspectives and methodological approaches. Using a single methodological approach involves risk of oversimplification. This work is purely quantitative. Climate denial as the main outcome variable in this dissertation, however, is a highly complex phenomenon (Poortinga et al., 2011). The different forms of climate denial have a psychological dimension pertaining to the functions they serve to protect the self (Manuscripts 1, 3-5; Norgaard, 2006a) and to maintain a privileging status quo (Manuscripts 5; e.g., Jylhä, 2016; Norgaard,

2019). They are related to the absence of mitigation action on climate change (Manuscripts 1-5; e.g., Stich & Wagner, 2012). But further, they are also socially constructed and deeply engrained with fossilized economic and political interests, privilege, and (global) power relations (Norgaard, 2011; Zerubavel, 2006). Climate denial is actively constructed by the "denial machine" (Oreskes & Conway, 2012), conservative think tanks obscuring the scientific consensus surrounding climate change for the economic benefit of the fossil industry (Almiron et al., forthcoming; Hultman et al., 2019; Norgaard, 2019). Psychology can contribute with explanations for predispositions for literal and interpretive climate denial (Jylhä et al., 2016), and with understanding the psychological functions climate denial serves, more visible in implicatory climate denial (Norgaard, 2006a, 2006b). Given the inherent embeddedness of individuals in pervasive economic-political contexts and the complexity of the human condition, future research should employ creative, mixed-methods designs that are not restricted by disciplinary boundaries. Qualitative research methods may be particularly informative to investigate the underlying functionality, complexities, inconsistencies, salience, and unconsciousness of climate denial in depth, and its relations to psychological predictors such as basic psychological need satisfaction and emotions. Needless to say, large-scale quantitative studies with representative samples are needed to complement such an in-depth understanding with generalizable findings (see section 3.4.2 on generalizability).

3.5.2 Cross-Sectionality

Although a valuable approach to obtain first insights, another limitation of this dissertation is its cross-sectional nature. Difficult and uncomfortable emotions surrounding climate change and self-protective strategies such as climate denial to cope with these emotions likely interact in complex ways and over time – within individuals but also in larger scale social groups. For example, Stoll-Kleemann and O'Riordan (2020) found that, in fact, the nature of climate denial in German-speaking contexts changed over the course of around twenty years. Diffusion and displacement of responsibility for climate mitigation (i.e., implicatory climate denial) seem to have in large parts replaced interpretive and literal climate denial (Stoll-Kleemann et al., 2001).

Forchtner (2021) shows a similar trend in the European Parliament. Thus, to shed light on the development and maintenance of climate denial, longitudinal studies are needed.

3.5.3 Reliance on Self-Report

Corroborating this recommendation is the fact that this dissertation relies almost exclusively on self-report (an exception are the implicit measures in Study 2 of Manuscript 3). Self-report measures may be unable to fully capture the dynamic nature of climate denial as described earlier. Nevertheless, self-report offers many benefits: It generally yields valid and reliable data and is economical (Paulhus & Vazire, 2007). The majority of the instruments used in this dissertation had been previously validated and are widely used. Nevertheless, there are problems associated with (retrospective) self-report, especially in the environmental domain (Kormos & Gifford, 2014). These include but are not limited to social desirability and self-presentation biases (Thomas & Walker, 2016), limited accessibility to introspection (Lertzman, 2015), and different interpretation of items among study participants (Paulhus & Vazire, 2007). Social desirability may bias answers, especially when topics are socially sensitive (e.g., Greenwald et al., 2009), complex, and deeply contextualized (Lertzman, 2015), such as in the case of climate denial or climate anxiety. In the case of basic psychological need satisfaction or pro-environmental behavior, people may simply have difficulty remembering exactly what their last three months looked like. Furthermore, defensive processes are often unconscious. Self-report measures are limited to conscious perception and explicit acknowledgment of the experience. Luckily, a range of measures may circumvent some of these limitations: Indirect measures relying on reaction times to reveal implicit attitudes such as the implicit association test (cf. Study 2, Manuscript 3; Greenwald & Farnham, 2000), study dropout or desire to escape the study situation (Hodgins et al., 2006), or analyses of written or spoken expressions (Benita, Kehat, et al., 2019; Dornschneider & Todd, 2021; Weinstein & Hodgins, 2009). Future research could also control for certain social desirability indicators (Larson, 2019; Nederhof, 1985) and complement self-report measures with more direct indicators of environmentalism, such as donation behavior (cf. Manuscripts 2 and 3), field observations, or more objective indicators of behavior such as

shopping receipts or electricity bills. It should further acknowledge that self-report measures are also limited by the cultural context they are administered in – an issue the next section covers.

3.5.4 The German Context and Generalizability

Importantly, human reactions to the climate crisis in the form of self-protective climate denial and emotional responses are normative in and contingent on different cultures (e.g., Kleres & Wettergren, 2017; Norgaard, 2011). I conducted this research in the Global North and specifically in Germany – a rich, privileged country. This is important to contextualize and interpret my findings. The Global North bears the biggest historical responsibility for climate change (Malm, 2016). It simultaneously has the biggest power to change global emissions. Germany is particularly interesting. It promotes itself as an environmentally friendly role model, for instance with reference to the "Energiewende" (Renn & Marshall, 2020). At the same time, it is the fourth largest economy in the world and the largest producer of lignite coal in the EU (Eurostat, 2021). It displaces a lot of its emissions to middle or low income countries with detrimental environmental consequences in those countries (environmental load displacement, Hao, 2020). CO_2-emissions per capita are high with ten tons yearly consumption-based carbon emissions in 2018 (Friedlingstein et al., 2020; Global Carbon Atlas, 2018). On average, Germans are highly privileged, both regarding education level (OECD, 2018) and GDP per capita (World Bank, 2018). Furthermore, most individuals in Germany can be characterized by a paradox: Germans tend to report high pro-environmental attitudes (BMU & UBA, 2019) and rarely translate those attitudes into effective pro-environmental behavior (Moser & Kleinhückelkotten, 2018). All of these factors make Germany a particularly worthwhile context to study climate denial. Germans have relatively great power over their actions (money and knowledge) and their actions matter, both regarding political impact and the (in)direct emissions associated with them. Simply put, Germans do not act, even though at first glance they know better, they care, and have the power to do something. The same research in a different cultural and political-economic context would have different implications. For example, in non-privileged,

low-emissions samples with people who are not responsible for the climate crisis and who cannot change their situation, the use of self-protective climate denial may be a healthy coping mechanism. When considering individual-level responses to the climate crisis, I argue that it may be especially interesting to understand privileged people whose actions have relatively high impacts. Given the context-specificity of this dissertation, is it even possible (or desirable to aim) to draw conclusions that generalize across-cultures? Here, I argue, one needs to distinguish first, between the underlying psychological process of defensive self-protection, and second, its manifestation in different forms of climate denial.

First, self-determination theory, which I used as a theoretical basis of this dissertation, claims that the absence of basic psychological need satisfaction and presence of need frustration lead to defensiveness and that these are universal processes (universality claim, Vansteenkiste et al., 2020). Even though I did not investigate the universality claim in this dissertation, I found the proposed relations and have no evidence to the contrary. It is likely that across cultures and contexts, people who lack basic psychological need satisfaction have more difficulties coping with the disturbing reality of climate change. This likely results in defensiveness and different forms of climate denial (compare theoretical predictions in Manuscript 1). Nevertheless, only large-scale cross-cultural studies could test this proposition.

Second, climate denial is contingent on socio-political contexts. As discussed in section 3.3.2, climate denial is an Anglo-American project (Jacques, in press; Oreskes & Conway, 2012). Most research on climate denial has been conducted in the US and found right-wing ideological conviction to be its strongest predictor (e.g., Feygina et al., 2010). Nevertheless, political ideology is deeply embedded in political-economic power structures. Even across the Global North, there are vast differences in how normalized it is to hold certain political views. Consistent with this, approximate-representative cross-cultural research has shown this connection to be weaker in other cultural contexts (Hornsey et al., 2018). In contexts outside of the US, literal climate denial is less common or socially accepted and the self-protective response likely manifests in different forms (Norgaard, 2011; Stoll-Kleemann & O'Riordan, 2020). It may thus not be a limitation that this dissertation did not produce findings that generalize across

cultures. Rather, it may be more important that findings generalize within the context they are investigated in (i.e., that findings generalize to the German population, see Manuscripts 4 and 5). Closely related to questions of generalizability is, thus, a discussion of the sampling approach employed in this dissertation.

3.5.5 Sampling Approach

Most of the conducted studies used a non-probable purposive sampling approach, yielding large but non-representative samples. For example, participants in the studies in Manuscripts 2 and 3 were relatively young and privileged. Although this is a particularly relevant group of the population, given that young people will live with climate change and its consequences the longest and privileged people are very informed and have influential behavior, this is a limitation of the present dissertation. The sample recruited for Manuscripts 4 and 5 remedied this limitation slightly. This was a larger German-speaking quota sample, stratified for age and gender. Relations in this sample were similar to those in Manuscripts 2 and 3, indicating that the findings perhaps generalize beyond their sample membership. Nevertheless, future studies should employ random sampling techniques to generate large, representative samples. Such studies would allow statements about psychological mechanisms in the population at large. They could, for example, allow the study of potential subgroups regarding basic psychological need frustration (see section 3.2) or complex interaction effects on climate denial. When non-random sampling techniques are used and homogeneous, non-representative samples are recruited, the samples should be studied more in depth to generate deeper understanding of the issues at hand in those specific subgroups. "Extreme group" samples such as members of the extreme right or those reporting high levels of climate anxiety may be particularly informative to understand the genesis of climate denial and its self-protective functionality. Based on the findings of this dissertation and its associated limitations, I now turn to suggestions for future research.

3.6 Directions for Future Research

Even though often presented otherwise, research is (also) a political act (e.g., Kuhn, 1962). If research has the ultimate aim of contributing to a socio-ecological transformation to create a world that is both just for humans and their environment, it needs to be transformation-oriented. In a recent opinion piece, Karen Hamann and I outlined what this might look like (Wullenkord & Hamann, 2021): First, we need to focus more on niches (i.e., small-scale protected spaces that develop and live radical social innovations) and individuals as political actors. Second, we need to investigate meaningful transformation-oriented variables (i.e., variables with ecological validity that capture high-impact phenomena), for example big points, sufficiency behaviors, or collective behaviors. Third, we need to acknowledge the embeddedness of all behavior in contexts. The following suggestions for future research directions are thus intended to contribute to such a transformation and set a transformation-oriented research agenda. The next sections cover suggestions for the investigation of causal relations targeting need satisfaction, interventions to overcome climate denial, and selected tangible study ideas to conduct either in the lab or in the field.

3.6.1 Interventions Influencing Basic Psychological Need Satisfaction

To investigate causal relations between basic psychological need satisfaction and the spectrum of climate denial, one may experimentally vary basic psychological need satisfaction and investigate the effects on climate denial. Of course, it is challenging (and probably unethical) to meaningfully influence people's general need satisfaction and frustration in the setting of a lab (see Sheldon & Filak, 2008). Thus, the expected effects are likely small. Nevertheless, if they do appear they would be even more meaningful as they may foster evidence-based suggestions for those creating social contexts and designing interventions aimed at overcoming climate denial.

In the lab, mainly priming and framing approaches have been used that could be adapted to the climate context. Most of these approaches focus on the need for autonomy, as the satisfaction of autonomy is proposed to influence the satisfaction of all other needs as well (Ryan & Deci, 2017). Priming makes concepts more readily accessible to cognitive processing. Need

satisfaction has successfully been primed in the lab using priming interventions such as sentence unscrambling tasks (semantic priming, Hodgins et al., 2006, 2010; Levesque & Pelletier, 2003; Prentice & Sheldon, 2015), or writing tasks to reflect about past need-satisfying or frustrating experiences (Pavey et al., 2011). Need-satisfying approaches have resulted in increased pro-social behavioral intentions (Pavey et al., 2011), less defensiveness (Benita, Kehat, et al., 2019; Hodgins et al., 2006, 2010), less self-serving bias and self-handicapping (Hodgins et al., 2006), more acceptance of threatening information (Pavey & Sparks, 2012), better emotion regulation (Benita, Kehat, et al., 2019), higher self-esteem (Hodgins et al., 2007), more sustainable use of resources in a resource dilemma game (Prentice & Sheldon, 2015), and better performance on tasks (Hodgins et al., 2010; Sheldon & Filak, 2008). In framing studies, one may frame certain behaviors, policies, or future scenarios as more or less need-satisfying. For example, one could frame pro-environmental behaviors as inherently need-satisfying (which they often are, see for example Isham et al., 2019) vs. need-frustrating and investigate effects on defensiveness and willingness to perform those behaviors themselves (see Pelletier & Sharp, 2008 for a similar suggestion). Consistent with this, one may frame a socio-ecological transformation as need-satisfying vs. need-frustrating and investigate effects on people's anticipated need satisfaction, climate denial, and emotionality around climate and societal change.

Another approach is the manipulation of basic psychological need satisfaction through direct experience. Commonly, researchers use need-satisfying or frustrating instructions (Amoura et al., 2015; Benita, Kehat, et al., 2019; Pavey et al., 2011; Sheldon & Filak, 2008). For example, Sheldon and Filak (2008) experimentally manipulated satisfaction and frustration of relatedness, competence, and autonomy needs in a 2x2x2-design. Participants were instructed in one of eight possible ways to play a puzzle game. Their enjoyment but also performance on the game depended on experimental condition. The more need-satisfied they were, the more they enjoyed playing and the better they performed. Such an approach could easily be adapted to the climate context, through adapting the game. Instead of playing a random game, participants could play an environmental game, in which they would need to find as many environmental words as possible or solve environmental challenges or dilemmas (see Prentice &

Sheldon, 2015). The need for relatedness specifically may be experimentally varied by means of playing Cyberball (Williams et al., 2000). Cyberball is a virtual ball-playing game, supposedly played with other study participants. Depending on study condition, participants get excluded from the game (relatedness need frustration) or remain part of the game (relatedness need satisfaction).

In the field, interventions could employ different need-based communication techniques to meet people's needs in the context of a conversation. One promising approach may be non-violent communication (Rosenberg, 1999), as outlined in section 3.4.1. Another approach is motivational interviewing (Miller, 1983), which aims at resolving people's ambivalence about change using person-centered techniques, specifically *change* and *sustain* talk. Motivational interviewing is a technique which, at its core, satisfies people's needs for autonomy (and to lesser extents competence and relatedness) to help them change. It has successfully been applied to foster pro-environmental behavior and environmental activism (Klonek et al., 2015; Tagkaloglou & Kasser, 2018). These techniques are designed to be non-threatening and may thus open up interesting opportunities that go beyond other interventions. Complementing a focus on basic psychological needs, another approach could be to directly target the main outcome variable of this dissertation in interventions, namely climate denial.

3.6.2 Interventions to Overcome Climate Denial and Self-Protection

As established previously (see section 3.5.4), while basic psychological needs are universal and everyone needs to meet them one way or another, climate denial manifest itself differently in different groups (see Manuscripts 2-5). Even though I found no evidence for distinct profiles of climate denial in my data (Manuscript 5), people differed in the extent to which they reported climate denial. Someone who uses a lot of literal climate denial will likely react differently to interventions than someone who generally acknowledges climate change as a problem but weakly denies its implications. Targeted interventions are therefore warranted, as long as they only differ on the variables that differ between people but acknowledge the universality of the human condition (see Rosenberg, 1999; Ryan & Deci, 2017). In the following, I will focus on

one related concept to climate denial: Emotion regulation.

Three types of emotion regulation can be distinguished (Roth et al., 2019): 1) Integrative emotion regulation (i.e., fully experiencing emotions, taking an interest in the emotional experience and its meaning); 2) controlled (or suppressive) emotion regulation (i.e., diminishing the emotional experience through avoidance, suppression, or re-appraisal), and 3) amotivated emotion regulation (i.e., the dysregulation of emotions). A range of studies has recently investigated different types of emotion regulation and their effects on different outcome variables, such as defensiveness (Benita, Kehat, et al., 2019; Roth et al., 2014). For example, Benita, Benish-Weisman et al. (2019) showed suppressive emotion regulation to be associated with ill-being across cultures, mediated by need frustration, and integrative emotion regulation to be associated with well-being across cultures, mediated by need satisfaction. People using suppressive emotion regulation strategies showed more defensive written expression (Benita, Kehat, et al., 2019). Based on these findings, a future study could be designed as follows: First, assess baseline climate denial and general basic psychological need satisfaction. Second, teach participants about integrative vs. suppressive emotion regulation techniques using autonomy-supportive vs. controlling instructions (2x2-design). Third, present threatening information about climate change and instruct participants either to suppress any uncomfortable emotions that arise (suppressive emotion regulation) or to take an interest in any uncomfortable emotions (integrative emotion regulation, similar to Study 2 in Roth et al., 2014). Forth, assess evoked emotions and climate denial. In line with previous findings, those in the autonomy-supportive, integrative emotion regulation condition should show less subsequent climate denial.

In summary, future research should design and evaluate interventions that meet people's basic psychological needs and thereby equip them with the psychological resources needed for proactive coping. Such interventions could be coupled with interventions based on emotion regulation research. As a result, they would ideally enable study participants to face threat and cope with uncomfortable and potentially disturbing emotions, and foster intrinsic motivation to translate those emotions into pro-environmental behavior and climate action. How could these ideas be implemented concretely?

3.6.3 The Climate Café – A Field-Based Study Idea

Even though the laboratory environment allows for both a manipulation of the context and precise measurement of variables, field-approaches offer the benefit of generating scientific knowledge during the implementation of solutions. They are also more ecologically valid. I argue that in the context of the climate crisis, in which we need to act fast, such approaches are needed if a basic understanding of the relations has previously been established. Therefore, I outline one concrete idea of how to implement interventions and investigate them – the "climate café".

The climate café could be a protected, need-satisfying space for the exploration of emotions and self-protective responses, with the goal of channelling them into action. For example, Weintrobe (2013) notes that the absence of "help, support, and containment to bear the anxiety and suffering that insights bring" (p. 44) is one factor that fosters climate denial. She continues: "people need genuine emotional support to bear their anxieties" (p. 46). One first step of overcoming denial is to talk about emotions (Ojala, 2013a). Inspired by the work on death cafés (Miles & Corr, 2017) and on grief and active hope (Macy & Johnstone, 2012), the climate café could provide a supportive safe space in which people can explore and work through their climate-related emotions. There are many different possibilities for how to engage people in such a space, ranging from different prompts that inspire discussion, over playing environmental games (e.g., Wesselow & Stoll-Kleemann, 2018), to watching and discussing movies, or even planning to become active or participating in environmental actions and discussing them afterwards. Furthermore, people could participate in workshops geared at strengthening their basic psychological need satisfaction (e.g., non-violent communication workshops), to give them the psychological resources to cope with threats.

Methodologically, the climate café may be designed and evaluated using a mixed-methods approach. Prior to setting up such a space, larger-scale representative questionnaire studies could be used to ask different groups of people what wishes they would have for such a space. This would provide insight into how to characterize different groups in different contexts, to target the offer to them. On site, selected group conversations could be analyzed. Such focus

group interviews could be supplemented by individual interviews. This could potentially reveal discrepancies between what is expressed in the social situation characterized by different social norms (e.g., group social desirability) vs. in a private, in-depth interview, revealing more about people's private thoughts. Such an approach could be used to understand the underlying workings of climate denial in the field. Furthermore, different strategies of integrative emotion regulation could be practiced and evaluated, after having tested them in the lab. Qualitative interview methods may even be coupled with psycho-physiological measurements. As such, the climate café could be a promising living lab with a real-world impact.

4 Conclusion

We need to act to mitigate anthropogenic climate change and time is running out. With this dissertation, I contribute original knowledge to the understanding of the complex phenomenon of climate denial: A manifestation of the deeply human tendency to protect the self in the face of threat, which represents a serious barrier in the way of climate action. I showed that climate denial serves both the psychological functions of protecting the self from uncomfortable emotions and from loss of privilege, when psychological resources are scarce. Only when the uncomfortable emotional experiences resulting from the climate crisis are channeled into action will there be larger scale change. Such proactive coping requires integrative emotion regulation, giving emotions space to be explored and felt. The satisfaction of basic psychological needs provides psychological resources to cope with the threats of climate change proactively and thereby, renders the denial superfluous. To this end, socio-political systems need to be drastically transformed to enable basic psychological need satisfaction for all people. This would contribute to equipping people with the psychological resources to face the climate crisis and channel their emotions into individual and collective climate action. It is my hope that this dissertation and the research directions that it promotes take a step in that direction.

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Manuscript 1

Climate Change through the Lens of Self-Determination Theory: How Considering Basic Psychological Needs May Bring Environmental Psychology Forward

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Manuscript 2

Avoidance, Rationalization, and Denial: Defensive Self-Protection in the Face of Climate Change Negatively Predicts Pro-Environmental Behavior

Wullenkord, M. C., & Reese, G. (2021). Avoidance, rationalization, and denial: Defensive self-protection in the face of climate change negatively predicts pro-environmental behavior. *Journal of Environmental Psychology, 77*(101683). https://doi.org/10.1016/j.jenvp.2021.101683

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Abstract:

Despite urgent need for climate action, denial of climate change and resulting absence of appropriate pro-environmental behavior are widespread. Interpretive (recognition of climate change as a problem but re-interpretation of its severity) and implicatory denial of climate change (recognition of climate change as a problem but denial of psychological, political, and moral implications) can be interpreted as self-protective strategies people use to protect the self in the face of threat. However, research has usually considered individual self-protective strategies but has not integrated them into one comprehensive measure. The present research aimed at reviewing the existing literature and constructing the Climate Self-Protection Scale (CSPS) to assess climate-relevant defensive, self-protective strategies. In Study 1, N=354 Germans responded to a pool of items. Using exploratory main axis analysis, we identified a five-factorial structure of the measure, corresponding to the self-protective strategies rationalization, avoidance, denial of personal outcome severity, denial of global outcome severity, and denial of guilt. Study 2 (N=453 Germans) used confirmatory factor analysis to verify the five-factorial structure of the CSPS. Self-protective strategies were positively related with each other (except for avoidance and denial of guilt) and fit into a framework of interpretive (denial of global and personal outcome severity) and implicatory denial (rationalization, avoidance, denial of guilt). They related positively to male gender and right-wing political orientation, and negatively to various indicators of pro-environmentalism, even when controlling for covariates. This provides evidence of criterion and construct validity of the CSPS. In future research, the scale could be used as a tool to examine climate-relevant self-protective strategies further.

Keywords: climate change; denial; defensiveness; test construction; self-protection; pro-environmental behavior

1 Introduction

Climate change is one of the biggest crises humanity ever faced, taking into account consequences for biodiversity, environmental justice, human rights, mass migration, and health, to name only a few. The climate crisis is visible across the planet (Crippa et al., 2019; IPCC, 2018), with devastating wildfires in the Arctic and Australia, droughts, melting permafrost in Siberia, extreme weather, and the five hottest years on record all within the last decade. The Global North, bearing the biggest historical responsibility for climate change, is no exception.

Nevertheless, emissions continue to grow (Peters et al., 2020). In fact, many privileged people in the Global North can be characterized by a paradox. For example, in Germany most people report environmentally friendly attitudes and intentions (BMU & UBA, 2019) but simultaneously ignore climate change in everyday life. Their attitudes are often inconsistent with appropriate environmentally friendly decisions such as local, organic, plant based diets, fossil-free and reduced collective rather than individualized traffic, and a general reduction in consumption (Moser & Kleinhückelkotten, 2018). Although individual behavior is strongly influenced by structural factors such as infrastructures (e.g., Steg & Vlek, 2009), this paradox may also be an indicator of inner conflicts, for example between opposing values or short- and long-term goals, or indicate lack of psychological resources to cope with threat proactively. Resulting defensive, self-protective strategies may lead to absence of appropriate pro-environmental behavior (PEB, Stich & Wagner, 2012). Understanding self-protective strategies, the psychological functions they serve, and the conditions under which they arise is relevant to enable people to deal proactively with the threat of climate change, both to maintain psychological health but also to work towards mitigating the crisis. In this paper, we develop and validate a tool measuring climate-relevant self-protective strategies – the Climate Self-Protection Scale (CSPS).

2 Theoretical Background

2.1 Self-Protection as a Reaction to Threat

Several theories and strands of research suggest that humans are motivated to protect their sense of self in the face of threat (e.g., self-determination theory, Deci & Ryan, 1985, 2000; cognitive dissonance theory, Festinger, 1957; transactional theory of coping, Lazarus, 1991; self-affirmation theory, Steele, 1988; psychoanalytic theory, e.g., Freud, 1936, and psychosocial research, e.g., Lertzman, 2015; sociological research, e.g., Norgaard, 2011). Acknowledgement of climate change and its consequences can lead to potentially traumatic emotions and threaten individual and collective identities (Norgaard, 2006a; Stokols et al., 2009; Woodbury, 2019). When psychological resources are insufficient to cope with threat proactively, people use defensive strategies to protect the self from the threat and corresponding uncomfortable or even painful emotions, to avoid identity conflicts, and to maintain positive self-esteem. In the remainder of this paper we will therefore call these strategies self-protective strategies. Various climate-relevant self-protective strategies have been described, ranging from the literal denial of climate change (e.g., Jylhä et al., 2016) to emotion-focused coping strategies, such as de-emphasizing the seriousness of climate change (e.g., Ojala, 2015). However, they have not yet been integrated into a comprehensive framework (but see Norgaard, 2019 on the spectrum of denial). Further, the terminology used to describe these self-protective strategies is inconsistent across but also within disciplines.

To summarize the existing literature on self-protection, we lean on Cohen's (2001) work on denial in the context of human rights violations and will use his terminology in the remainder of the paper. Cohen notes that "the term denial refers to the maintenance of social worlds in which an undesirable situation (event, condition, phenomenon) is unrecognized, ignored or made to seem normal" (p. 51). He distinguishes between three forms of denial – literal, interpretive, and implicatory denial – that can be mapped onto the various self-protective strategies.

2.1.1 Literal Denial

Literal denial refers to denial of facts, the claim that something is not true. Climate change denial is usually understood to be literal – the denial that climate change is happening at all, in spite of evidence to the contrary.

Most research investigating literal climate denial focused on ideological variables and gender. Häkkinen and Akrami (2014) found social-dominance orientation – an individuals' preference for social hierarchies and devaluation of low-status groups (Pratto et al., 1994) – to be most predictive of climate denial. Ideological variables such as right-wing authoritarianism and social dominance orientation consistently related to climate denial in cross-sectional data (McCright & Dunlap, 2011; Milfont et al., 2013). However, only right-wing authoritarianism predicted change in climate denial over time (Stanley et al., 2017). This indicates that climate denial can be understood as a desire to conform to traditional values rather than through a motivation to dominate over nature or other groups that are harmed by climate change. This research describes climate deniers as people with a (far) right political identity who feel threatened by acknowledging climate change. They want to defend the status quo because they benefit from it, either economically or psychologically (system justification, Feygina et al., 2010). Further, literal climate denial is more common in men than in women (Jylhä et al., 2016; Feygina et al., 2010; McCright & Dunlap, 2011; Ojala, 2015; Poortinga et al., 2011). However, given that accounts of literal denial are relatively rare in Germany (e.g., Steentjes et al., 2017; Stoll-Kleemann & O'Riordan, 2020) we did not include literal denial in the present research.

2.1.2 Interpretive Denial

Interpretive denial means the absorption of traumatic events into the psyche through distortion of facts or emotional distancing, to numb and distance the self from uncontrollable, overwhelming situations (Ager, 2008). Only few studies have examined literal denial without confounding its measurement with interpretive denial (e.g., Jylhä et al., 2016). Interpretive denial describes the re-interpretation of facts and, thus, does not include denial of facts per se. Common examples are changing words to disguise the meaning of events (e.g., euphemisms;

non-comprehensive, distancing technical jargon). Regarding climate change, this could be acknowledging that climate change is happening but claiming that its consequences are exaggerated. Literature on emotion-focused coping and sociological, psychoanalytic, and addiction and trauma research describe various interpretive forms of denial, such as de-emphasizing the seriousness of climate change (Ojala, 2012, 2015; Ojala & Bengtsson, 2019), relativization (Homburg et al., 2007), denial of outcome severity (Opotow & Weiss, 2000; Sparks et al., 2010), or normalization and minimization (Ager, 2008; Lertzman, 2015; Norgaard, 2006a). Various variables predicted interpretive climate denial among Swedish adolescents over a one-year period, for example, environmental and hedonistic/egoistic values, knowledge about and feelings of powerlessness in societal matters, and descriptive social norms such as social influence from parents and peers (Ojala, 2015). Parents', especially fathers' dismissive and despondent communication style also predicted interpretive climate denial (Ojala & Bengtsson, 2019).

2.1.3 Implicatory Denial

Lastly, implicatory denial means that awareness of facts is not integrated in everyday life or translated into social action. One acknowledges the information per se but denies its psychological, political, or moral implications. Regarding climate change, this includes the denial that knowing about anthropogenic climate change has moral implications, such as having a responsibility or perhaps moral obligation to act in a way that does not further promote climate change or that helps mitigate its consequences. Various researchers describe implicatory denial as similar to a conscious cognitive awareness without the emotional acknowledgement of the implications ("knowing but not knowing", e.g., Norgaard, 2006b). Denial here is a matter of self-protection when environmental problems are simultaneously deeply disturbing and invisible (Ager, 2008; Haseley, 2019; Lertzman, 2015; Norgaard, 2006a). For example, Swiss citizens found the prospect of changing their lifestyles to mitigate climate change more threatening than the reality of climate change itself. They employed various implicatory denial strategies, such as blaming others' inaction and doubting one's own ability to act (Stoll-Kleemann et al., 2001). Similarly, a recent German study (Stoll-Kleemann & O'Riordan, 2020) showed that implicatory

denial, diffusion, and displacement of responsibility for climate action has replaced literal and interpretive denial. Ojala (2013) identified distancing as means not to engage with the problem in Swedish youth. Norgaard (2006a), Ager (2008), and Lertzman (2015) describe societies that live under the constant threat of the consequences of climate change or environmental devastation but choose to ignore the risk and continue everyday life as normal. In other words: When one avoids the problem, one does not need to engage with it. Based on an extensive interview study in Norway, Norgaard (2006a) describes an implicatory denial of climate change that serves to avoid unpleasant emotions in a culture that acknowledges climate change as a problem. Specifically, her sample collectively engaged in socio-cultural narratives of "perspectival selectivity" (i.e., taking a perspective that favors oneself and blames others' bad actions) and "selective attention" (i.e., focusing attention away from certain information and not thinking too far ahead). These strategies served the function of protecting the self from threat, maintaining a sense of innocence for the deniers, and creating positive self-representations (Norgaard, 2006a). Others describe strategies such as the denial of guilt (and responsibility, Homburg et al., 2007), denial of stakeholder inclusion (Sparks et al., 2010), and deflection of responsibility (Norgaard, 2006b; Ojala, 2013, 2015; Stoll-Kleemann et al., 2001).

The two latter forms of denial (interpretive and implicatory denial) may offer an explanation for the paradox of failing to act despite good intentions – people protect themselves by knowing but not knowing at the same time, and thus they justify not acting.

2.1.4 Self-Protection and Pro-Environmentalism

Self-protective strategies should be represented in various forms of pro-environmentalism, ranging from environmental awareness, over environmental motivation to actual PEB. Environmental awareness can be understood as being conscious of environmental issues and having positive attitudes toward the environment, while environmental motivation is the quality of the motivation one has for performing PEB. PEB represents low-impact environmentally-friendly behavior that reduces one's ecological footprint. Self-protective strategies have been found to be negatively related with PEB (Homburg et al., 2007; Ojala, 2012, 2013) and environmental

values predicted interpretive climate denial of Swedish adolescents (Ojala, 2015). Given the relations between environmental motivation and PEB (e.g., Pelletier et al., 1998), we expect that the pattern would be similar for relations between environmental motivation and self-protective strategies. However, we acknowledge that (the absence of) pro-environmentalism is influenced by a plethora of factors (e.g., Bamberg & Möser, 2007; Hines et al., 1987) so that we do not expect very large relations.

2.2 Aim and Overview of Studies

Previous research employed a range of methods to assess climate-relevant self-protective strategies, such as interviews (Lertzman, 2015; Norgaard, 2019; Stich & Wagner, 2012), open-ended questions (Ojala, 2012), and questionnaires (Homburg et al., 2007; Jylhä et al., 2016; Jylhä & Akrami, 2015; Ojala, 2015; Sparks et al., 2010). But despite its relevance, there is, to our knowledge, no comprehensive measure that assesses the extent to which people endorse various defensive sentiments reflective of self-protective strategies that people may use to protect themselves from the threatening reality of climate change. As such, our approach combines different constructs from different disciplines, sociology and psychology in particular, allowing for a more unified understanding of such strategies. We therefore conducted two studies to (1) construct a questionnaire that measures defensive, climate-relevant self-protective strategies and (2) to validate this measure and its underlying structure.

Based on Cohen's (2001) conceptual framework of denial, we classified and interpreted different self-protective strategies and expected to replicate his findings regarding interpretive and implicatory denial. Further, we assessed relations with pro-environmentalism, gender, and political orientation as measures of construct validity (specifically convergent and factorial validity) and criterion validity. We use definitions by Moosbrugger and Kelava (2012) for construct validity as the extent to which the interpretation of a test result is in line with its theoretical underpinnings (e.g., relations of self-protection with gender and political orientation) and for criterion validity as the extent to which a test result allows for extrapolation to practically relevant outcomes (e.g., relations of self-protection with PEB).

We conducted both studies in Germany. Besides practical reasons for selection of the samples, the German population is particularly informative. Germans tend to have strong environmental awareness (BMU & UBA, 2019), which rarely translates into impactful PEB (see Moser & Kleinhückelkotten, 2018). In global comparison, Germans are highly privileged, for example in terms of education level (OECD, 2018) and GDP per capita (World Bank, 2018), and have among the largest CO2-impact per capita (11t consumption-based carbon emissions in 2016, Quéré et al., 2018). Thus, it is a societal context in which individuals have relatively great power (money and knowledge) over their actions. Their actions also have relatively great impact, both politically and in terms of (in)direct emissions. Germany, thus, provides a societal context in which climate-relevant self-protective strategies are particularly relevant. Conducting this research in a non-privileged, low-emissions sample – with people not responsible for the climate crisis and whose actions may have relatively little impact – would certainly yield different results. In those groups, the employment of self-protective strategies may perhaps be the healthiest way to cope. In contrast, those who emit most also need to change most (e.g., Sabbagh & Schmitt, 2016). Understanding a privileged, high-impact group and the predictors for its behavior is most indicative when considering individual reactions to climate change and PEB.

3 Study 1

3.1 Aim and Hypotheses

We designed Study 1 to develop a valid and reliable scale that assesses defensive, self-protective strategies people may use to protect the self when coping with climate change. To this end, we constructed items both based on and taken from the reviewed literature. We then interpreted the emerging self-protective strategies with regard to interpretive and implicatory denial (Cohen, 2001). We describe the steps of item collection and selection, the internal consistency of the measure's subscales, and test their relations with each other and with measures of PEB. We tested the following hypotheses:

- H1: The identified self-protective strategies are positively related with each other.
- H2: The identified self-protective strategies can be mapped onto Cohen's categories of interpretive and implicatory denial.
- H3: Right-wing political orientation correlates positively with the identified self-protective strategies.
- H4: Men report self-protective strategies to a larger extent than women.
- H5: The identified self-protective strategies are negatively related with (a) PEB and (b) willingness to donate to environmental organizations.

3.2 Method

3.2.1 Participants and Procedure

A convenience sample of N=354 German individuals participated in an online study (M_{age}= 27.74 years, SD=11.68, range:18-78) hosted on the platform SoSci-Survey (Leiner, 2014). The sample was predominantly female (80.29%) and was formally well educated (59.00% high school degree, 32.45% university degree).

Participants gave informed consent in line with the DGPS and Helsinki declarations and then responded to items about self-protective strategies, PEB, socio-demographic background (age, gender, education, income), and political orientation. Afterwards, participants could participate in a raffle for money as compensation for their participation. To avoid sequence effects, we presented items in randomized order within the sections on self-protection and PEB, respectively. We also randomized the order in which we presented the sections on self-protection and PEB but found order not to influence answers (see supplemental material).

3.2.2 Methods and Materials

Climate Self-Protection Scale. We constructed the CSPS based on a literature review of psychological and sociological studies on defensive, self-protective strategies and coping in the environmental domain. We developed a pool of items based on qualitative interviews by Stich and Wagner (2012), Norgaard (2011), and Klonek and Kauffeld (2015), open-ended questions by Ojala (2012), and theoretical considerations by Opotow and Weiss (2000). Moreover, we translated and adapted quantitative measures by Homburg et al. (2007), Sparks et al. (2010), Lavergne and Pelletier (2015), and Zaalberg et al. (2009) into German. Based on own theoretical considerations, we created additional items for potential strategies not considered in the work above, yielding 99 items in total. Participants indicated (dis)agreement with the statements on a seven-point Likert scale (1=*strongly disagree*, 7=*strongly agree*). After data collection but before analysis, we re-examined items individually and deleted eighteen items due to ambiguous phrasing (e.g., "I cannot act extremely environmentally friendly and perhaps there is no necessity for it"). See Table 2 for the final scale and item statistics, and supplemental material for information about the origin of each item.

PEB. We used nineteen items to capture a range of impactful private- and public-sphere PEB (cf. Stern, 2000; eight items by Cooke et al., 2016; eight items from the General Ecological Behavior scale, Kaiser & Wilson, 2004, and three own items; e.g., "I participate in environmental demonstrations"; see supplemental material). Participants rated items on a five-point Likert scale (1=*never*, 5=*always*). We dichotomized items (0=*never*, *seldom*, *occasionally*; 1=*often*, *always*) for Rasch-modelling, following recommendations by Kaiser and Wilson (2004). We excluded eight people with missing data. Person separation reliability was satisfactory (R_p=.78). Item mean square infit values ranged from .55 to 1.08, well below the recommended 1.30 for samples with N<500 (Bond & Fox, 2013).

Furthermore, as compensation for their participation, participants could take part in a raffle (4x50€). They could choose to keep the money for themselves or donate all or part of it to an environmental organization. We analyzed this willingness to donate to obtain another estimate of PEB.

3.2.3 Data Preparation and Statistical Analysis

We used the statistical program R, version 3.6.1 (R Core Team, 2019) for all statistical analyses. Prior to analysis, we examined variables for accuracy of data entry and missing data. We used bogus regression analysis to determine fit between data distributions and assumptions of multivariate data analysis. These analyses revealed multivariate normality. An inspection of bivariate scatter plots revealed no evidence for heteroscedasticity or nonlinearity. We excluded two cases because the relative speeding index (RSI) was >2, (as recommended by Leiner, 2019). RSI is computed dividing the median completion time across participants by completion time for each participant. A factor of 2 thus indicates that a given participant answered the questionnaire in half the time the typical respondent took. Based on Mahalanobis distance, we removed three multivariate outliers (p<.001), leaving a total of N=349 cases. Excluding outliers and including covariates did not substantially influence results. Nevertheless, refer to the supplemental material for data analyses using the entire dataset without exclusions, and analyses without covariates.

To reduce the amount of items in the scale, we conducted a factor analysis (Thompson, 2004). Finally, we examined inter-relations of the resulting subscales using Gaussian graphical modeling (Bhushan et al., 2019) and correlation analysis, and relations with PEB and socio-demographic variables using t-tests and regression analysis. Our sample was sufficiently large to compute multiple hierarchical regression analyses (minimum required sample size to detect a small-medium effect of f^2=.07 with $\alpha = .05$ and $\beta = .95$ was N=346, G*Power 3, Faul et al., 2007).

3.3 Results

3.3.1 Descriptives

Descriptive statistics for study variables are displayed in Table 1. On average, participants scored rather high on PEB. Most people (N=292, 85.88%) wanted to participate in the raffle. Of those, 162 people (55.48%) indicated they would be willing to donate some or all of the

Table 1

Spearman Correlations and Descriptive Statistics of Study Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	α [95%CI]	*M* *(SD)*	Skewness (Kurtosis)
1. Overall self-protection	—	[.84, .88]	[.54, .69]	[.59, .72]	[.65, .77]	[.42, .59]	[-.48, -.31]	[-.29, -.05]	[-.11, .12]	[-.17, .09]	[.25, .44]	.91 [.89, .92]	2.70 (.80)	.39 (-.28)
2. Rationalization	.85**	—	[.19, .42]	[.42, .60]	[.48, .67]	[.32, .54]	[-.44, -.27]	[-.27, -.03]	[-.12, .12]	[-.19, .06]	[.23, .44]	.91 [.89, .92]	2.88 (1.25)	.62 (.07)
3. Avoidance and suppression	.65**	.36**	—	[.07, .30]	[.11, .33]	[-.21, .01]	[-.37, -.18]	[-.19, .05]	[-.23, -.03]	[-.28, -.06]	[.04, .24]	.90 [.88, .92]	2.64 (1.11)	.45 (-.50)
4. Denial of personal outcome severity	.66**	.51**	.25**	—	[.39, .62]	[.18, .42]	[-.36, -.16]	[-.24, .06]	[-.12, .11]	[-.09, .15]	[.07, .33]	.86 [.84, .88]	2.27 (1.12)	.96 (.85)
5. Denial of global outcome severity	.68**	.54**	.31**	.52**	—	[.35, .57]	[-.43, -.26]	[-.30, -.08]	[-.07, .16]	[-.09, .20]	[.27, .48]	.87 [.85-.89]	1.91 (1.05)	1.37 (1.69)
6. Denial of guilt	.47**	.35**	-.04	.28**	.37**	—	[-.17, .02]	[-.25, .00]	[.17, .34]	[.12, .30]	[.07, .32]	.77 [.73, .81]	3.52 (1.21)	.49 (-.06)
7. Pro-environmental behavior	-.42**	-.38**	-.30**	-.30**	-.36**	-.08	—	[.16, .42]	[.04, .25]	[-.06, .18]	[-.43, -.24]	.78[a]	-.05 (1.38)	.43 (.93)
8. Willingness to donate	-.19*	-.17	-.10	-.11	-.19*	-.16	.30**	—	[-.10, .17]	[-.01, .27]	[-.31, -.07]	-	25.12 (16.19)	.51 (-1.17)
9. Age	.03	.01	-.11	.02	.01	.23**	.10	-.03	—	[.60, .80]	[.02, .28]	-	27.74 (11.68)	2.01 (3.46)
10. Income	-.08	-.12	-.14	.01	-.07	.15	.11	.07	.61**	—	[-.04, .22]	-	948.67 (898.43)	2.13 (4.78)
11. Political orientation	.29**	.28**	.13	.15	.31**	.15	-.33**	-.19*	.08	.05	—	-	33.29 (17.70)	.44 (.01)

Note. We display descriptive statistics of Rasch person parameter for pro-environmental behavior. p-values adjusted for multiple tests. Above the diagonal are 95% confidence intervals.

[a]Person separation reliability

$p<.05$, $^{**}p<.01$.

money to an environmental organization, in case they would win (M=25.12€, SD=16.19€, range:3-50€).

3.3.2 Exploratory Main Axis Analysis

Following recommendations by Tabachnick and Fidell (2013), we excluded four items that had high inter-item correlations (r>.80). We then ran an exploratory main axis analysis with oblique rotation to reduce the number of items of the CSPS further. Data were well suited for factor analysis (KMO=.93). Horn's (1965) parallel analysis suggested a seven-factor solution (Eigenvalues=2.43–8.38). We deleted 40 items with low communality indicating low item-total correlations (h^2<.50; Tabachnick & Fidell, 2013), seven items with low factor loadings (<.45), and one cross-loading item.

We then ran a second main axis analysis with the remaining 29 items (KMO=.93). Horn's (1965) parallel analysis suggested a five-factor solution (Eigenvalues=2.14–5.77). We deleted one additional item because its factor loading was <.45, one item because it was cross-loading, and one item that had low communality (h^2=.40). Examination of internal consistency if single items were dropped revealed that no further items needed to be excluded.

The final 26 items were well suited for factor analysis (KMO=.92) and distributed over five factors (Eigenvalues=1.86–4.80). We suggest to interpret the factors as follows: 1) rationalization, the reinterpretation of one's own actions to make them seem more consistent (e.g., "How I behave toward the environment has minimal impact on climate change", α = .91); 2) avoidance, the withdrawal from information or thoughts about climate change in everyday life (e.g., "I try to avoid negative thoughts about climate change in my everyday life", α = .90), 3) denial of personal outcome severity, the reinterpretation of the consequences of climate change for oneself (e.g., "I expect climate change to affect other regions but not to burden me", α = .86); 4) denial of global outcome severity, the reinterpretation of the global consequences of climate change (e.g., "I believe that climate change won't be as severe as expected in the future", α = .87); and 5) denial of guilt, the acknowledgement of climate change but disavowal of one's own contribution to it (e.g., "I don't need to make climate change a matter of con-

science", $\alpha = .77$). The overall 26-item scale had excellent internal consistency (α=.91). The resulting model explained 60% of sample variance. All items loaded exclusively on their target factors (factor loadings>.45). Communalities were good (lowest h^2=.48). Table 2 shows items statistics, factor loadings after oblique rotation, communalities, and Eigenvalues and explained variance of the factors. The subscales 2 and 3 displayed skewness indicative of non-normal distribution (see Table 1). To remedy this, we used log transformations and performed all relevant analyses with and without transformed data (Tabachnick & Fidell, 2013).

3.3.3 Short Summary of the Scale and Its Subscales

People indicated medium-low levels of self-protection. They reported denial of global outcome severity least, while denial of guilt was more common. As displayed in Table 1, rationalization correlated strongly with denial of global outcome severity and denial of personal outcome severity but also with avoidance and denial of guilt. Interestingly, avoidance was unrelated to denial of guilt but had medium positive correlations with all other self-protective strategies.

The two factors capturing interpretive forms of denial, namely denial of global outcome severity and denial of personal outcome severity, correlated strongly with each other and with rationalization, and less strongly with avoidance and denial of guilt (see above). These results mainly support H1. Complementing the inferential analysis, we visualized partial correlations between the self-protective strategies using Gaussian graphical modelling with the glasso algorithm and extended Bayesian information criterion for an optimal setting of the tuning parameter (Figure 1). Gaussian graphical modelling is a Bayesian technique that displays partial correlations between variables, controlling for all other variables in the dataset (Bhushan et al., 2019). This analysis revealed only weak clustering of self-protective strategies, contradicting H2.

Table 2

Factor Loadings and Communalities of Main Axis Analysis (Promax-Rotation) for Self-Protective Strategies and Descriptive Statistics for Individual Items

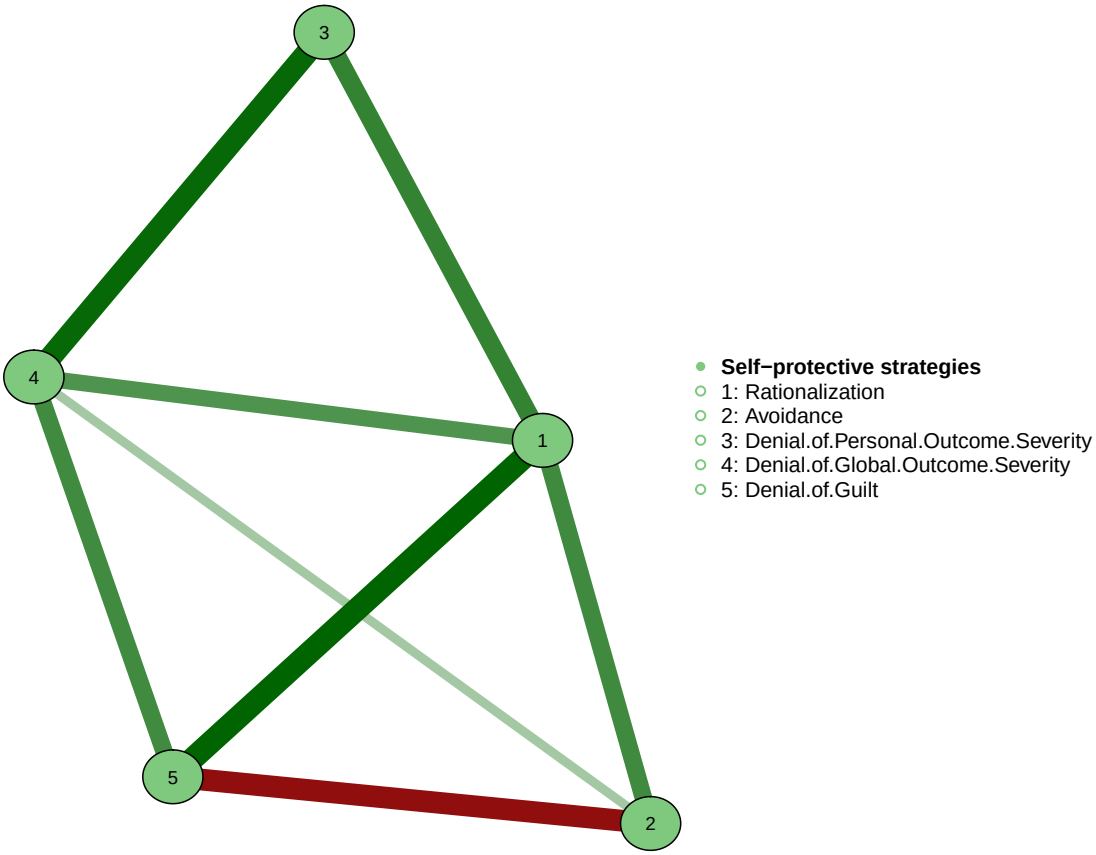
Items	F_1	F_2	F_3	F_4	F_5	h^2	*M*	*SD*	Skew-ness	Kurto-sis
34. It doesn't make a difference for climate change if I change my behavior or if I don't change my behavior.	.85					.73	2.53	1.44	.97	.53
38. How I behave toward the environment has minimal impact on climate change.	.82					.52	3.38	1.67	.36	-.71
10. My individual behavior probably doesn't have a measurable influence on the environment.	.82					.54	3.23	1.74	.30	-1.02
41. No matter what I do, I cannot do anything against climate change ultimately.	.80					.67	2.83	1.49	.66	-.11
37. In my lifetime, I cannot make an important contribution to the reduction of climate change.	.79					.56	2.92	1.58	.60	-.38
36. My personal influence on climate change is negligible.	.75					.68	3.01	1.55	.56	-.30
30. I myself cannot do anything against climate change.	.70					.62	2.30	1.39	1.10	.85
50. When I get worried about climate change, I try to think of something else.		.84				.62	2.72	1.35	.39	-.55
53. I don't obsess over climate change because it would burden me psychologically.		.77				.57	2.38	1.35	.79	-.17
61. I try to avoid negative thoughts about climate change in my everyday life.		.76				.55	3.09	1.57	.33	-.73
56. I often suppress my thoughts about climate change because otherwise I would probably go crazy.		.75				.53	2.64	1.63	.81	-.21
57. I try not to think about climate change.		.74				.64	2.56	1.45	.51	-.84
55. I try to ignore climate change in everyday life to feel safe.		.73				.61	2.19	1.32	1.00	.17
63. I don't think much about my impact on the environment because I might not be able to handle knowing how negative my influence really is.		.64				.52	2.57	1.46	.61	-.61
94. I tend to suppress thoughts about climate change in my everyday life.		.59				.48	2.97	1.46	.58	-.04
27. Climate change will not affect me here in Germany.			.82			.70	2.22	1.33	1.07	.55
28. I expect climate change to affect other regions but not to burden me.			.82			.69	2.34	1.39	.88	-.04
06. Nothing will happen to me as a consequence of climate change because Germany is a safe country.			.74			.53	2.23	1.34	1.05	.64
23. Climate change does not really affect people in Germany.			.65			.49	2.28	1.30	.96	.24
25. I believe that climate change won't be as severe as expected in the future.				.89		.76	2.03	1.19	1.23	1.16
14. The damage that climate change will bring about will not be as severe as being claimed.				.87		.72	1.86	1.16	1.75	3.55
18. The influence of humans on climate change is being overstated.				.70		.62	1.85	1.20	1.64	2.54
95.[i] I have a guilty conscience because I know that I should behave more sustainably.					.81	.60	3.86	1.62	.28	-.63
49.[i] I feel guilty because I know about climate change but do not take a lot of action against it.					.78	.61	4.24	1.59	.05	-.69
47. I don't need to make climate change a matter of conscience.					.46	.62	3.01	1.59	.59	-.38
43. I have nothing to blame myself for when it comes to climate change.					.46	.50	2.95	1.49	.69	.12
Eigenvalues	4.80	4.40	2.42	2.21	1.86					
Percent of variance	.18	.17	.09	.08	.07					
Cumulative percent of variance	.18	.35	.45	.53	.60					

Note. F_1=Rationalization, F_2=Avoidance, F_3=Denial of personal outcome severity, F_4=Denial of global outcome severity, F_5=Denial of guilt.

[i]Reverse-coded.

Figure 1

Gaussian Graphical Model Displaying Interrelations of the Subscales of the CSPS



Note. Green lines indicate positive and red lines negative partial correlations. Thickness of lines indicates strength of relationships. For sake of clarity, only partial correlations above .1 are shown.

3.3.4 Self-Protective Strategies and Socio-Demographics

Reporting self-protective strategies was unrelated to age (except for a positive correlation between age and denial of guilt) and income, but positively related with political orientation. Those who reported right-wing political orientation generally reported higher use of self-protective strategies, especially denial of global outcome severity and rationalization (see Table 1). This supports H3.

A series of Welch two sample t-tests revealed differences between the genders[1]. Women reported significantly more avoidance than men (t[120.40]=-4.21, p<.001, d=.50, 95%CI of group difference [-.80, -.29], $M[SD]_{\text{female}}$=2.73[1.14], $M[SD]_{\text{male}}$=2.19[.88]), and less denial of personal outcome severity (t[86.43]=2.05, p=.043, d=.32, 95%CI[.01, .70], $M[SD]_{\text{female}}$=2.18[1.07], $M[SD]_{\text{male}}$=2.53[1.29]), denial of global outcome severity (t[78.39]=2.63, p=.010, d=.46, 95%CI [.12, .84], $M[SD]_{\text{female}}$=1.80[.93], $M[SD]_{\text{male}}$=2.28[1.39]), and denial of guilt (t[93.86]=4.43, p<.001, d=.63, 95%CI[.40, 1.06], $M[SD]_{\text{female}}$=3.35[1.15], $M[SD]_{\text{male}}$=4.08[1.21]). We found no difference between the genders in terms of rationalization. These findings partially confirm H4. A series of Kruskal-Wallis H tests revealed no differences between levels of education.

3.3.5 Self-Protective Strategies and PEB

Overall, self-protective strategies correlated negatively with PEB and willingness to donate (see Table 1). We performed a hierarchical multiple regression analysis, predicting PEB from self-protective strategies and covariates (see Table 3 for coefficients and model summaries).

As described above, we ran the analysis using original and log-transformed data. Results of those analyses did not differ significantly. To ease interpretation, we thus only report results using original data in writing (Table 3 includes analyses with transformed data). We found no evidence for singularity or multicollinearity (VIF<10). Entering age, gender, income, and political orientation explained 17% of the variance in PEB (F[4, 316]=17.56, p<.001, R^2=.18, R^2_{adjusted}=.17). Adding self-protective strategies explained another 8% of variance (F[9, 311]=12.69, p<.001, R^2=.27, R^2_{adjusted}=.25). In the final model, those who reported less avoidance, women, older, and left-wing participants reported more PEB. We interpret this as evidence for H5a.

[1]We excluded people who reported being non-binary from this analysis because with a sample size of n=2, we deemed any analyses to lack sufficient power.

Table 3
Hierarchical Regression Predicting PEB

	Step 1				Step 2			
	B	β	[95%CI]	*SE*	*B*	β	[95%CI]	*SE*
Intercept	.00			.28	.87* (.71†)			.37 (.37)
Gender (1=female)	.31†	.09	[-.26, .44]	.18	.36* (.35†)	.10 (.10)	[-.25, .46] ([-.25, .45])	.18 (.18)
Age	.03***	.25	[.23, .27]	.01	.03*** (.03***)	.24 (.23)	[.22, .25] ([.21, .25])	.01 (.01)
Income	.00	-.07	[-.07, -.07]	.00	.00 (.00)	-.11 (-.11)	[-.11, -.11] ([-.11, -.11])	.00 (.00)
Political orientation	-.03***	-.38	[-.39, -.38]	.00	-.02*** (-.02***)	-.27 (-.27)	[-.28, -.26] ([-.28, -.27])	.00 (.00)
Self-protective strategies								
Rationalization					-.14† (-.12)	-.12 (-.11)	[-.27, .03] ([-.26, .04])	.08 (.08)
Avoidance					-.20** (-.19**)	-.16 (-.15)	[-.30, -.03] ([-.29, -.02])	.07 (.07)
Denial of personal outcome severity					-.06 (-.23)	-.05 (-.08)	[-.20, .09] ([-.41, .25])	.07 (.17)
Denial of global outcome severity					-.15 (-.34†)	-.11 (-.12)	[-.30, .07] ([-.50, .26])	.09 (.19)
Denial of guilt					.07 (.07)	.06 (.06)	[-.08, .20] ([-.08, .20])	.07 (.07)
R^2				.18				.27(.27)
Adjusted R^2				.17				.25(.25)
ΔR^2								.09(.09)

Note. In parentheses are results after log-transformation of denial of personal and global outcome severity, n=321.
†p<.10, *p<.05, **p<.01, ***p<.001.

To predict willingness to donate to an environmental organization, we performed a sequential logistic regression analysis. We did not analyze the amount people were willing to donate but willingness per se, as a continuous variable would have been severely skewed. A model using age, gender, income, and political orientation as predictors was statistically significant against an intercept-only model (χ^2[4, N=277]=20.36, p<.001; see Table 4 for regression coefficients and odds ratios) but had small predictive value (McFadden's R^2-index=.054). A model also including self-protective strategies was significant against the null-model (χ^2[9, N=277]=28.40, p<.001), but did not significantly improve model fit of the first model (χ^2[5, N=277]=8.04,

p=.15). Only male gender was a significant predictor of willingness to donate (McFadden's R^2-index=.075). Based on these results we cannot confirm H5b.

Table 4

Sequential Logistic Regression Predicting Willingness to Donate

	Step 1			Step 2		
	B	SE	Odds Ratio [95%CI]	*B*	SE	Odds Ratio [95%CI]
Intercept	-.32	.53	.73 [.25, 2.05]	-1.07	.72	.34 [.08, 1.39]
Gender (1=female)	-.97**	.33	.38 [.20, .71]	-.96**	.35	.38 [.19, .75]
Age	.01	.02	1.01 [.98, 1.05]	.01	.02	1.01 [.97, 1.05]
Income	-.00	.00	1.00 [1.00, 1.00]	-.00	.00	1.00 [1.00, 1.00]
Political orientation	.02**	.01	1.02 [1.01, 1.04]	.01†	.01	1.01 [1.00, 1.03]
Self-protective strategies						
Rationalization				.08	.15	1.08 [.81, 1.45]
Avoidance				.12	.14	1.12 [.86, 1.47]
Denial of personal outcome severity				-.23	.15	.80 [.59, 1.06]
Denial of global outcome severity				.24	.18	1.28 [.90, 1.84]
Denial of guilt				.15	.14	1.17 [.89, 1.54]
χ^2(df)			20.36***(4)			28.40***(9)

Note. n=277.

†p<.10, **p<.01, ***p<.001.

Overall, the self-protective strategies were unrelated to age, income, and education but were related to male gender and right-wing political orientation, providing evidence for H3 and H4.

3.4 Discussion

Using an exploratory main axis analysis, we identified a five-factorial structure of the CSPS, corresponding to the self-protective strategies rationalization, avoidance, denial of personal

outcome severity, denial of global outcome severity, and denial of guilt. As expected in H1, the identified self-protective strategies mostly related positively to each other. Contrary to H2, inspection of partial correlations of the self-protective strategies (compare Figure 1) did not suggest strongly that they may be placed in Cohen's framework of denial (2001).

3.4.1 Reliability and Validity

This study revealed high internal consistency of the CSPS across subscales. Furthermore, we found evidence for criterion and construct validity, as the self-protective strategies predicted PEB. The less people reported using self-protective strategies, the more they also reported acting in environmentally friendly ways. This relation did not appear with willingness to donate. However, donation behavior may give a very limited account of actual PEB. It is based on the premise that climate change can be reduced through donating money to certain actors rather than directly reducing consumption and emissions. Two explanations are possible: 1) Those who use less self-protective strategies also donate because they acknowledge the importance of supporting actors fighting against climate change. 2) Donating can also be understood as a way of 'buying one's way out' of taking responsibility or perhaps to relieve feelings of guilt, legitimizing anti-environmental sentiments or behavior (see Andreoni, 1990; Meijers et al., 2015; Sachdeva et al., 2009). Willingness to donate, thus, could correlate positively or negatively with self-protection and relations within potential sub-groups should be disentangled.

4 Study 2

4.1 Aim and Hypotheses

Study 2 aimed at verifying the factorial structure of the CSPS (factorial validity). Further, it aimed at investigating criterion and construct validity of the subscales of the measure by investigating their relations with various indicators of pro-environmentalism and exploring relations with socio-demographic variables and political orientation. We expected to find the following:

- H1: The five-factorial structure of the CSPS can be replicated.
- H2: The five factors can be represented by two secondary factors representing implicatory and interpretive denial.
- H3: Right-wing political orientation correlates positively with self-protective strategies.
- H4: Men report more self-protective strategies than women.
- H5: Self-protective strategies are negatively related to indicators of pro-environmentalism.

4.2 Method

4.2.1 Participants and Procedure

We recruited N=453 German individuals from a different participant pool using the SoSci-Survey panel for an online study hosted on SoSci-Survey (Leiner, 2014). We followed the same procedure as in Study 1, except that we presented participants with the final CSPS constructed in Study 1 and also assessed environmental awareness and environmental motivation1. The sample averaged 37.68 years (SD=15.69, range:18-87), was more balanced in terms of gender (62.59% female), and was well educated (34.95% high school degree, 49.54% university degree).

4.2.2 Materials

PEB. We assessed PEB as in Study 1. However, participants answered items about private-sphere PEB (14 items, e.g., "I limit the amount of meat I eat") on a five-point Likert scale (1=*never*, 5=*always*) and items about public-sphere PEB (4 items, e.g., "I participate in environmental demonstrations") on a four-point Likert scale (1=*never*, 4=*often*). We dichotomized items (0=*never, seldom, occasionally*; 1=*often, always*) for Rasch modelling (Kaiser & Wilson, 2004) and no cases had missing data. Person separation reliability was satisfactory (R_p=.72). Item mean square infit values ranged from .80 to 1.05, well below the recommended 1.30 for samples with N<500 (Bond & Fox, 2013).

Environmental awareness. We measured environmental awareness with four items from the 2016 German Environmental Awareness Study (e.g., "We can only solve our environmental problems through fundamentally transforming our economic system and way of life", BMU & UBA, 2017). Participants indicated agreement with the statements using a slider bar (1=*strongly disagree*, 101=*strongly agree*).

Environmental motivation. The Motivation Toward the Environment scale (Pelletier et al., 1998) measured environmental motivation. Participants indicated agreement with 24 statements about reasons to act environmentally friendly, on a seven-point Likert scale (1=*strongly disagree*, 7=*strongly agree*). The scale assesses three forms of environmental motivation on six subscales, ranging from intrinsic (e.g., "for the pleasure I experience when I find new ways to improve the quality of the environment") to extrinsic motivation (i.e., integrated [e.g., "because being environmentally conscious has become a fundamental part of who I am"], identified [e.g., "because I think it's a good idea to do something about the environment"], introjected [e.g., "because I would feel bad if I didn't do anything"], and external regulation [e.g., "to avoid being criticized"]) to amotivation (e.g., "I truly have the impression I'm wasting my time doing things for the environment"). We calculated overall environmental motivation using mean scores in the following formula (Sheldon et al., 2017): Environmental motivation=intrinsic motivation+integrated regulation+identified regulation–introjected regulation–external regulation–amotivation.

4.2.3 Data Preparation and Statistical Analysis

Prior to analysis, we followed the same procedures as in Study 1. We excluded ten cases because RSI (Leiner, 2019; see above) was >2, leaving a total of N=443 cases. Using Mahalanobis distance, we identified another ten cases as multivariate outliers (p<.001), which we excluded from multivariate analyses (final N=433). Please refer to the supplemental material for a full data analysis using the entire dataset, and analyses without covariates. Those results did not significantly differ from results reported in text.

To validate the factor structure of the CSPS we performed a confirmatory factor analysis

Table 5

Spearman Correlations and Descriptive Statistics of Self-Protective Strategies

Variable	1	2	3	4	5	6	α [95%CI]	*M*	*SD*	Skewness	Kurtosis
1. Overall self-protection	—	[.80, .85]	[.61, .73]	[.64, .75]	[.59, .70]	[.40, .55]	.90 [.89, .92]	2.75	.82	.38	-.11
2. Rationalization	.83**	—	[.29, .46]	[.39, .56]	[.34, .49]	[.25, .44]	.89 [.88, .91]	3.00	1.27	.42	-.35
3. Avoidance	.69**	.39**	—	[.18, .39]	[.09, .32]	[-.16, .05]	.90 [.88, .91]	2.68	1.15	.48	-.43
4. Denial of personal outcome severity	.70**	.49**	.36**	—	[.48, .65]	[.20, .41]	.88 [.86, .9]	2.05	1.11	1.30	1.48
5. Denial of global outcome severity	.64**	.44**	.31**	.58**	—	[.34, .50]	.88 [.86, .9]	1.94	1.17	1.50	1.94
6. Denial of guilt	.43**	.30**	-.04	.28**	.36**	—	.71 [.67, .76]	3.75	1.18	.36	-.22

Note. p-values adjusted for multiple tests. Above the diagonal are 95% confidence intervals.
*$p<.01$.

Table 6

Spearman Correlations of Self-Protective Strategies with Study Variables and Descriptive Statistics of Study Variables

Variable	1 [95%CI]	2 [95%CI]	3 [95%CI]	4 [95%CI]	5 [95%CI]	6 [95%CI]	α [95%CI]	*M*	*SD*	Skewness	Kurtosis
8. Pro-environmental behavior	-.36** [-.46, -.30]	-.31** [-.40, -.23]	-.28** [-.39, -.21]	-.24** [-.35, -.17]	-.31** [-.38, -.24]	-.03 [-.14, .03]	.72[a]	.47	1.21	.62	1.27
9. Willingness to donate	-.04 [-.18, .10]	.03 [-.10, .18]	-.13 [-.28, .00]	-.02 [-.13, .14]	-.12 [-.23, .09]	.09 [-.03, .25]	-	31.08	16.79	-.07	-1.50
10. Environmental awareness	-.44** [-.55, -.38]	-.33** [-.43, -.25]	-.28** [-.31, -.08]	-.39** [-.53, -.34]	-.50** [-.62, -.45]	-.18* [-.34, -.16]	.89 [.88, .91]	81.27	17.12	-1.02	.74
11. Environmental motivation	-.44** [-.54, -.38]	-.38** [-.49, -.32]	-.40** [-.49, -.31]	-.35** [-.44, -.24]	-.32** [-.39, -.22]	.04 [-.07, .10]	.90 [.88, .91]	140.75	49.44	-.22	-.31
12. Age	.02 [-.06, .13]	.02 [-.05, .13]	-.10 [-.19, -.01]	.00 [-.10, .10]	.03 [-.07, .13]	.26** [.18, .35]	-	37.68	15.69	.69	-.61
13. Income	-.02 [-.20, .01]	-.02 [-.19, .02]	-.09 [-.22, -.07]	.06 [-.10, .07]	-.01 [-.13, .04]	.10 [-.06, .15]	-	1833.50	2519.33	9.83	141.96
14. Political orientation	.23** [.16, .36]	.19** [.10, .29]	.13 [.04, .21]	.14 [.09, .30]	.25** [.21, .40]	.13 [.05, .26]	-	35.80	19.29	.33	-.28

Note. 1=Overall self-protection, 2=Rationalization, 3=Avoidance, 4=Denial of personal outcome severity, 5=Denial of global outcome severity, 6=Denial of guilt. We display descriptive statistics of Rasch person parameters for pro-environmental behavior. p-values adjusted for multiple tests.

[a]Person separation reliability.

$p<.05$, $^{**}p<.01$.

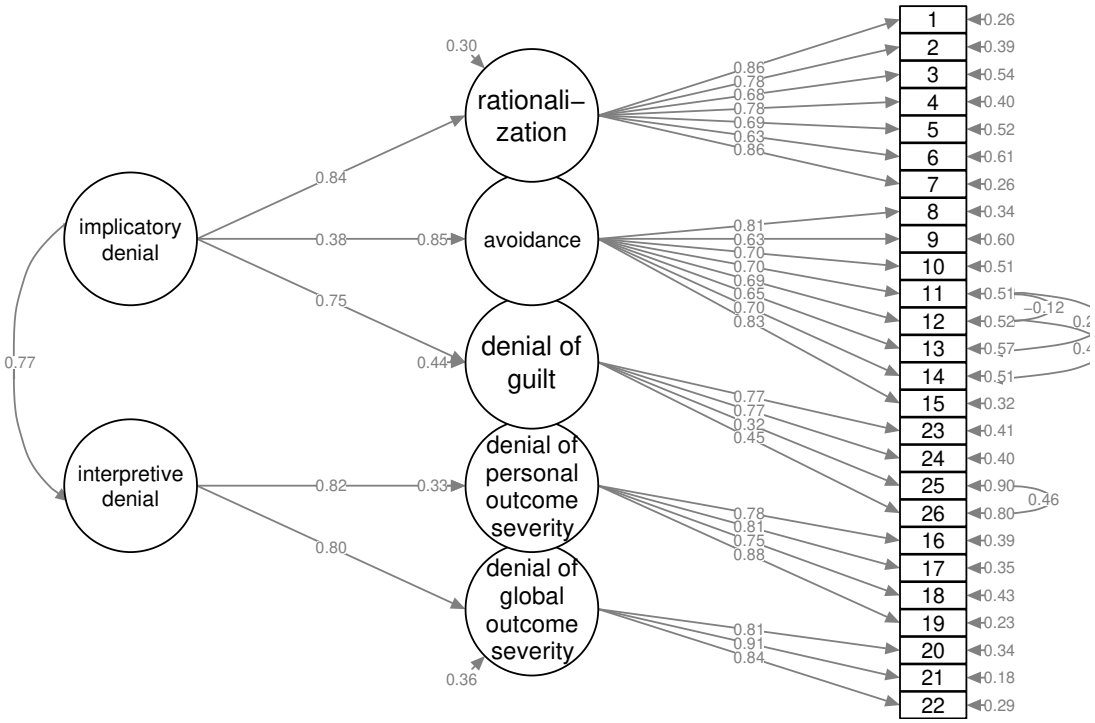
As suggested in Study 1, we hypothesized a five-factor model and all factors to co-vary with each other. To test whether the respective factors can be understood in terms of Cohen's framework in this more balanced sample, we also included two secondary factors, namely, interpretive denial (denial of personal outcome severity and denial of global severity) and implicatory denial (rationalization, avoidance, and denial of guilt). We constrained latent factors to have a mean of 0 and a variance of 1. With between 58 and 66 parameters to be estimated, N/q was approximately 7. The model was identified. Graphical representations of all models including (un)standardized parameter estimates, standardized residuals, squared multiple correlation coefficients, and empirical and model-implicated variance-covariance-matrices are in the supplemental material.

Model Estimation. The hypothesized model had acceptable fit (Hu & Bentler, 1999), Satorra-Bentler $\chi^2(293, N=443)=814.24$, $p<.001$, Robust Comparative Fit Index (CFI)=.91, Akaike Information Criterion (AIC)=36262.22, Robust Root Mean Square Error of Approximation (RMSEA)=.069, 90%CI[.063, .074]. Based on modification indices and theoretical feasibility, we estimated three residual covariances of three items loading onto the factor avoidance and one additional covariance between two items loading onto the factor denial of guilt (see Figure 2). This improved model fit significantly, Satorra-Bentler $\chi^2(289, N=443)=618.51$, $p<.001$, Robust CFI=.94, AIC=36036.50, Robust RMSEA=.055, 90%CI[.049, .061], $\chi^2_{\text{diff}}(4, N=443)=154.54$, $p<.001$. Internal consistency of the replicated self-protective strategies was acceptable to excellent ($\alpha = .71$–$.90$).

Inspection of standardized parameter estimates of the secondary factors revealed that the factor avoidance did not load highly on the secondary factor implicatory denial ($\beta = .39$). Since there is theory to suggest that avoidance may be a separate process than implicatory denial (e.g., Salander & Windahl, 1999), we decided to include avoidance as its own secondary factor. The resulting model did not significantly differ from the previous model, Satorra-Bentler $\chi^2(288, N=443)=618.19$, $p<.001$, Robust CFI=.94, AIC=36037.33, Robust RMSEA=.055, 90%CI[.049, .061], $\chi^2_{\text{diff}}(1, N=443)=.75$, $p=.385$.

Figure 2

Final Model Showing the Five Factors of the Climate Self-Protection Scale and Two Secondary Factors Corresponding to Interpretive and Implicatory Denial



Note. Displayed are standardized parameter estimates. Latent variables (factors) are drawn as circles and measured items are drawn as rectangles.

We also analyzed a model without secondary factors, Satorra-Bentler $\chi^2(285, N=443)=593.06$, $p<.001$, Robust CFI=.94, AIC=36011.40, Robust RMSEA=.053, 90%CI[.047, .059]. Even though the resulting model had slightly better model fit than models including secondary factors ($\chi^2_{diff}[3, N=443]=20.43$, $p<.001$ and $\chi^2_{diff}[4, N=443]=21.24$, $p<.001$), the difference was very small and its real-life significance may be questionable. We interpret this as support for H1 and H2, especially given theoretical support of a higher-order structure and following guidelines by Chen (2007) who suggests that a difference in CFI of less than .01 and a difference in RMSEA of less than .015 supports the more restricted model.

4.3.3 Relations of Subscales

Replicating findings from Study 1, people indicated overall medium-low levels of self- protection. Participants reported denial of global outcome severity least, while denial of guilt was more common. The pattern of correlations between the subscales was similar to that in Study 1. As in Study 1, we log-transformed the subscales denial of personal and global outcome severity because their distributions were skewed.

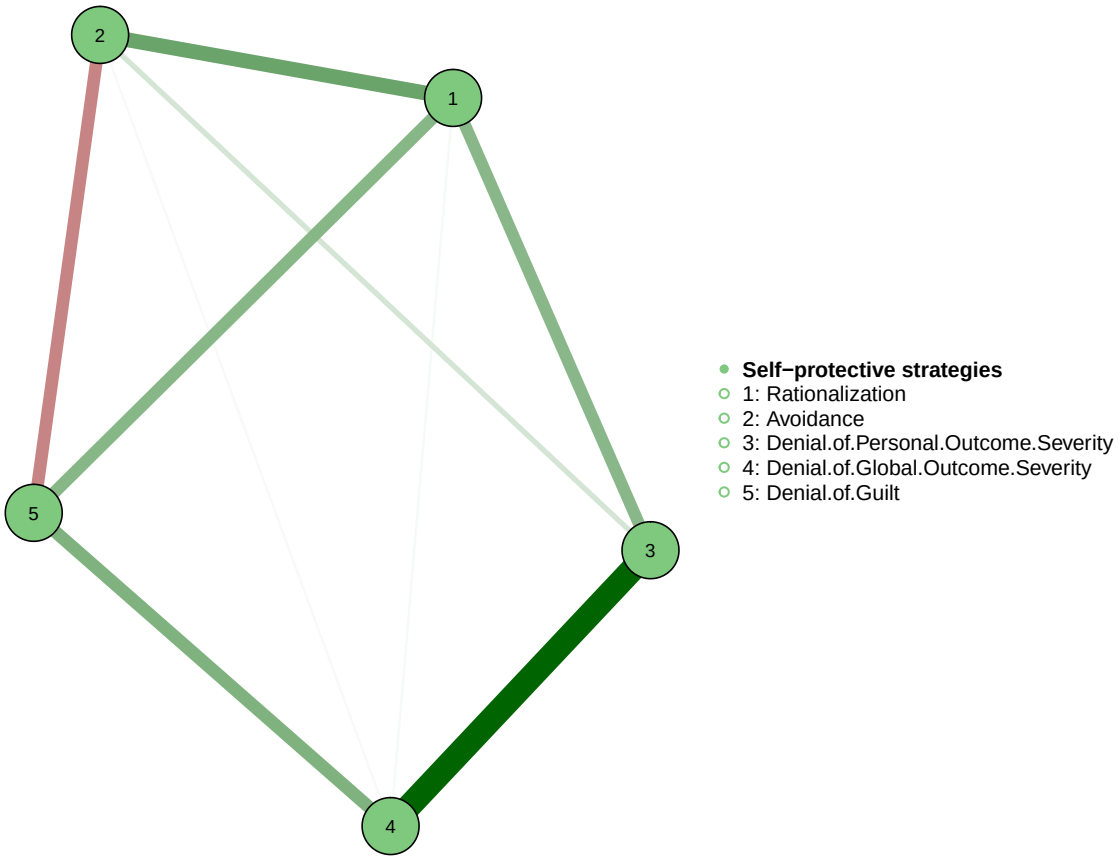
Further, we visualized partial correlations between the subscales of the CSPS using Gaussian graphical modelling (Bhushan et al., 2019, Figure 3). We observed two clusters consisting of denial of personal and global outcome severity, and rationalization, avoidance, and denial of guilt, respectively. We interpret this as interpretive and implicatory denial strategies clustering together, providing further evidence for H2.

4.3.4 Self-Protective Strategies and Socio-Demographics

Replicating findings from Study 1, self-protective strategies were mostly unrelated to age and income, except for a medium positive relation between denial of guilt and age. Overall, self-protective strategies were positively related to right-wing political orientation, especially rationalization and denial of global outcome severity, confirming H3. A series of Welch two sample t-tests revealed differences between the genders1. Women reported significantly less rationalization (t[305.55]=2.55, p=.011, d=.26, 95%CI of group difference [.08, .59], $M[SD]_{\text{female}}$=2.88[1.22], $M[SD]_{\text{male}}$=3.21[1.34]), denial of global outcome severity (t[279.41]=2.46, p=.015, d=.26, 95%CI[.06, .54], $M[SD]_{\text{female}}$=1.84[1.07], $M[SD]_{\text{male}}$=2.14[1.31]), and denial of guilt (t[326.09]=4.27, p<.001, d=.43, 95%CI[.27, .73], $M[SD]_{\text{female}}$=3.56[1.16], $M[SD]_{\text{male}}$=4.06 [1.17]) than men, supporting H4. A series of Kruskal-Wallis H tests revealed no differences between levels of education.

Figure 3

Gaussian Graphical Model Displaying Interrelations of the Subscales of the Climate Self-Protection Scale



Note. Green lines indicate positive and red lines negative partial correlations. Thickness of lines indicates strength of relationships. For sake of clarity, only partial correlations above .1 are shown.

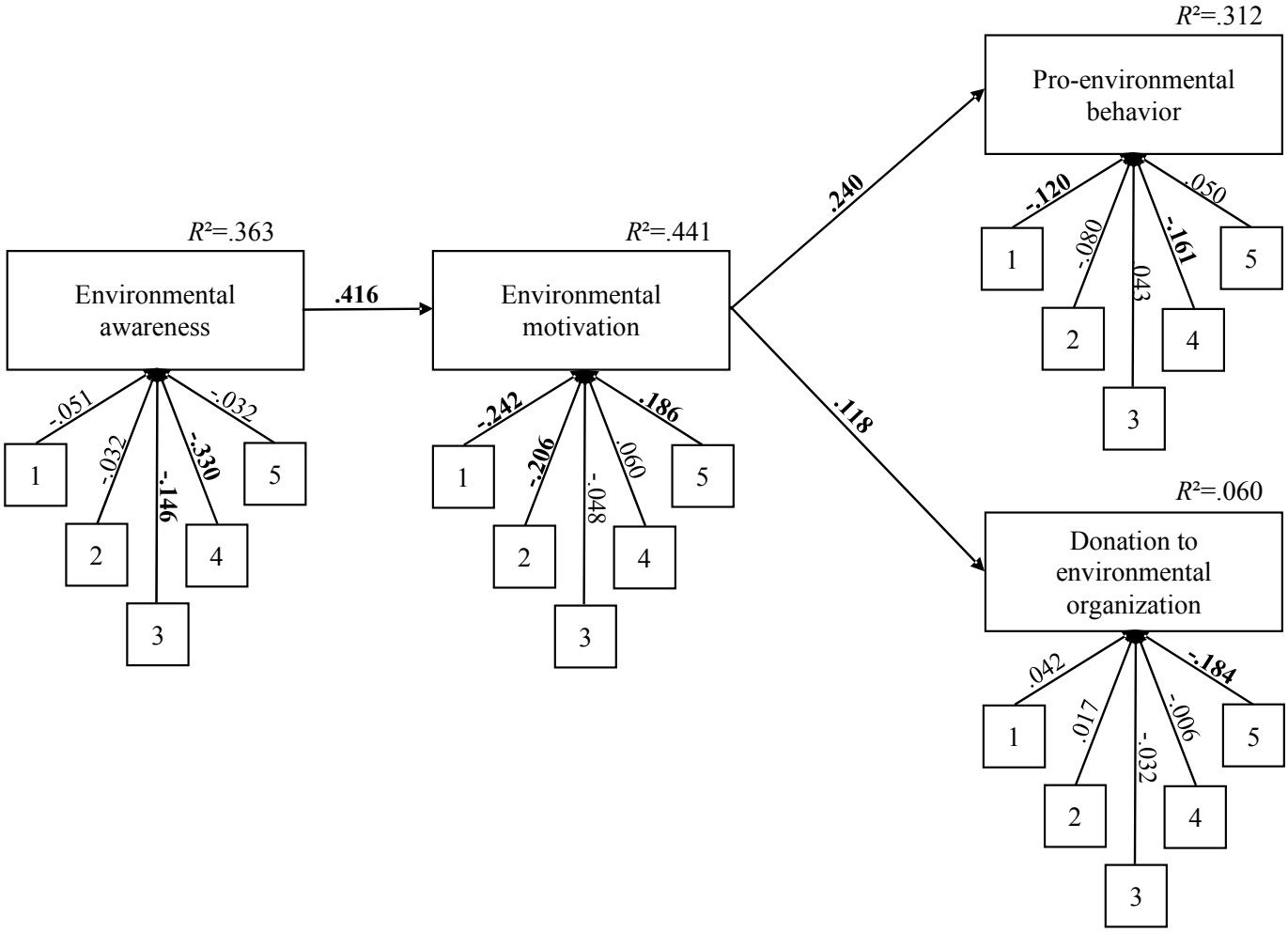
4.3.5 Self-Protective Strategies and Indicators of Pro-Environmentalism

All self-protective strategies correlated negatively with all indicators of pro-environmentalism (see Table 6), except for willingness to donate, which appeared unrelated to self-protective strategies. To investigate relations between self-protective strategies and different indicators of pro-environmentalism, we ran a path model with self-protective strategies predicting different environmental indicators, environmental awareness predicting environmental motivation,

and environmental motivation predicting environmental behavior, controlling for age, gender, political orientation, and income (see Figure 4 for a simplified visualization of the model with path coefficients and supplemental material for standardized residuals and empirical and model-implicated variance-covariance-matrices).

Figure 4

Path Model Displaying Relations Between Self-Protective Strategies and Pro-Environmentalism



Note. Path model displaying relations between self-protective strategies and pro-environmentalism. Displayed are standardized parameter estimates. Significant results are bold. 1=Rationalization, 2=Avoidance, 3=Denial of personal outcome severity, 4=Denial of global outcome severity, 5=Denial of guilt.

The Doornik-Hansen test revealed multivariate non-normality ($E(26)$=16549.01, p<.001). We therefore used MLM (Finney & DiStefano, 2013) and log-transformed data for denial of personal and global outcome severity. With N=397 and 44 parameters to be estimated, N/q was approximately 9. The model was identified. The hypothesized model fit the data well (Hu & Bentler, 1999), with Satorra-Bentler $\chi^2(2, N=397)=15.68$, $p<.001$, Robust CFI=.997, AIC=11831.75, Robust RMSEA=.125, 90%CI[.072, .186]. In sum, interpretive denial predicted environmental awareness, implicatory denial and environmental awareness predicted environmental motivation, rationalization, denial of global outcome severity, and environmental motivation predicted PEB, and denial of guilt and environmental motivation predicted donations. We interpret this as partial evidence for H5.

4.4 Discussion

This study provides further evidence for criterion, construct, and factorial validity of the CSPS, replicating and strengthening findings from Study 1. Using CFA, we replicated its five-factorial structure and found evidence for Cohen's framework, providing evidence for factorial validity of the CSPS. Gaussian graphical modelling revealed self-protective strategies to be predominantly positively related to each other and to cluster into interpretive (denial of personal and global outcome severity) and implicatory denial (rationalization, avoidance, and denial of guilt). Avoidance did not cluster as closely to the other implicatory strategies and was negatively related to denial of guilt.

As expected and replicating findings from Study 1, male gender and right-wing political orientation were positively related to self-protective strategies. Self-protective strategies were generally negatively related to various indicators of pro-environmentalism, even when controlling for covariates, providing evidence for criterion and construct validity of the CSPS. However, relations with environmental awareness and motivation were more consistent than relations with PEB.

5 General Discussion

The present research aimed at constructing and validating an instrument that could be used to assess self-protective strategies people use to deal with the threat of climate change. Two studies found evidence for the CSPS to be an internally consistent and valid measure of climate self-protective strategies. Across studies, the CSPS was negatively related to various indicators of pro-environmentalism, and positively related to male gender and right-wing political orientation.

5.1 Interpretation of Results

Regarding criterion and construct validity, we mainly found results in line with our hypotheses. Self-protective strategies were negatively related to various indicators of pro-environmentalism. More specifically, interpretive denial predicted environmental awareness, while implicatory denial predicted environmental motivation. A mix of both predicted actual behavior. This partly replicates Ojala (2015) who found that de-emphasizing the seriousness of climate change, a strategy corresponding to interpretive denial, was associated with less PEB. Denial of guilt was a negative predictor of willingness to donate in Study 2, replicating findings by Homburg et al. (2007).

Nevertheless, findings were less consistent across both studies. Even though denial of guilt was not a significant predictor of PEB, it seemed to relate positively rather than negatively with PEB and correlated positively with willingness to donate in Study 1. Those who denied their guilt and were confronted with this through answering the questionnaire may have developed a sense of obligation and therefore indicated to donate money as a way to calm their consciousness (see Andreoni, 1990; Meijers et al., 2015; Sachdeva et al., 2009). However, one may also speculate that those who deny guilt do so because they already do all they can for the environment. In this case, an absence of feelings of guilt would not be a self-protective strategy. Nevertheless, this inconsistency of findings may indicate effects of third variables, or subgroups within the data that future research should try to identify.

Interestingly, avoidance and denial of guilt were negatively related in both samples. Perhaps those who felt guilty and did not deny those feelings took a larger effort to avoid the reality of climate change to enable themselves to cope with the demands of everyday life. Salander and Windahl (1999) recommend to split what people commonly refer to as denial into denial, disavowal, and avoidance, with avoidance being a conscious process, and the least clinically relevant strategy of the three. This suggests avoidance may be separate from the other implicatory strategies of denial that may be described as disavowal – the preconscious process of simultaneous knowing but not knowing. In fact, the results of the CFA in Study 2 showed no difference between models, with and without avoidance as an implicatory strategy. Further, the negative relation between avoidance and denial of guilt may indicate different subgroups in our samples that employ differing self-protective strategies. This may even indicate a process people go through before they arrive at more constructive strategies. Future research could disentangle these findings further.

Across studies, women used self-protective strategies to a lesser extent than men. Other researchers consistently found that men engage in more literal and interpretive ("conservative male effect", Jylhä et al., 2016; Feygina et al., 2010; McCright & Dunlap, 2011; Ojala, 2015; Poortinga et al., 2011), and implicatory climate denial (Norgaard, 2006a). Men may be more motivated to deny to preserve the contemporary system because they benefit from it, relative to women, for example in terms of relatively higher positions of power (Jylhä et al., 2016).

Further, right-wing political orientation and self-protective strategies were related. We expected this finding, given the literature on relations between climate denial, right-wing authoritarianism, and conservatism (Jylhä & Akrami, 2015; Milfont et al., 2013). Across studies, these relations were stronger for interpretive denial than implicatory denial. Norgaard (2019) found that climate denial exists on a spectrum of responses entailing both the political left and right. Typically, the center-left employs implicatory forms of denial (Norgaard names public apathy and trust in neoliberal market solutions, such as "green" technology, that do not solve the root of the crisis), while the political right employs interpretive and literal denial. While the manifest shape of the denial is different, the function it serves is similar across the contin-

uum. Ultimately, it is a reaction to (psychological) threat and entails a reinforcement of social structures and solidification of power relations (Norgaard, 2019). The present research is partly in line with these findings.

5.2 Limitations and Future Directions

Our studies have both strengths and limitations that deserve comment. We used a non-probable purposive sampling approach to recruit participants for Study 1 and relied on a panel provider to recruit participants for Study 2. While this led to non-representative samples we argue that our relatively young privileged participants are particularly relevant as they will live with the climate crisis the longest, are very informed, and have relatively influential behavior. However, a follow-up study should further validate the CSPS in a representative sample.

As we touched upon in the introduction, climate-relevant defensive self-protection is contingent on socio-political contexts. The links between self-protective strategies and pro-environmentalism that we discovered in our study may thus not generalize to socio-cultural contexts that are very different from Germany. For instance, Hornsey et al. (2018) showed in an approximate-representative cross-cultural sample that the link between ideological beliefs and literal climate denial was strongest in the US. Nevertheless, climate denial is not only a phenomenon in the US but takes different shapes depending on socio-cultural context (see Norgaard, 2019). We argue that the CSPS allows the assessment of more subtle and "hidden" forms of denial that are easily missed when only investigating overt literal denial. It may therefore be a practical tool to assess types of climate-relevant defensive self-protection in a given sample and context to be able to target it accordingly, for instance through communication campaigns (see Goldberg, 2020).

Nevertheless, when researching defensive, self-protective strategies, it is important to remember that these processes are often unconscious and that social desirability may bias answers. It is thus challenging to research them using methods that rely on conscious recollection. Future research should complement our approach with implicit methods (e.g., Implicit Association Test, Greenwald et al., 1998).

In our studies, we used a general measure of political left-right orientation to predict self-protective strategies. As prior research revealed the predictive role of more specific ideological variables on literal climate denial, especially social dominance orientation (Jylhä & Akrami, 2015; McCright & Dunlap, 2011) and system justification (Feygina et al., 2010), future studies should include such specific predictors and examine their relations with the self-protective strategies identified in our research. Further, as all levels of denial seem to be related to protection of the self from threat, the CSPS could be used to investigate relations with fundamental indicators of human well-being and functioning, regardless of ideological outlook (e.g., basic psychological needs). For example, limited psychological resources to face the threat of climate change due to thwarted basic psychological need satisfaction (Deci & Ryan, 2000), may be one antecedent of self-protective strategies.

Lastly, the approach employed in this paper may be criticized for oversimplification of a highly complex phenomenon (e.g., Poortinga et al., 2011) that can and should be examined using a multitude of scientific perspectives. Not only are self-protective strategies relevant regarding the psychological functions they serve and resulting absence of action, but also regarding ideology and (global) power relations, economic and political interests, and implications for environmental justice, self-determination, democracy, human rights, and environmental collapse. It is important to note that denialism is also actively constructed by conservative think tanks (Hultman et al., 2019; Norgaard, 2019). Thus, psychological factors cannot fully explain denialism but rather explain predisposition for agreement with it (Jylhä et al., 2016; Norgaard, 2011). At the same time, we acknowledge that the complexity of the human condition and embeddedness of individuals in pervasive economic-political contexts require transdisciplinary and mixed-methods approaches. Qualitative approaches that are able to capture the inherent inconsistencies and ambiguities in the human experience may be particularly informative. Nevertheless, we believe that our new measure may be a valuable contribution to the understanding of psychological functions and antecedents of denial, to overcome it and enable action.

5.3 Conclusion

Self-protective strategies are dangerous because they prevent the action needed to avert and buffer the dire consequences of the climate crisis. They serve the psychological function of protecting the self so it can go about its everyday life without panicking. However, people may need guidance on how to deal with uncomfortable, negative, and potentially traumatic feelings associated with the threat of climate change, to overcome denial and start action, while maintaining mental health. The present study fills in one piece of the puzzle by providing a tool to measure climate-relevant self-protective strategies. Pursuing this research further may at some point allow recommendations for a society that is resilient in the face of crisis and able to deal with threat proactively and constructively, both on individual and collective levels.

6 References

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Manuscript 3

Looking the Other Way: Basic Psychological Need Satisfaction Negatively Predicts Defensive Self-Protection in the Face of the Climate Crisis

Wullenkord, M. C. (under review). Looking the other way: Basic psychological need satisfaction negatively predicts defensive self-protection in the face of the climate crisis. *Journal of Environmental Psychology.*

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Abstract:

The climate crisis and its consequences threaten not only human survival as a species but also the social organization of society. To protect themselves from those threats and associated uncomfortable emotions, people often use self-protective strategies such as the denial that climate change is as severe as predicted, avoidance of information about it in everyday life, or rationalization of one's inability to act. Self-determination theory proposes that the frustration of basic psychological needs predicts defensiveness. Therefore, the present research aimed at investigating basic psychological need satisfaction as a negative predictor of climate-relevant defensive self-protection. Furthermore, I examined gender and political orientation as correlates of self-protection. Study 1 (N=453) is an online study assessing need satisfaction both generally and in the environmental domain, autonomous environmental motivation, environmental awareness, pro-environmental behavior, and self-protection. Path analysis revealed that low need satisfaction was related to self-protection, and high need satisfaction was related to autonomous environmental motivation and pro-environmental behavior. Study 2 (N=392) is an experimental between-subjects design assessing the effect of threat and need satisfaction on self-protection using self-report and two single category implicit association tests. Low need satisfaction predicted explicitly measured self-protection but not implicitly measured self-protection. This was especially true for men, while self-protection did not vary with need satisfaction for women. Future research should investigate these findings further to eventually develop need-based interventions that aid people in coping with the threat of climate change in proactive ways.

Keywords: climate change; psychological needs; denial; defensiveness; self-protection; pro-environmental behavior

1 Introduction

Even though the threat of climate change is abundantly clear and its consequences already noticeable across the world (Masson-Delmotte et al., 2018; Steffen et al., 2015), climate action at both individual and societal levels is lagging behind. People in the Global North, and in Germany in particular, can be characterized by a paradox: They have high knowledge about climate change and report high pro-environmental attitudes (BMU & UBA, 2019) but simultaneously act in ways that do not mitigate the climate crisis (see Moser & Kleinhückelkotten, 2018), resulting in ten tons yearly consumption-based CO_2-emissions per capita (Friedlingstein et al., 2020; Global Carbon Atlas, 2018). One explanation for this seeming apathy is that many people may simply not have the psychological resources to cope with the demands of everyday life and the threats that climate change and its consequences poses - both for human survival as a species and for the social organization of society. Rather, they may use a range of self-protective strategies that prevent uncomfortable emotions, justify inaction, preserve self-esteem, and ultimately prevent climate action. Self-determination theory (Deci & Ryan, 2000; Ryan & Deci, 2017) may be used to understand defensiveness in the climate context (see Wullenkord, 2020, for a theoretical argument). Here, I present two studies using self-determination theory to investigate climate-relevant defensive self-protection (henceforth *self-protection*).

2 Theoretical Background

2.1 Self-Determination Theory

Self-determination theory is a dialectical humanistic theory of human motivation, proposing the three basic psychological needs (*needs* in the following) for autonomy (agency), competence (efficacy), and relatedness (belonging) as "innate psychological nutriments that are essential for ongoing psychological growth, integrity, and well-being" (Deci & Ryan, 2000, p. 3). Put more simply: The needs and their satisfaction are fundamental for healthy human functioning, well-being (Deci & Ryan, 2000), and the ability to cope with threat (Sheldon et al., 2016),

while their frustration has detrimental effects and leads to defensiveness and self-protection (Deci & Ryan, 2000; Vansteenkiste & Ryan, 2013). Need satisfaction is also a pre-requisite for autonomous motivation. That is the motivation one has when behavior is self-endorsed and in line with one's interests, values, or sense of self, or when behavior is performed for its own sake (intrinsic motivation). The more need satisfaction one experiences, the more autonomously motivated one is (Deci & Ryan, 2000).

2.1.1 Basic Psychological Need Satisfaction, Autonomous Environmental Motivation, and Pro-Environmentalism

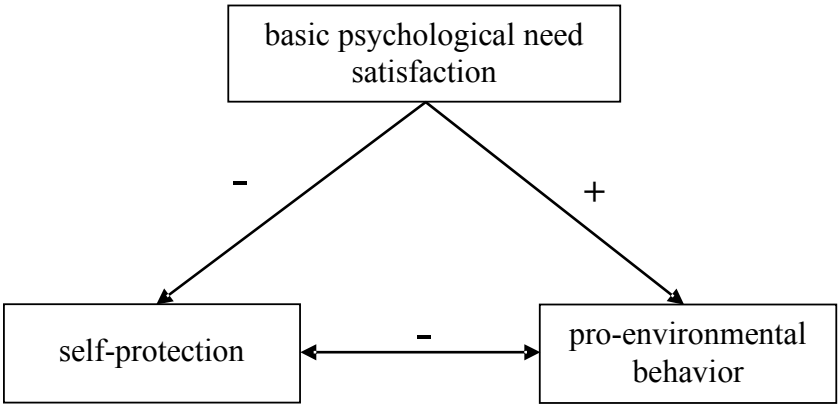
Given that need satisfaction enables coping in the face of threat (Sheldon et al., 2016), it should also lead to proactive coping in the face of climate change threat, for instance in the form of pro-environmental behavior (PEB). Need frustration, however, should lead to self-protection (see Figure 1; Wullenkord, 2020). A range of studies showed need satisfaction to be related to more autonomous environmental motivation and performance of various PEBs. For instance, need satisfaction was related to lower environmental impact (Cooke et al., 2016), sustainable clothing consumption (Taljaard & Sonnenberg, 2019) and participation in community gardens (Quested et al., 2018). Students whose needs were satisfied in school (Kaplan & Madjar, 2015) and people who perceived that their government implemented legislation protecting the environment in an autonomy-supportive way (Lavergne et al., 2010) engaged in more PEB. Furthermore, need satisfaction predicted autonomous environmental motivation in a range of studies investigating difficult PEB (Aitken et al., 2016), PEB in the family home (Grønhøj & Thøgersen, 2017) and in schools (Darner, 2012), and engagement in small pro-environmental initiatives (Reznickova & Zepeda, 2016). In sum, several correlational studies showed a relation between need satisfaction and PEB. Based on these findings and theoretical considerations, I hypothesized that:

- H1: *Stronger need satisfaction is related to stronger pro-environmentalism.*
- H2: *Stronger need satisfaction is related to more autonomous environmental motivation.*

- H3: *More autonomous environmental motivation is related to stronger PEB.*

Figure 1

Working Model on Basic Psychological Need Satisfaction and Frustration and Responses to Climate Change Threat



Note. In the face of climate change threat, need satisfaction enables people to cope proactively, which is associated with pro-environmental behavior. Need frustration, however, should be related to an inability to cope proactively, which is associated with higher levels of self-protection. Adapted from Wullenkord (2020).

2.1.2 Need Frustration and Climate-Relevant, Defensive Self-Protection

Self-determination theory proposes that need frustration leads to defensiveness and self-protection when facing threat. Self-protective strategies are defensive strategies used to protect the self from threat and accompanying uncomfortable emotions to maintain positive self-esteem. In the context of climate change, such self-protective strategies exist on a spectrum of denial (Cohen, 2001; Norgaard, 2019; Wullenkord & Reese, 2020): literal denial (i.e., the denial that climate change exists), interpretive denial (i.e., the distortion of what climate change entails and emotional distancing from it), and implicatory denial (i.e., acknowledgement of climate change as a problem but denial of its psychological, political, or moral implications). By implication, self-protective strategies prevent people from engaging with the issue of climate change in proactive ways, such as in the form of PEB (Homburg et al., 2007; Ojala, 2012, 2013). A range of studies showed climate denial to be a primarily male, right-wing phenomenon (Hultman

& Pulé, 2018; Jylhä et al., 2016; McCright & Dunlap, 2011; Nelson, 2020). Based on those findings, I hypothesized that:

- *H4: Stronger self-protection is related to weaker pro-environmentalism.*
- *H5: Stronger self-protection is related to male gender.*
- *H6: Stronger self-protection is related to right-wing political orientation.*

When needs are frustrated, people are more vulnerable in the face of threat because they have fewer psychological resources to cope with threat proactively (Vansteenkiste & Ryan, 2013). For example, need frustrated people were less likely to act in line with their values (Di Domenico et al., 2013) and used more self-protective strategies in stressful situations (Hodgins et al., 2006, 2010). People with fragile self-esteem (likely associated with need frustration, Ryan & Brown, 2003; Ryan & Deci, 2017) used more defensive self-protection when faced with self-esteem threat (McGregor & Marigold, 2003). These relations likely extend to human responses to the climate crisis. In the environmental domain, people with non-autonomous environmental motivation (likely a result of need frustration) used more self-protective strategies to justify their inconsistent, environmentally damaging actions (Lavergne & Pelletier, 2015), especially when their sense of self was threatened (Lavergne & Pelletier, 2016). I therefore hypothesized that:

- *H7: Stronger need frustration is related to stronger self-protection.*
- *H8: Need satisfaction and threat interact to predict self-protection, such that need frustrated people experiencing threat use most self-protective strategies and need satisfied people experiencing no threat use least self-protective strategies.*

2.2 Aims and Overview of Studies

The main aim of this research was thus to investigate need satisfaction as a predictor for climate-relevant defensive self-protection (see Figure 1). To this end I conducted a correlational study (Study 1) and an experimental between-subjects design assessing the effect of threat and need satisfaction on direct and indirect operationalizations of self-protection (Study 2).

3 Study 1

Study 1 aimed at investigating relations between need satisfaction and frustration and self-protection. Furthermore, I assessed autonomous environmental motivation and PEB, and measured gender, political orientation, and environmental awareness as control variables. This study focusses on the investigation of H1 to H3 and H7. Please note that I used the same data set to investigate H4 to H6 in another study that did not examine relations with need satisfaction (Wullenkord & Reese, 2020).

3.1 Methods Study 1

3.1.1 Participants and Procedure

Drawing on the SoSci-Survey panel (www.soscipanel.de), I recruited a convenience sample of N=453 German-speaking individuals for an online study (M_{age}=37.7 years, SD=15.7, range:18-87) hosted on the platform SoSci-Survey (Leiner, 2020). The majority of participants identified as female (62.6%) and had a rather high educational background (35.0% high school degree, 49.5% university degree). After giving their informed consent in line with ethical guidelines by the DGPS and the Declaration of Helsinki, participants responded to items about general and environmental need satisfaction, autonomous environmental motivation, PEB, self-protection, socio-demographic background (age, gender, education, income), and political orientation and environmental awareness as control variables. Within sections, I randomized the order in which items were presented to avoid sequence effects. Finally, participants could choose to enter a raffle for money as compensation for their participation. They could indicate whether they would donate part or all of the money to an environmental organization in case they would win. I used this willingness to donate as another indicator of PEB.

3.1.2 Methods and Materials

If not otherwise indicated, participants responded to items on seven-point Likert-scales (1 = *strongly disagree/does not apply at all*, 7 = *strongly agree/applies completely*).

Basic Psychological Need Satisfaction. The 18 items of the Balanced Measure of Psychological Needs Scale (Sheldon & Hilpert, 2012; German translation by Neubauer & Voss, 2016) assess overall autonomy satisfaction (e.g., "I was free to do things my own way", α=.69) and frustration (e.g., "I had to do things against my will", α=.67), competence satisfaction (e.g., "I took on and mastered hard challenges", α=.82) and frustration (e.g., "I experienced some kind of failure, or was unable to do well at something", α=.74), and relatedness satisfaction (e.g., "I felt close and connected with other people who are important to me", α=.85) and frustration (e.g., "I felt unappreciated by one or more important people", α=.72) with reference to the past month.

Additionally, I adapted the same scale to assess need satisfaction in the environmental domain: Participants first listed what they usually do to help the environment and then indicated how autonomous, competent, and related they usually feel whilst doing so. Internal consistency was acceptable (α's=.68-.90, see supplementary material S1 for instructions and adaptation).

Autonomous Environmental Motivation. The *Motivation Toward the Environment scale* (Pelletier et al., 1998) measures autonomous environmental motivation using 24 statements about reasons to act environmentally friendly. These statements correspond to three forms of environmental motivation that correspond to decreasing relative autonomy: intrinsic motivation (e.g., "for the pleasure I experience when I find new ways to improve the quality of the environment", α=.85), extrinsic motivation (i.e., integrated regulation [e.g., "because being environmentally conscious has become a fundamental part of who I am", α=.90], identified regulation [e.g., "because I think it's a good idea to do something about the environment", α=.89], introjected regulation [e.g., "because I would feel bad if I didn't do anything", α=.79], and external regulation [e.g., "to avoid being criticized", α=.79]), and amotivation (e.g., "I truly have the impression I'm wasting my time doing things for the environment", α=.81). Participants indicated their agreement with the statements using slider bars (1=*disagreement*, 101=*agreement*). Following standard procedures (Sheldon et al., 2017), I applied the following formula to calculate a relative autonomy index of environmental motivation using means scores: Autonomous environmental motivation = intrinsic motivation + integrated regulation + iden-

tified regulation – introjected regulation – external regulation – amotivation. Possible scores range from -300 indicating relatively controlled environmental motivation to 300 indicating relatively autonomous environmental motivation.

Pro-Environmental Behavior. Nineteen items captured a broad range of impactful private- and public-sphere PEB (cf. Stern, 2000): I used eight items by Cooke et al. (2016), eight items from the General Ecological Behavior scale (Kaiser & Wilson, 2004), and three own items (e.g., "I participate in environmental demonstrations"). Participants indicated how often they performed private-sphere PEB on a five-point Likert-scale (1=*never*, 5=*always*, 14 items, e.g., "I limit the amount of meat I eat") and public-sphere PEB on a four-point Likert-scale (1=*never*, 4=*often*, 4 items, e.g., "I participate in environmental demonstrations"). I used Rasch-modelling to analyze the items. There were no missing data. Following recommendations by Kaiser and Wilson (2004), I dichotomized items (0=*never/seldom/occasionally*, 1=*often/always*). With R_p=.72, the analysis revealed satisfactory person separation reliability and with values between 0.79 and 1.05, item mean square infit values were well below the recommended threshold of 1.30 for samples with N<500 (Bond & Fox, 2013).

As described above, I also assessed willingness to donate to environmental organizations as another indicator of PEB.

Climate-Relevant Defensive Self-Protection. I used the *Climate Self-Protection Scale* (Wullenkord & Reese, 2020) to assess self-protection. The scale consists of 26 items on five subscales: 1) rationalization (e.g., "How I behave toward the environment has minimal impact on climate change", α=.90), 2) avoidance (e.g., "I try to avoid negative thoughts about climate change in my everyday life", α=.89), 3) denial of personal outcome severity (e.g., "I expect climate change to affect other regions but not to burden me", α=.88), 4) denial of global outcome severity (e.g., "I believe that climate change won't be as severe as expected in the future", α=.89), and 5) denial of guilt (e.g., "I don't need to make climate change a matter of conscience", α=.73). These subscales correspond to interpretive (denial of outcome severity) and implicatory forms of denial (rationalization, avoidance, and denial of guilt).

Environmental Awareness. Four items (e.g., "We can only solve our environmental

problems through fundamentally transforming our economic system and way of life") from the 2016 German Environmental Awareness Study (BMU & UBA, 2017) measured environmental awareness (α=.80).

3.1.3 Data Preparation and Statistical Analysis

I analyzed the data with R, version 4.0.3 (R Core Team, 2020). Based on the relative speeding index (RSI), I excluded ten speeders with RSI>2 (as recommended by Leiner, 2019). The RSI is the quotient of the sample's median completion time and each individual's completion time. It, thus, indicates unrealistically fast study participation (i.e., RSI>2 means that an individual completed the study in half the time of the sample average). There were no multivariate outliers based on Mahalanobis distance at p<.001. After removing one case with missing data, the final sample size was N=442. To perform a path analysis with non-normal continuous variables, a minimum sample size of N=250 (Hu & Bentler, 1999) or a ratio of cases to estimated parameters of $N/q \geq 10$ was needed (Hair et al., 2019). A Monte Carlo power analysis for indirect effects (Schoemann et al., 2017) revealed a sample of N=330 to be sufficient to interpret an indirect effect with 1-β=.95 and α=.05 (see supplementary material S1 for details). Removing speeders and outliers did not substantially influence results. Please find complete data analysis in supplementary material S2, and analyses using the entire dataset without exclusions and analyses without covariates in supplementary material S3.

3.2 Results Study 1

3.2.1 Descriptives

Descriptive statistics and correlations of study variables can be found in Table 1 (and supplementary material S1). On average, participants reported higher need satisfaction than frustration, rather high PEB, relatively autonomous environmental motivation, medium-low self-protection, high environmental awareness, and relatively left-wing political orientation. The majority of participants wanted to participate in the raffle (80.5%). About half of them (N=196, 53.9%) were willing to donate some or all of the money to an environmental organization

(M=31.08€, SD=16.79€, range:1-50€).

3.2.2 Basic Psychological Need Satisfaction, Self-Protection, and Pro-Environmentalism

An inspection of correlation coefficients (see Table 1) revealed support for the hypotheses: There were generally negative relations between need satisfaction and self-protection. Environmental autonomy and competence need frustration was positively related with self-protection. Further, pro-environmentalism (i.e., PEB, autonomous environmental motivation, environmental awareness, and willingness to donate) was generally positively related with need satisfaction and negatively related with need frustration. Correlations were stronger with environmental need satisfaction than with general need satisfaction. I used the R-package lavaan, version 0.6-3 (Rosseel, 2012) to perform path analyses to further examine relations between need satisfaction, autonomous environmental motivation, PEB, self-protection, and environmental awareness. The models differed with respect to inclusion of general need satisfaction and environmental need satisfaction.

Hypothesized Model and Assumptions. Data were not normally distributed according to the Doornik-Hansen test, $E(40)$=275.48, p<.001. To remedy multivariate non-normality, I estimated models using robust maximum likelihood estimation with Satorra-Bentler correction (MLM, Finney & DiStefano, 2013). I hypothesized models with need satisfaction predicting self-protection and autonomous environmental motivation, self-protection predicting pro-environmentalism (autonomous environmental motivation, PEB, and environmental awareness), autonomous environmental motivation predicting PEB, and environmental awareness predicting both autonomous environmental motivation and PEB. I also controlled for age, gender, income, and political orientation. See Figure 2 for a simplified visualization of models with path coefficients and supplementary material S2 for standardized residuals and empirical and model-implicated variance-covariance-matrices. I both models, I examined relations between composite scores of need satisfaction and self-protection to ensure sufficient power for the analyses. N/q was approximately 17, with N=406 and 24 parameters to be estimated. Models were identified.

Table 1

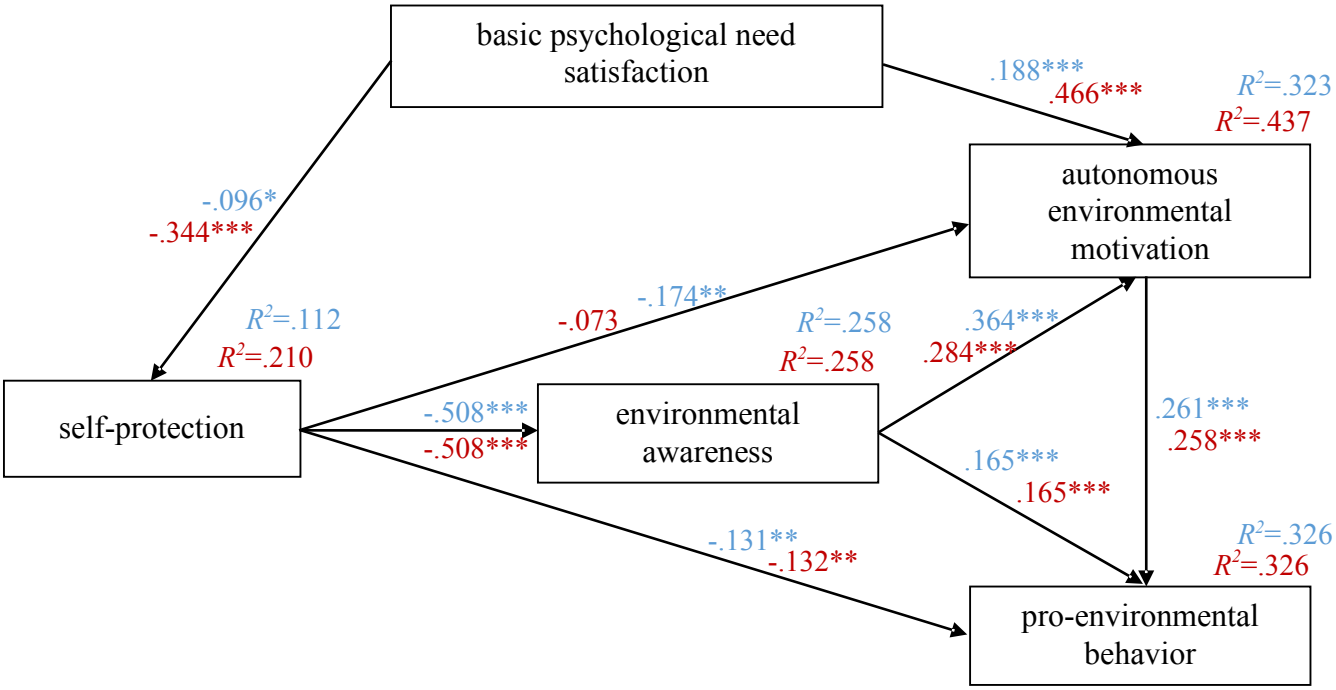
Spearman Correlations of Basic Psychological Need Satisfaction with Study Variables and Descriptive Statistics of Study Variables

Variable	1 [95%CI]	2 [95%CI]	3 [95%CI]	4 [95%CI]	5 [95%CI]	6 [95%CI]	7 [95%CI]	8 [95%CI]	9 [95%CI]	10 [95%CI]	11 [95%CI]	12 [95%CI]	α [95%CI]	*M* *(SD)*	Skewness (Kurtosis)
Overall self-protection	-.21** [-.28, -.07]	-.01 [-.10, .08]	-.14** [-.20, -.04]	.01 [-.08, .09]	-.18** [-.38, -.24]	.00 [-.24, -.08]	-.22** [-.30, -.13]	.01 [-.11, .06]	-.30** [-.40, -.21	.17** [.03, .23]	-.38** [-.49, -.32]	.29** [.22, .41]	.90 [.89, .92]	2.70 (0.82)	0.66 (0.37)
Rationalization	-.22** [-.31, -.11]	.01 [-.08, .10]	-.16** [-.26, -.11]	.07 [-.01, .17]	-.14** [-.24, -.06]	.00 [-.10, .11]	-.22** [-.31, -.12]	-.02 [-.12, .04]	-.31** [-.43, -.23]	.25** [.12, .32]	-.36** [-.46, -.28]	.24** [.13, .31]	.90 [.89, .91]	3.04 (1.32)	0.47 (-0.27)
Avoidance	-.19** [-.28, -.08]	.10* [.01, .20]	-.17** [-.27, -.08]	.19** [.11, .28]	-.29** [-.38, -.22]	.20** [.11, .30]	-.17** [-.25, -.06]	.20** [.08, .26]	-.32** [-.39, -.19]	.38** [.29, .45]	-.32** [-.38, -.18]	.36** [.26, .43]	.90 [.88, .91]	2.67 (1.15)	0.47 (-0.44)
Denial of personal outcome severity	-.10* [-.16, .03]	-.05 [-.17, .02]	-.10* [-.13, .02]	-.04 [-.14, .03]	-.15** [-.19, -.02]	-.03 [-.15, .04]	-.14** [-.22, .04]	-.01 [-.15, .03]	-.17** [-.26, -.06]	.03 [-.09, .10]	-.27** [-.38, -.20]	.24** [.13, .34]	.88 [.86, .90]	2.07 (1.12)	1.25 (1.32)
Denial of global outcome severity	-.14** [-.17, .02]	.02 [-.09, .09]	-.04 [-.08, .09]	-.02 [-.14, .05]	-.10* [-.17, .01]	.03 [-.11, .10]	-.11* [-.22, -.03]	.03 [-.11, .06]	-.22** [-.31, -.12]	.07 [-.07, .11]	-.32** [-.43, -.23]	.28** [.19, .41]	.88 [.87, .90]	1.96 (1.19)	1.48 (1.79)
Denial of guilt	-.08† [-.15, .03]	-.07 [-.16, .04]	.00 [-.09, .10]	-.16** [-.23, -.06]	.07 [-.01, .18]	-.12* [-.21, -.02]	-.09† [-.20, -.01]	-.12* [-.22, -.04]	.02 [-.15, .06]	-.17** [-.27, -.08]	-.06 [-.23, .02]	-.05 [.08, -.12]	.73 [.69, .77]	3.79 (1.21)	0.41 (-0.15)
Pro-environmental behavior	.17** [.06, .21]	-.08 [-.17, .04]	.15** [.03, .22]	-.11* [-.21, -.03]	.20** [.10, .28]	-.09† [-.19, .00]	.33** [.23, .40]	.07 [-.17, -.01]	.41** [.22, .34]	-.09† [-.20, -.01]	.44** [.37, .51]	-.23** [-.32, -.17]	.72[a]	0.45 (1.22)	0.06 (1.17)
Autonomous environmental motivation	.27** [.19, .36]	-.11* [-.22, -.03]	.18** [.03, .23]	-.17** [-.26, -.09]	.27** [.19, .36]	-.12* [-.21, -.03]	.36** [.26, .45]	-.07 [-.22, .07]	.50** [.20, .44]	-.21** [-.30, -.10]	.64** [.58, .70]	-.47** [-.54, -.39]	.86 [.83, .88]	1.40 (0.52)	-0.19 (-0.12)
Environmental awareness	.15** [.02, .18]	-.09† [-.14, .04]	.07 [-.09, .09]	-.06 [-.10, .08]	.07** [.01, .22]	.01 [-.06, .13]	.24** [.15, .32]	.03 [-.15, -.05]	.34** [.09, .23]	-.06 [-.12, .06]	.45** [.37, .53]	-.27** [-.35, -.17]	.80 [.77, .83]	0.81 (0.17)	-1.00 (0.60)
Willingness to donate	.12 [.05, .27]	-.22** [-.36, -.13]	.03 [-12, .16]	-.24** [-.37, .11]	.15* [.00, .29]	-.25** [-.40, -.15]	.13† [.01, .27]	-.18* [-.35, -.05]	.20** [.01, .15]	-.06 [-.20, .10]	.10 [-.08, .24]	-.14† [-.27, .05]	-	31.05 (16.76)	-0.06 (-1.50)
Age	-.06 [-.12, .06]	-.11* [-.23, -.04]	.09† [-.01, .14]	-.29** [-.38, -.21]	.05 [-.01, .19]	-.17** [-.30, -.11]	.13* [-.06, .25]	-.09† [-.23, -.01]	.08 [.00, .17]	-.07 [-.15, .03]	.09† [-.02, .17]	-.12* [-.16, .01]	-	37.98 (15.94)	0.69 (-0.60)
Political orientation	-.07 [-.17, .03]	.05 [-.07, .13]	-.06 [-.14, .04]	-.02 [-.13, .06]	-.06 [-.15, .02]	.05 [-.07, .13]	-.16** [-.25, -.07]	-.01 [.11, .06]	-.09† [-.15, .01]	.07 [-.06, .14]	-.17** [-.08, -.29]	.16** [.07, .29]	-	35.88 (19.58)	0.34 (-0.28)

Note. 1=General relatedness satisfaction, 2=General relatedness frustration, 3=General competence satisfaction, 4=General competence frustration, 5=General autonomy satisfaction, 6=General autonomy frustration, 7=Environmental relatedness satisfaction, 8=Environmental relatedness frustration, 9=Environmental competence satisfaction, 10=Environmental competence frustration, 11=Environmental autonomy satisfaction,

Figure 2

Path Model Displaying Relations Between Basic Psychological Need Satisfaction, Self-Protection, and Pro-Environmentalism



Note. Displayed are standardized parameter estimates. Blue numbers signify relations with general need satisfaction, red numbers signify relations with environmental need satisfaction. *p<.05, **p<.01, ***p<.001

Model Estimation. The hypothesized models had generally good fit to the data (Hu & Bentler, 1999): The model including general need satisfaction had Satorra-Bentler $\chi^2(6, N=402)=34.19$, p<.001, Robust Comparative Fit Index (CFI)=.988, Akaike Information Criterion (AIC)=2158.80, Robust Root Mean Square Error of Approximation (RMSEA)=.102, 90%CI[.071, .137], Standardized Root Mean Square Residual (SRMSR)=.040. The model including environmental need satisfaction had Satorra-Bentler $\chi^2(6, N=402)=34.19$, p<.001, Robust CFI=.983, AIC=2025.55, Robust RMSEA=.129, 90%CI[.098, .162], SRMSR=.052. In both models, need satisfaction negatively predicted self-protection, and positively predicted autonomous environmental motivation. Autonomous environmental motivation predicted PEB. Self-protection, in turn, negatively predicted autonomous environmental motivation, PEB, and environmental

awareness. Environmental awareness predicted both autonomous environmental motivation and PEB. Relations with environmental need satisfaction were stronger than with general need satisfaction. These findings support H1 to H3 and H7.

To investigate relations between need satisfaction and self-protection more specifically, I ran a series of six hierarchical multiple regression analyses predicting self-protection from need satisfaction and frustration (see Table 2 for coefficients and model summaries). In all analyses, I controlled for age, gender, income, and political orientation in a first step. In a second step, I added the six dimensions of general need satisfaction and frustration and in a third step added the six dimensions of environmental need satisfaction and frustration. Because the subscales denial of personal and denial of global outcome severity were severely skewed, I used log-transformation to approximate normal distribution. Since this did not significantly influence results, I report results using original data in text and in Table 2 (but see supplementary material S2 for results using transformed data). There was no evidence for singularity or multicollinearity (VIF<10).

When considering both environmental and general need satisfaction, environmental autonomy satisfaction negatively and frustration positively predicted overall self-protection (F[16, 385]=8.95, p<.001, R^2=.27, $R^2_{adjusted}$=.24). Environmental competence frustration predicted rationalization (along with negative general relatedness satisfaction) and avoidance (along with environmental autonomy frustration). Environmental autonomy frustration predicted avoidance, denial of personal outcome severity, and denial of global outcome severity. Interestingly, environmental competence frustration negatively predicted denial of global outcome severity and denial of guilt. In almost all models, right-wing political orientation significantly predicted self-protection. Male gender significantly predicted rationalization and female gender predicted denial of guilt. These findings partially support H6 and H7.

Table 2

Hierarchical Regressions Predicting Self-Protection

	Overall self-protection		Rationalization		Avoidance		Denial of personal outcome severity		Denial of global outcome severity		Denial of guilt	
	β	[95%CI]	β	[95%CI]	β	[95%CI]	β	[95%CI]	β	[95%CI]	β	[95%CI]
Gender (1=female)	-.05	[-.21, .10]	-.08	[-.33, .18]	.11*	[-.11, .32]	-.03	[-.26, .20]	-.05	[-.28, .19]	-.13*	[-.37, .12]
Age	.10*	[.10, .11]	.08	[.07, .09]	.03	[.02, .03]	-.02	[-.02, -.01]	.02	[.01, .03]	.22***	[.21, .23]
Income	-.07	[-.07, -.07]	-.03	[-.03, -.03]	-.07	[-.07, -.07]	-.03	[-.03, -.03]	-.07	[-.07, -.07]	-.04	[-.04, -.04]
Pol orient	.17***	[.17, .18]	.11*	[.10, .11]	.07	[.06, -.07]	.12*	[.11, .12]	.21***	[.20, .21]	.09†	[.09, .10]
Needs												
Gen rel sat	-.08	[-.16, -.01]	-.15**	[-.27, -.02]	-.05	[-.16, .06]	.00	[-.11, .12]	-.01	[-.12, .11]	-.07	[-.19, .05]
Gen rel frus	-.07	[-.14, .01]	-.08	[-.19, .02]	-.09	[-.18, .06]	-.08	[-.17, .01]	.01	[-.09, .11]	-.01	[-.11, .09]
Gen comp sat	-.01	[-.08, .05]	-.08	[-.18, .02]	-.01	[-.10, .08]	.01	[-.09, .10]	.09†	[-.00, .19]	.04	[-.17, .06]
Gen comp frus	-.02	[-.09, .05]	.08	[-.03, .19]	.03	[-.07, .12]	-.05	[-.15, .05]	-.08	[-.19, .02]	-.06	[-.17, .05]
Gen aut sat	-.05	[-.14, .05]	.02	[-.12, .17]	-.11†	[-.24, .02]	-.11†	[-.25, .02]	-.06	[-.19, .06]	.08	[-.06, .23]
Gen aut frus	-.06	[-.14, .02]	-.09	[-.22, .04]	.03	[-.09, .14]	-.10	[-.22, .01]	-.07	[-.19, .06]	.03	[-.10, .16]
Env rel sat	-.01	[-.07, .06]	.01	[-.09, .12]	-.02	[-.11, .08]	-.02	[-.12, .08]	.02	[-.08, .12]	-.03	[-.13, .08]
Env rel frus	-.08	[-.15, -.01]	-.10†	[-.21, .02]	.05	[-.05, .14]	-.08	[-.18, .08]	-.09	[-.19, .02]	-.05	[-.16, .06]
Env comp sat	-.04	[-.14, .06]	-.07	[-.24, .10]	-.12†	[-.27, .02]	.07	[-.18, .03]	-.07	[-.22, .09]	.06	[-.10, .22]
Env comp frus	.04	[-.03, .11]	.22***	[.11, .32]	.23***	[.14, .33]	-.06	[-.08, .22]	-.11*	[-.21, -.01]	-.15*	[-.26, -.04]
Env aut sat	-.23**	[-.34, -.13]	-.24***	[-.41, -.08]	-.07	[-.22, .07]	-.20*	[-.16, -.04]	-.13†	[-.28, .02]	-.15†	[-.31, .01]
Env aut frus	.19**	[.10, .28]	.03	[-.11, .17]	.14*	[.01, .26]	.20**	[.07, .33]	.28***	[.15, .41]	.02	[-.12, .16]
R^2	.27		.26		.28		.15		.22		.17	
$R^2_{adjusted}$	.24		.23		.25		.11		.19		.13	
ΔR^2	.17		.20		.14		.11		.21		.06	

Note. Displayed are final models, ΔR^2 specifies differences between models including only covariates vs. models including covariates and basic psychological need satisfaction and frustration, pol orient=political orientation, gen=general, env=environmental, rel=relatedness, comp=competence, aut=autonomy, sat=satisfaction, frus=frustration, n=405. $^{\dagger}p<.10$, $^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$

3.3 Discussion Study 1

Corroborating my hypotheses, people reporting lower need satisfaction also reported more self-protection, especially when their need satisfaction was low in the environmental domain. People reporting higher need satisfaction, especially in the environmental domain, reported more autonomous environmental motivation, which was related to higher reported levels of PEB. Self-protection and various indicators of pro-environmentalism were, in turn, negatively related. People with stronger right-wing political orientation reported more self-protection.

Study 1 replicates previous findings on the positive relations between need satisfaction, autonomous environmental motivation, and pro-environmentalism (e.g., Aitken et al., 2016; Cooke et al., 2016; Kaplan & Madjar, 2015; Lavergne et al., 2010). It is also, to my knowledge, the first study investigating associations between climate-relevant defensive self-protection and need satisfaction and frustration, both generally and in the environmental domain. It reveals that it is not only context-specific need satisfaction but also general need satisfaction that are relevant to consider when understanding how people cope with climate change.

3.3.1 Limitations

Some limitations of Study 1 deserve comment: I used a validated measure to assess self-protection. However, it is likely that people do not consciously reflect on these self-protective processes or do not want to acknowledge them because they are not socially desirable (see Thomas & Walker, 2016 on self-presentation biases). Given that self-protection is socially sensitive, indirect measures are useful to circumvent these potential biases (see Greenwald et al., 2009). Therefore, Study 2 used both self-report and implicit association tests (IAT, Greenwald et al., 1998) to assess self-protection.

Furthermore, Study 1 assumed that PEB can be viewed as indicating a latent person characteristic and be measured using self-report items on impactful behaviors (Kaiser & Wilson, 2004). However, the *eco-friendliness* such measures assess may not necessarily represent actual environmental impact in terms of CO_2-emissions (Bleys et al., 2018). Even though the items employed in Study 1 were impact-oriented, quantifying actual CO_2-emissions of peo-

ple's lifestyles likely gives a more valid account of environmental impacts[1]. Therefore, Study 2 employed a footprint calculator.

Lastly, self-determination theory proposes that humans react with defensiveness in the face of threat. Study 1 assumed that the threat of climate change is ever present. Nevertheless, it might be indicative to explicitly manipulate threat to assess its effects in the interplay of need satisfaction and self-protection. To this end, Study 2 employed an experimental between-subjects design manipulating self-esteem threat in the context of climate change.

4 Study 2

Building on Study 1, Study 2 uses an experimental between-subjects design to assess the effect of self-esteem threat on self-protection. It aimed at investigating whether people use more implicit[2] and explicit self-protection when they experience self-esteem threat, especially when they report low need satisfaction.

4.1 Methods Study 2

4.1.1 Participants and Procedure

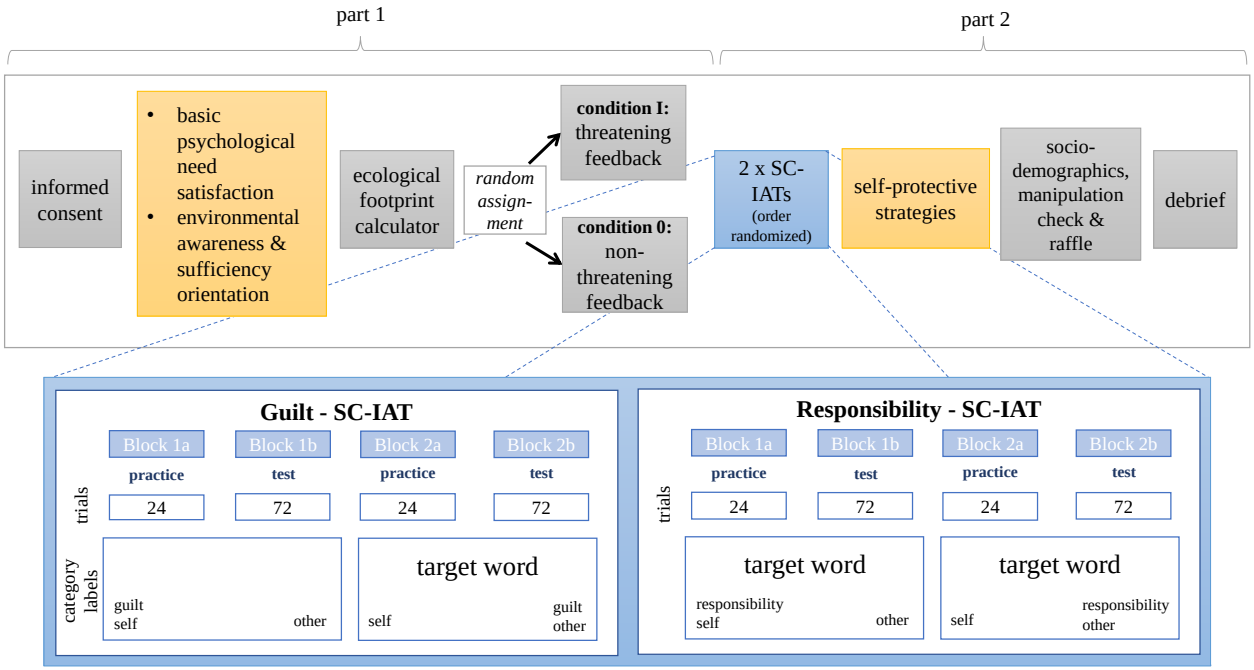
I recruited a total of N=392 German-speaking individuals that participated in an online study hosted on SoSci-Survey (Leiner, 2020), M_{age}=36.1 years, SD=12.8, range:18-67, 57.0% female, 31.6% high school degree, 56.0% university degree, M_{income}=1646€, SD=1227, range:0-6000. The study was advertised as a "footprint study", in which participants could calculate their ecological footprints. Figure 3 depicts the procedure of the experiment. After signing informed consent, participants answered questions about their need satisfaction, environmental awareness and sufficiency orientation (i.e., the endorsement of a lifestyle and consumption patterns in line with ecological boundaries), and their ecological footprint.

[1] Of course, not all PEB has directly quantifiable consequences. For example, assessing the environmental impact of environmental activism and related behaviors is very complex. It is thus important to keep in mind that only assessing private-sphere behaviors is limited.

[2] When talking about implicit self-protection, I mean self-protection that is implicitly measures, revealing more automatic processes. However, I use simple phrasing for sake of legibility.

Figure 3

Experimental Procedure



Note. Yellow boxes signify questionnaires.

Then, participants were randomly assigned to either a threat- or a no-threat-condition, in which they received incorrect feedback about the size of their ecological footprints. This allowed to investigate how self-esteem-threatening feedback influences self-protection. Participants in the threat-condition read the following: "If everyone lived like you, we would need 6.7 planets. This is far above the average in Germany and your behavior is a major contributor to climate change. If all people lived like the average German, we would need almost 3 planets." Participants in the no-threat-condition read: "If everyone lived like you, we would need 0.9 planets. This is far below the average in Germany, and your behavior makes a significant contribution to climate protection. If all people lived like the average German, we would need almost 3 planets." I informed both groups that they would receive more detailed information about their footprints at the end of the study. Of the initial sample, N=252 decided to participate in the second part of the study. Here, participants reported on their self-protection, both implicitly using two single-category IATs (SC-IATs) on the topics of guilt and responsibility, and explicitly

using self-report. Afterwards, participants reported their socio-demographic background (age, gender, education, income) and political orientation, answered two questions that served as a manipulation check[3], and were offered the opportunity to participate in a raffle for 5x50€ as compensation. Again, participants could choose to donate all or part of the money to an environmental organization. Finally, participants were debriefed and received the opportunity to find out about the real size of their ecological footprint (see supplementary material S1). The local ethics committee judged the study to be in line with ethical guidelines by the DGPS and the Declaration of Helsinki (report number: 179_2019).

4.1.2 Methods and Materials

I used the same measures as in Study 1 to assess need satisfaction and self-protection.

Environmental Awareness and Sufficiency Orientation. Besides four items from the 2016 German Environmental Awareness Study (BMU & UBA, 2017), I used three items by Verfuerth et al. (2019; e.g., "I want to manage to consume as few resources [petroleum, rare earth minerals...] as possible through my lifestyle.") and two items by Loy et al. (2021, e.g., "To reduce environmental impact, it is necessary to reduce consumption.") aimed at assessing sufficiency orientation. Because of significant conceptual overlap of the items, I ran an exploratory main axis analysis with oblique rotation (KMO=.92). After exclusion of one cross-loading item, Horn's (1965) parallel analysis suggested that items loaded on two factors (Eigenvalues=1.82-2.21, factor loadings>.4, KMO=.90): 1) Criticizing the economic system (α=.83), 2) taking responsibility (α=.71).

Ecological Footprint Calculator. To estimate ecological footprints in CO_2-equivalents, I presented participants with a fill-in-the-blank text about environmentally impactful behavior. Depending on the question, participants could write their answers freely (11 items) or choose an answer from a dropdown menu (5 items, see supplementary material S1). Questions were taken from the Global Footprint Network (http://www.footprintcalculator.org/) and from http://ecologicalfootprint.com/. Based on data by the German Environment Agency

[3]The manipulation checks entailed one question on the size of participants' ecological footprints and one question about how surprised they felt when receiving feedback about the size of their ecological footprints.

(Schächtele & Hertle, 2007), I estimated CO_2-equivalents in the areas housing, nutrition, mobility, and consumption, and computed an overall score that I used as an estimate of people's ecological footprints. Further details about the computation can be found in supplementary material S2.

Single-Category Implicit Association Test. I used two SC-IATs (Karpinski & Steinman, 2006) as an indirect measure of self-protection. They assessed the degree to which participants automatically associated the concepts of *guilt* and *responsibility* with the evaluative categories *self* or *other*. Based on a pre-test with N=36 university students (M_{age}=24.0 years, SD=13.8, 75.9% female), I selected seven attribute words for guilt and responsibility, respectively, and six attribute words for self and other, respectively. Further details on the IAT as a method and the pre-test are in supplementary material S1.

The procedure of the two SC-IATs followed guidelines by Karpinski and Steinman (2006, see Figure 3): First, self-words were paired with the target category (guilt/responsibility). Participants practiced for 24 trials and pressed the left response key on their keyboard if a self- or a guilt/responsibility-word appeared, and pressed the right response key if an other-word appeared. Their answers on the following 72 trials were recorded. Then, participants worked on a second block consisting of 24 practice trials and 72 test trials, in which other-words were paired with the target category. During the entire test, categories were displayed at the bottom of the screen on the side corresponding to the response keys on the keyboard. Participants received feedback after each trial and were asked to respond more quickly if their response took more than 1500ms. I randomized the order for the SC-IATs on guilt and responsibility. Guidelines by Greenwald et al. (2003) were used to score the SC-IATs, resulting in two D-scores per participant. Positive D-scores indicated that participants associated the respective target concept (i.e., guilt/responsibility) more with themselves than with others. Internal consistency estimated by correlating a separate D-score for the first and the last third of all trials was rather low compared to many IAT studies (Nosek et al., 2005), r's(287)=.45-.51, p<.01.

4.1.3 Data Preparation and Statistical Analysis

I analyzed the data with R, version 4.0.3 (R Core Team, 2020). A total of 51 participants responded incorrectly to two attention check items (e.g., "Please click on the answer option on the far right.") and I excluded 22 speeders with RSI>2 (as recommended by Leiner, 2019). I excluded another 23 participants because they gave a wrong answer to the manipulation check. Based on Mahalanobis distance at $p<.001$, I excluded six multivariate outliers and one univariate outlier based on boxplots. The final sample size was $N=289$ and $n=192$ had complete answers on all study variables. An a-priori power analysis using G*Power, version 3.1.9.4 (Faul et al., 2007) revealed that a sample of $N=172$ was needed to discover a small-medium effect of $f^2=.10$ with a power of 1-β=.80 and α=.05 in a multiple regression analysis. Removing speeders and outliers slightly influenced results. Please find complete data analysis in supplementary material S4, and analyses using the entire dataset without exclusions and analyses without covariates in supplementary material S5.

4.2 Results Study 2

4.2.1 Descriptives

Tables 3 and 4 display descriptive statistics and correlations of study variables for both experimental groups. On average, participants reported higher need satisfaction than frustration, high environmental awareness and sufficiency orientation, emitted an estimated 12 tons of CO_2 per year, associated both guilt and responsibility more with others than with themselves, reported medium-low self-protection, and relatively left-wing political orientation. Those who finished the study after the footprint calculator did not significantly differ from those who completed the study, on most variables (relatedness, autonomy, taking responsibility, environmental impact, belongingness to threat-condition). Interestingly, completers reported significantly less competence satisfaction than dropouts, $t(187.72)=2.34$, $p=.020$, $d=.29$, 95%CI [.05, .54], $M(SD)_{dropout}=4.97(1.39)$, $M(SD)_{completer}=4.57(1.34)$, 95%CI of group difference [.06, .74], and significantly less critique of the economic system, $t(200.83)=2.26$, $p=.025$, $d=.28$, 95%CI [.04,

.53], $M(SD)_{dropout}$=6.10(0.95), $M(SD)_{completer}$=5.83(0.99), 95%CI of group difference [.03, .51].

4.2.2 Basic Psychological Need Satisfaction and Self-Protection Are Associated with Pro-Environmentalism

Participant's ecological footprints did not vary with need satisfaction. Participants reporting higher satisfaction of relatedness and competence criticized the economic system slightly more and took slightly more responsibility. Taken together, these findings partly confirm H1. Self-protection was positively related with bigger ecological footprints in the areas of housing and nutrition and negatively related to criticizing the economic system and taking responsibility, confirming H4.

4.2.3 Basic Psychological Need Satisfaction and Threat Predict Self-Protection

As a test of validity of the newly developed SC-IATs, I correlated scores on the SC-IATs with the explicit measure of self-protection, the CSPS. Across groups, scores on the SC-IATs were unrelated to scores on the CSPS. To test whether people in the threat-condition with low need satisfaction used more self-protection, as indicated by overall score on the CSPS, the five subscales of CSPS, and the two SC-IATs, I performed a series of eight hierarchical multiple regression analyses: Covariates (age, gender, income, political orientation, criticizing the economic system, taking responsibility, ecological footprints) entered all analyses in a first step. I then regressed a composite score of need satisfaction and threat on the eight indicators of self-protection in a second step, and their interaction in a third step (see Table 5 for coefficients and model summaries for significant models). Again, I log-transformed the CSPS-subscales denial of personal and global outcome severity because they were severely skewed. Nevertheless, this did not significantly influence results. I report on original data in both text and in Table 5 (but see supplementary material S4 for results using transformed data and non-significant models). Analyses for singularity and multicollinearity (VIF<10) were satisfactory.

Table 3

Descriptive Statistics of Study Variables in Both Groups

Variable	Total sample				No-threat-condition				Threat-condition			
	N	*M* (*SD*)	Skewness (Kurtosis)	α [95%CI]	*N*	*M* (*SD*)	Skewness (Kurtosis)	α [95%CI]	*N*	*M* (*SD*)	Skewness (Kurtosis)	α [95%CI]
Relatedness satisfaction	289	5.41 (1.29)	-1.15 (1.31)	.91 [.89, .93]	139	5.42 (1.36)	-1.29 (1.63)	.92 [.90, .94]	150	5.40 (1.23)	-0.96 (0.73)	.89 [.86, .92]
Relatedness frustration	289	3.01 (1.43)	0.48 (-0.48)	.74 [.69, .79]	139	2.95 (1.39)	0.49 (-0.38)	.71 [.63, .79]	150	3.06 (1.47)	0.46 (-0.60)	.77 [.71, .84]
Competence satisfaction	289	4.70 (1.37)	-0.49 (-0.23)	.85 [.82, .88]	139	4.70 (1.36)	-0.34 (-0.52)	.85 [.81, .89]	150	4.70 (1.38)	-0.62 (-0.02)	.85 [.81, .89]
Competence frustration	289	3.31 (1.45)	0.28 (-0.76)	.77 [.73, .82]	139	3.29 (1.49)	0.28 (-0.83)	.79 [.73, .85]	150	3.33 (1.41)	0.28 (-0.73)	.76 [.69, .83]
Autonomy satisfaction	289	4.96 (1.23)	-0.65 (0.11)	.81 [.77, .85]	139	4.99 (1.18)	-0.57 (0.04)	.79 [.73, .85]	150	4.94 (1.29)	-0.70 (0.07)	.82 [.78, .87]
Autonomy frustration	289	3.49 (1.29)	0.09 (-0.46)	.66 [.59, .73]	139	3.45 (1.24)	-0.12 (-0.67)	.60 [.49, .71]	150	3.52 (1.34)	0.22 (-0.41)	.71 [.62, .79]
Criticizing the economic system	289	5.92 (0.98)	-1.17 (1.56)	.83 [.80, .86]	139	6.02 (0.91)	-0.96 (0.60)	.80 [.75, .85]	150	5.84 (1.05)	-1.24 (1.73)	.85 [.82, .89]
Taking responsibility	289	5.66 (1.00)	-1.10 (2.05)	.71 [.66, .77]	139	5.69 (0.92)	-0.60 (-0.23)	.67 [.57, .76]	150	5.62 (1.07)	-1.35 (2.89)	.74 [.67, .81]
Ecological footprint	288	12.12 14.40	3.96 (19.75)		138	12.55 (16.48)	3.94 (18.78)		150	11.72 (12.22)	3.45 (14.11)	
Implicit guilt	289	-0.28 (0.39)	-0.83 (-0.02)		139	-0.34 (0.42)	-0.63 (-0.27)		150	-0.23 (0.36)	-0.99 (0.18)	
Implicit responsibility	289	-0.23 (0.42)	-1.07 (1.75)		139	-0.30 (0.44)	-1.02 (0.39)		150	-0.16 0.39	-1.09 (3.55)	
Overall self-protection	193	2.63 (0.97)	0.94 (1.12)	.94 [.93, .95]	98	2.62 (0.94)	0.86 (0.82)	.93 [.92, .95]	95	2.64 (1.01)	0.99 (1.25)	.94 [.93, .96]
Rationalization	193	2.91 (1.34)	0.66 (0.14)	.90 [.88, .92]	98	2.90 (1.32)	0.64 (0.25)	.90 [.87, .92]	95	2.93 (1.35)	0.67 (-0.04)	.90 [.88, .93]
Avoidance	193	2.64 (1.20)	0.32 (-0.56)	.92 [.91, .94]	98	2.59 (1.22)	0.21 (-1.10)	.93 [.91, .95]	95	2.70 (1.17)	0.46 (-0.03)	.92 [.90, .94]
Denial of personal outcome severity	193	1.98 (1.03)	0.99 (0.09)	.87 [.85, .90]	98	1.92 (0.99)	0.98 (0.12)	.88 [.85, .91]	95	2.05 (1.07)	0.96 (-0.07)	.87 [.84, .90]
Denial of global outcome severity	193	2.10 (1.37)	1.57 (2.29)	.92 [.90, .94]	98	2.03 (1.34)	1.64 (2.65)	.91 [.88, .93]	95	2.17 (1.40)	1.48 (1.87)	.93 [.91, .95]
Denial of guilt	193	3.51 (1.33)	0.55 (0.12)	.80 [.76, .84]	98	3.65 (1.29)	0.38 (0.26)	.76 [.69, .83]	95	3.36 (1.35)	0.74 (0.12)	.83 [.78, .87]

Table 4 *Spearman Correlations of Study Variables in Both Groups*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	-	-.25*	.33**	-.28**	.50**	-.21**	.20	.24**	-.09	-.12	.12	.03	-.08	.10	-.02	-.33**	-.39**	-.20†	-.29**	-.29**	-.06
2	-.28**	-	.01	.53**	-.18*	.46**	-.05	-.09	.14	.12	.08	.11	.13	.11	.12	.37**	.31**	.39**	.42**	.31**	.03
3	.35**	-.01	-	-.23*	.53**	-.18*	.09	.14†	-.01	-.09	-.11	.10	.05	.03	.17†	-.35**	-.41**	-.28**	-.27*	-.21*	-.07
4	-.29**	.55**	-.34**	-	-.38**	.56**	-.03	-.11	-04	.09	.00	-.01	-.01	.17*	.09	.28**	.25*	.39**	.30**	.25*	-.13
5	.40**	-.27**	.41**	-.41**	-	-.44**	.07	.09	-.06	-.12	.03	-.03	-.01	.04	.18*	-.22*	-.26*	-.03*	-.22*	-.28*	.13
6	-.32**	.57**	-.08	.56**	-.51**	-	-.06	-.13	.14	.18	-.03	.03	.09	-.04	.04	.12	.13	.24*	.15	.15	-.13
7	.05	.01	.18*	.10	.10	-.01	-	.58**	-.25**	-.31**	-.17*	-.11	-.14	.03	.02	-.49**	-.38**	-.37**	-.50**	-.40**	-.27*
8	.10	-.05	.26**	-.01	.15†	-.05	.64**	-	-.36**	-.30**	-.27**	-.09	-.31**	-.05	-.09	-.57**	-.55**	-.46**	-.59**	-.50**	-.19†
9	.01	-.11	-.04	-.06	-.03	.03	-.11	-.17*	-	.64**	.28**	.55**	.90**	.02	.03	.20†	.13	.22*	.26*	.23*	.05
10	-.06	-.04	-.07	-.07	-.03	-.02	-.09	-.08	.53**	-	.24**	.05	.43**	-.04	-.02	.22*	.11	.21*	.23*	.31**	.11
11	-.03	-.06	-.04	-.11	-.08	-.05	-.39**	-.45**	.29**	.23**	-	.09	.17†	-.12	.02	.14	.09	.12	.18†	.09	.17†
12	.11	-.15†	-.02	.08	.03	.05	-.01	-.10	.52**	.02	.10	-	.49**	.05	-.07	.03	.00	.09	.09	.07	-.02
13	.01	-.12	-.08	-.08	-.02	.04	-.09	-.13	.89**	.28**	.18*	.46**	-	.02	.05	.14	.16	.20†	.19†	.11	-.01
14	.06	.04	-.01	.16*	.11	.08	.12	.16†	-.16*	-.01	-.20*	.04	-.17*	-	.46**	.10	.10	.15	.03	.15	-.10
15	.14†	.02	.05	.09	.10	.00	.04	.13	-.19*	.09	-.09	-.12	-.22*	.45**	-	.09	.02	-.09	.03	-.02	.02
16	.02	.04	-.29**	.04	-.02	.01	-.61**	-.61**	.01	.15	.38**	-.09	-.07	.03	.16	-	.81**	.70**	.86**	.82**	.56**
17	-.01	-.02	-.25*	.04	-.03	.07	-.44**	-.58**	-.06	.12	.35**	-.08	-.13	.04	.12	.85**	-	.52**	.65**	.55**	.33**
18	.06	.10	-.08	.13	-.16	.12	-.29**	-.37**	.06	.16	.20†	-.07	.01	.04	.23†	.63**	.43**	-	.60**	.59**	.05
19	-.01	.05	-.38**	.14	-.04	-.02	-.42**	-.48**	-.06	-.01	.29**	-.09	-.08	-.07	.11	.75**	.59**	.45**	-	.78**	.37**
20	.01	.17	-.21*	.05	-.04	.06	-.60**	-.55**	-.02	.15	.34**	-.08	-.13	.08	.19†	.83**	.63**	.51**	.63**	-	.32**
21	-.01	-.10	-.13	-21*	.17	-.15	-.61**	-.43**	-.01	.10	.32**	-.11	-.01	-.09	.02	.73**	.59**	.21*	.43**	.50**	-

Note. 1=Relatedness satisfaction, 2=relatedness frustration, 3=competence satisfaction, 4=competence frustration, 5=autonomy satisfaction, 6=autonomy frustration, 7=criticizing the economic system, 8=taking responsibility, 9=overall ecological footprint, 10=footprint housing, 11=footprint nutrition, 12=footprint mobility, 13=footprint consumption, 14=implicit guilt, 15=implicit responsibility, 16=overall self-protection, 17=rationalization, 18=avoidance, 19=denial of personal outcome severity, 20=denial of global outcome severity, 21=denial of guilt. Above the diagonal are values for the no threat-condition, below the diagonal are values for the threat-condition. $^{\dagger}p<.10$, $^{*}p<.05$, $^{**}p<.01$

In line with predictions, need satisfaction and threat significantly negatively predicted overall self-protection (F[7, 173]=11.67, p<.001, R^2=.32, $R^2_{adjusted}$=.29) and rationalization (F[7, 173]=10.01, p<.001, R^2=.29, $R^2_{adjusted}$=.26) but there was only a trend for the effect of their interaction. Need satisfaction significantly negatively predicted avoidance (F[7, 173]=3.45, p=.001, R^2=.12, $R^2_{adjusted}$=.09), denial of personal outcome severity (F[7, 173]=5.43, p<.001, R^2=.18, $R^2_{adjusted}$=.14), and denial of global outcome severity (F[7, 173]=11.57, p<.001, R^2=.32, $R^2_{adjusted}$=.19). Right-wing political orientation predicted overall self-protection, rationalization, denial of global outcome severity, and denial of guilt (overall supporting H7). Models predicting implicit guilt and responsibility were not significant.

The direction of the interaction effects was unexpected (see Figure 4): Participants reporting low need satisfaction in the no-threat-condition reported most self-protection and least self-protection in the threat-condition. These relations were reversed for people reporting high need satisfaction, such that those in the no-threat-condition reported least self-protection and higher levels in the threat-condition. Across conditions, participants who reported high need satisfaction reported lower levels of (the respective) self-protective strategies than those who reported low need satisfaction. I interpret this as evidence against H8 but in favor of H7.

4.2.4 Basic Psychological Need Satisfaction, Gender, and Self-Protection

Male gender predicted overall self-protection and all subscales of the CSPS except for avoidance, and there was only a trend for denial of personal outcome severity. Given these clear relations in both studies and in the literature, I also explored interaction effects of need satisfaction and gender on self-protection (see supplementary material S4 for details). There was a significant interaction effect of need satisfaction and gender on overall self-protection and all subscales of the CSPS. Across models, men who reported low need satisfaction reported most self-protection and men who reported high need satisfaction reported least self-protection. Women reported relatively low self-protection regardless of their need satisfaction. Only denial of guilt differed slightly from this general pattern. I interpret this as evidence for H5.

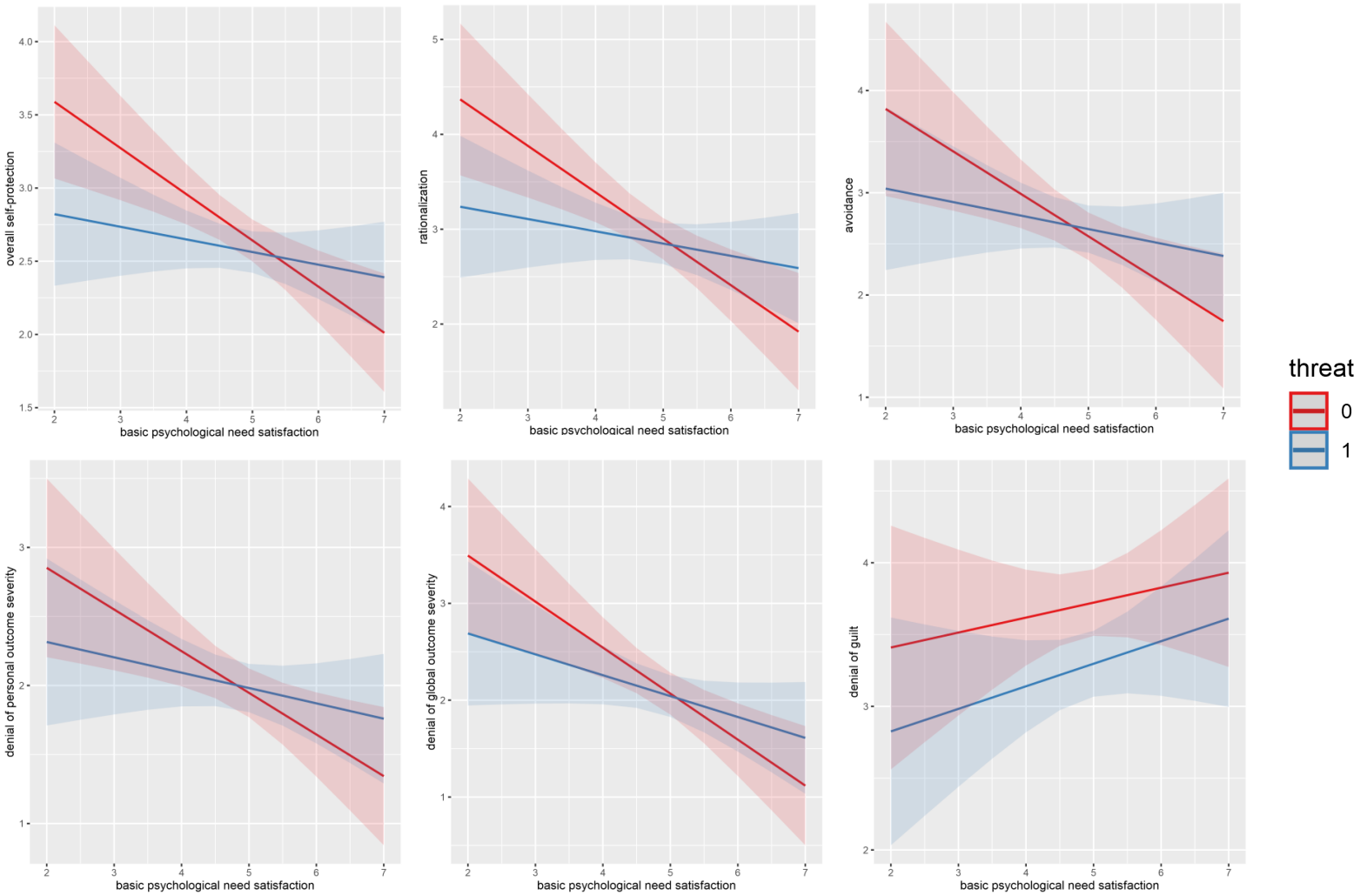
Table 5

Hierarchical Regressions Predicting Self-Protection

	Overall self-protection		Rationalization		Avoidance		Denial of personal outcome severity		Denial of global outcome severity		Denial of guilt	
	β	[95%CI]	β	[95%CI]	β	[95%CI]	β	[95%CI]	β	[95%CI]	β	[95%CI]
Gender (1=female)	-.14*	[-.35, .07]	-.14*	[-.46, .18]	-.00	[-.34, .33]	-.11†	[-.37, .15]	-.14*	[-.45, .18]	-.13*	[-.47, .20]
Age	.11†	[.10, .12]	.09	[.08, .10]	.05	[.03, .06]	.08	[.07, .10]	.03	[.01, .04]	.17*	[.15, .18]
Income	-.04	[-.04, -.04]	-.07	[-.07, -.07]	-.03	[-.03, -.03]	-.03	[-.03, -.03]	.07	[.07, .07]	-.08	[-.08, -.08]
Pol orient	.16**	[.15, .16]	.16*	[.15, .17]	.02	[.01, .03]	-.01	[-.02, -.00]	.23***	[.22, .24]	.18*	[.17, .18]
Critique eco	-.30***	[-.43, -.18]	-.14†	[-.33, .06]	-.05	[-.26, .15]	-.25**	[-.41, -.09]	-.33***	[-.53, -.14]	-.39***	[-.59, -.18]
Taking resp	-.32***	[-.46, -.19]	-.37***	[-.58, -.15]	-.33***	[-.56, -.11]	-.36***	[-.52, -.19]	-.20**	[-.41, .01]	-.03	[-.25, .20]
Env impact	-.01	[-.01, .00]	-.09	[-.10, -.08]	.06	[.04, .07]	.07	[.06, .08]	.02	[.01, .03]	-.06	[-.07, -.05]
Need sat	-.28***	[-.45, -.10]	-.13***	[-.58, -.04]	-.29**	[-.58, -.00]	-.25**	[-.47, -.03]	-.29***	[-.56, -.02]	.07	[-.22, .36]
Threat (1=threat)	-.63*	[-1.81, -.55]	-.69*	[-2.49, 1.10]	-.56	[-2.48, 1.35]	-.44	[-1.90, 1.01]	-.48	[-2.27, -1.31]	-.26	[-2.17, 1.65]
Need sat × threat	.59†	[.36, .83]	.68†	[.31, 1.04]	.60	[.21, .98]	.46	[.17, .75]	.47	[.11, .83]	.10	[-.28, .49]
R^2	.56		.45		.23		.41		.50		.36	
$R^2_{adjusted}$	.53		.42		.18		.38		.47		.33	
ΔR^2	.04		.04		.04		.03		.04		.03	

Note. Displayed are final significant models, ΔR^2 specifies differences between models including only covariates vs. models including covariates, need, threat, and their interaction, pol orient=political orientation, critique eco=criticizing the economic system, resp=responsibility, env=environmental, sat=satisfaction, n=192.

Figure 4. Influence of Need Satisfaction, Threat, and Their Interaction on Self-Protection.



Note. Threat was only a significant predictor of overall self-protection and rationalization. Interactions were non-significant but there were trends for overall self-protection and rationalization. 0=*no threat*, 1=*threat*.

4.3 Discussion Study 2

As predicted, people with low need satisfaction used more self-protection, especially when they were male and reported right-wing political orientation. This replicates Study 1 and confirms findings on need frustration and defensiveness (Ryan & Deci, 2017; Vansteenkiste & Ryan, 2013), studies that show people high in need satisfaction to be more resistant against self-esteem threat (Ryan & Brown, 2003; Ryan & Deci, 2017), and studies showing that climate denial and defensive self-protection are male, right-wing phenomena (Jylhä et al., 2016; McCright & Dunlap, 2011; Wullenkord & Reese, 2020). I also found an interaction effect of need satisfaction and gender on overall self-protection and most subscales of the CSPS: Men with low need satisfaction reported most self-protection and men with high need satisfaction reported least self-protection, while for women self-protection was consistently low and differed only slightly with need satisfaction. This finding may suggest that denying climate change is not a means of self-protection for women but only for men. This is in line with literature finding that it tends to be men who deny climate change (Hultman & Pulé, 2018; McCright & Dunlap, 2011; Nelson, 2020), while women consistently engage in more PEB (Bloodhart & Swim, 2020; Gifford & Nilsson, 2014; Stoll-Kleemann & Schmidt, 2017). Denying climate change and thereby protecting the status quo ultimately serves men relatively more than women because men are still relatively more privileged (e.g., Nelson, 2020) and PEB is often seen as feminine (Swim et al., 2020). Acknowledging climate change and its implications may endanger this male privilege. For men whose need satisfaction is low, this may be too threatening. They may instead employ self-protective strategies to protect their selves, justify their actions, and ultimately protect the status quo. Future research should investigate this effect in relation to ideological convictions, such as system justification tendencies, and investigate its potential underlying functionality further.

Some results were counterintuitive. Even though not significant, the direction of the interaction effects of need satisfaction and threat was unexpected: Participants reported most self-protection when their need satisfaction was low and they were in the no-threat-condition, whereas self-protection did not differ as strongly with need satisfaction for people in the threat-

condition. Put differently, participants with low need satisfaction reported most self-protection when receiving non-threatening feedback and lower levels when receiving threatening feedback. When participants had high need satisfaction, these relations were reversed such that those in the no-threat-condition reported least self-protection and higher levels in the threat-condition. For people with low need satisfaction, this finding contradicts previous research on need frustration and defensiveness (Ryan & Deci, 2017; Vansteenkiste & Ryan, 2013). Two explanations are possible: First, people who experience low need satisfaction also tend to have low self-esteem or a negative self-image (Deci & Ryan, 1995; Hodgins et al., 2007; Moller et al., 2006; Ryan & Deci, 2017). The self-esteem threat in Study 2 was thus congruent with their self-esteem or self-image and may not actually have been perceived as threatening. In fact, Soenens et al. (2005) found that University students low on need satisfaction reacted more defensively when confronted with self-incongruent information rather than congruent information. Transferred to Study 2, low need satisfied people who read that their behavior was destructive and negative (threat-condition) received feedback in line with their self-image and did not need to defend themselves as much. However, low need satisfied participants who read that their behavior was in fact beneficial and exemplary (no-threat-condition) received feedback incongruent with their self-image and may have reacted more defensively. Second, those with low need satisfaction in the threat-condition may have reported less subsequent self-protection in an attempt to regain some self-esteem (see Ryan & Deci, 2017, p. 184 for a similar interpretation of a comparable finding). Nonetheless, this finding was only a trend and needs to be interpreted with caution.

Across groups, direct and indirect indicators of self-protection were unrelated. Previous studies found low to moderate positive correlations between direct and indirect indicators of the same concept, indicating that measures assess separate but related facets of the same constructs (Hofmann et al., 2005; Nosek, 2005). Even though IATs have been successfully used in environmental psychology research (e.g., Thomas & Walker, 2016; Wang et al., 2019), I used unvalidated SC-IATs in a new area of interest and split-half reliability was low. In fact, IATs often have low reliability (Nosek et al., 2005). The SC-IATs as employed in Study 2 may not have been a valid and reliable means to assess implicit self-protection. Descriptively, people in

the threat-condition associated both responsibility and guilt slightly more with themselves than with others but both groups associated the concepts more with others than with themselves. In other words: There was no evidence for implicit self-protection in the threat-condition. Nevertheless, these findings need to be interpreted with caution, given the absence of statistical significance and questionable validity and reliability of the SC-IATs.

Contrary to expectations and literature (Cooke et al., 2016; Wullenkord, 2020), need satisfaction was unrelated to ecological footprints. This is a surprising finding worthy of further investigation, given that those with high need satisfaction reported more PEB as assessed using impact-oriented self-report items in Study 1 and more environmental awareness and sufficiency orientation. Cooke et al. (2016) found need satisfaction to negatively predict size of environmental footprints. Nevertheless, they assessed need satisfaction in the environmental domain rather than general need satisfaction. Future research should further examine these effects, taking potential mediators such as social desirability into account.

5 General Discussion

Understanding wide-spread defensive, self-protection in the face of climate change is critical. These studies are the first to show that people who use more defensive climate-relevant self-protection have lower need satisfaction, tend to be male, and have right-wing political convictions. People who experience a general sense of satisfied autonomy, competence, and relatedness use less self-protection, are more resistant in the face of threat, and report more autonomous environmental motivation, PEB, environmental awareness, and sufficiency orientation.

Interestingly, it was often not frustration of needs that predicted self-protection, as previous literature would suggest (e.g., Vansteenkiste & Ryan, 2013) but absence of their satisfaction. There is a subtle difference between the need frustration and absence of need satisfaction: In the second case, a need is simply not met (i.e., less satisfaction), whereas in the first case, need satisfaction is actively undermined (i.e., more frustration). Both configurations are related but

distinct, and predict unique and opposing outcomes: the support of need satisfaction predicts well-being and vitality outcomes, whereas the thwarting of need satisfaction predicts maladaptive outcomes (Bartholomew et al., 2011; Vansteenkiste & Ryan, 2013). Based on these results, I expected need frustration rather than lack of need satisfaction to predict self-protection. Several explanations are possible why the absence of need satisfaction predicted self-protection in my studies: First, perhaps some people who experience need frustration may be so given up that they no longer use self-protective strategies. Research on the absence of an optimism bias in severely depressed people (who likely experience need frustration) may support this proposition: When presented with undesirable information about the future, severely depressed people were pessimistic (i.e., expected to experience adversity), whereas healthy or only mildly depressed people had a more unrealistic optimistic outlook (Korn et al., 2014). In my studies, people experiencing more severe need frustration may not have used self-protective strategies, whereas those experiencing milder need frustration may indeed have used self-protective strategies, resulting in an absence of an overall clear relation. Future research should investigate whether, how, and why people with differing levels of need frustration and low need satisfaction differ with respect to the self-protective strategies they employ. Second, studies investigating unique contributions of absence of need satisfaction and presence of need frustration have typically considered very "obvious" ill-being outcomes such as depressiveness or loneliness (Bartholomew et al., 2011; Heissel et al., 2018; Neubauer & Voss, 2016). Climate-relevant defensive self-protection may not, however, be as clearly comparable to those outcome variables, as it is also political and socially constructed, serving different individuals in different ways (Hultman et al., 2019; Norgaard, 2019; Zerubavel, 2006). For example, for a wealthy, male, conservative business owner, denying climate change comes with more benefits than for a poor woman who is relatively underprivileged and would personally benefit more from climate mitigation efforts, a consequence of acknowledging climate change and its implications.

5.1 Limitations and Future Directions

Study 2 meets some of the limitations of Study 1. Nevertheless, both studies can be improved. I relied on convenience sampling when recruiting participants for both studies. Even though the generated samples were large and sufficient for the purposes of two first studies on the relations of need satisfaction and self-protection, bigger, more representative samples from a host of regions would be indicative to disentangle some potential findings that require higher-power statistical procedures. For instance, such studies would allow to study potential subgroups along the spectrum of need frustration, potential complex interaction effects between need satisfaction, threat, gender, and ideology on self-protection, or relations between an array of different indicators of environmentalism and need satisfaction.

Furthermore, both studies are cross-sectional. However, the development and maintenance of self-protection is likely complex. Longitudinal studies with qualitative elements could remedy the shortcomings of this cross-sectional approach. In the long term, this work could be used to design and evaluate need-based interventions targeted at reducing people's self-protection and equip them with psychological resources needed to cope proactively. These interventions could be designed to meet needs, support people in facing threat and uncomfortable or even disturbing emotions, and fostering intrinsic motivation for pro-environmental behavior and climate action.

5.2 Implications and Conclusion

In conclusion, this study shows that *general* need satisfaction matters for climate denial and self-protection. This has implications for the real world. Even though causal links have not yet been explored, both studies suggest that those whose basic psychological needs are generally satisfied are better equipped to cope in proactive ways with the threatening nature of climate change. This is relevant as it points to the importance of meeting people's needs generally in everyday life, irrespective of the environmental context, to cope with specific crises such as the climate crisis. Thus, need satisfaction has broader societal implications that go beyond individual health and well-being. Given the dialectical nature of self-determination theory that proposes need satisfaction to be a function of the social context, we need to ensure

social contexts are shaped in ways that are human friendly – even on a broader, societal level. When we (as a collective but especially policy makers) shape contexts to allow people to meet their basic psychological needs, we may as well enable them to work for a better world.

6 References

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Manuscript 4

Anxiety and Climate Change: A Validation of the Climate Anxiety Scale in a German-Speaking Quota Sample and an Investigation of Psychological Correlates

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Anxiety and climate change: a validation of the Climate Anxiety Scale in a German-speaking quota sample and an investigation of psychological correlates

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Abstract
The climate crisis is an unprecedented existential threat that causes disturbing emotions, such as anxiety. Recently, Clayton and Karazsia measured climate anxiety as "a more clinically significant 'anxious' response to climate change" (2020, p. 9). To gain a more nuanced understanding of the phenomenon from an empirical psychological perspective, we translated the core of the Climate Anxiety Scale into German and assessed potential correlates in a large German-speaking quota sample ($N = 1011$, stratified by age and gender). Overall, people reported low levels of climate anxiety. Climate anxiety correlated positively with general anxiety and depressiveness, avoidance of climate change in everyday life, frustration of basic psychological needs, pro-environmental behavioral intentions, and policy support. It correlated negatively with different forms of climate denial and was unrelated to ideological beliefs. We were not able to replicate the two dimensions found in the original scale. Moreover, we argue that items appear to measure a general climate-related emotional impairment, rather than distinctly and comprehensively capturing climate anxiety. Thus, we encourage researchers to rework the scale and include an emotional factor in future research efforts.

Keywords Climate anxiety · Climate denial · Pro-environmental intentions · Ideology · Psychological needs · Eco-anxiety

1 Introduction

The climate crisis represents an existential threat to human well-being and survival (Masson-Delmotte et al. 2018; Steffen et al. 2015). Its effects on (non)human ecosystems are tremendous and surpass previous predictions substantially (Masson-Delmotte et al. 2018). Given its existential nature, it is not surprising that people experience disturbing emotions in relation to the climate crisis (Albrecht 2012; Böhm 2003; Norgaard 2006a). Nevertheless, empirical psychological research has only recently started

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to investigate climate anxiety as a specific emotional response to the climate crisis, its potential impacts on mental health and well-being, and its consequences for climate action (e.g., Clayton & Karazsia 2020; Stanley et al. 2021; Pikhala 2020). With an expected increase in people reporting climate anxiety, "an urgent response is needed from clinicians, public health practitioners, families, researchers, educators, and policy makers" (Cunsolo et al. 2020, p. e261). To contribute to the discourse and empirical evidence about climate anxiety in our own discipline, we report data from a large German-speaking quota sample, originally collected as part of a larger project on the spectrum of climate denial. Building on empirical psychological research by Clayton and Karazsia (2020; see Pikhala (2020) for a review of research on climate anxiety in other disciplines), our research has three goals: First, we validate a German translation of the two core dimensions of the *Climate Anxiety Scale* (CAS) by Clayton and Karazsia (2020). Second, going beyond previous research, we investigate relations of climate anxiety with climate denial, political ideologies, basic psychological needs, and aspirations. Third, we test whether climate anxiety relates to pro-environmental behavioral intentions and policy support.

2 Theoretical background

2.1 Climate anxiety

Complex emotional responses to the climate crisis such as anxiety, fear, and worry (Böhm 2003; Pikhala 2020), grief (Cunsolo & Ellis, 2018), guilt (Rees et al. 2015), hopelessness (Norgaard, 2006a), or melancholia (Lertzman 2015) can be uncomfortable if not deeply disturbing. They have wide-ranging consequences for the sense of self, personal and place identity, and a sense of continuity and safety (Norgaard 2011). *Climate anxiety* can be defined as "anxiety which is significantly related to anthropogenic climate change" (Pikhala 2020, p. 3). Similarly, the broader term *eco-anxiety* can be defined as the apprehension and stress about anticipated threats to ecosystems (Cunsolo et al. 2020) or "the generalized sense that the ecological foundations of existence are in the process of collapse" (Albrecht 2012, p. 250). Within empirical psychology, Clayton and Karazsia recently defined climate anxiety as "a more clinically significant 'anxious' response to climate change" (2020, p. 9) that may impair human well-being and functioning. However, interpreting climate anxiety as "pathological" would contribute to a deficit-oriented health discourse and potentially cause stereotyping and marginalization (e.g., see Hyett et al. 2019). Rather, it may be an adaptive, reasonable response to an existential threat. Nevertheless, if climate anxiety indeed required clinical attention, it would be necessary to develop means to assess its severity, which "allow for consistency in measurements and understandings" (Clayton & Karazsia 2020, p. 3). To this end, Clayton and Karazsia (2020) developed the CAS to assess climate anxiety and its impacts in everyday life. In our study, we aim to replicate the two core dimensions of the original scale and some of the study's findings in a large German-speaking quota sample. Given that Clayton and Karazsia (2020) conceptualize climate anxiety as potentially "clinically significant," we expect to replicate their finding:

Climate anxiety correlates positively with general anxiety and depressiveness (H1).

2.2 Potential correlates of climate anxiety

Given its psychological significance, it is likely that various psychological factors relate to how much climate anxiety people actually report. In the following, we elaborate on potential correlates that were available in our dataset. These correlates pertain to two aspects of human responses to the climate crisis: First, environmental correlates such as acknowledgment of the climate crisis as a problem, ideological beliefs that are closely related to responses to the climate crisis, and pro-environmental behavioral intentions and policy support, and second, well-being correlates such as basic psychological need satisfaction, aspirations, and general anxiety and depressiveness.

2.2.1 Climate denial

One way to cope with debilitating emotional experiences is to use defensive, self-protective strategies that serve to suppress, deny, or avoid uncomfortable emotions and thereby protect the self from pain and loss (see Jonas et al. 2014; Weintrobe 2013). If these strategies are successful, uncomfortable emotions like anxiety may not be (consciously) felt and/or reported (e.g., in questionnaire studies, Lertzman 2015). Following Cohen's work on the denial of human rights violations (2001), climate-relevant defensive, self-protective strategies can be classified into literal denial (i.e., denial of hard facts), interpretive denial (i.e., distortion of facts or emotional distancing), and implicatory denial (i.e., recognition of facts but denial of their psychological, political, or moral implications). These strategies can be more or less successful in numbing the emotional response. For example, one prerequisite for reporting climate anxiety is the recognition that climate change is a threat with vast consequences for human existence (Weintrobe 2013). Denying the existence of climate change (literal denial) or reinterpreting its implications (interpretive denial) should reduce the reported anxiety more than rationalizing one's own contribution to the climate crisis or merely avoiding information about it in everyday life (implicatory denial). This does not mean that the underlying anxiety disappears. The denial may simply be a repressed manifestation of underlying anxiety, masking it, and breeding more anxiety in the long run (see Weintrobe (2013, p. 39) on the "vicious spiral" of anxiety and denial). In the case of avoidance, feelings of anxiety remain but are pushed away by avoiding its triggers in everyday life (Salander & Windahl, 1999). In a recent study, Kapeller and Jäger (2020) simulated complex interactions of climate anxiety and literal denial and generally found them to be negatively related. Based on the findings reviewed above, we hypothesized:

Climate anxiety correlates negatively with climate denial (H2).

2.2.2 Ideological beliefs

Previous research shows that people with certain ideological beliefs use denial to protect what the climate crisis threatens, such as the safety and privileges the status quo affords them (Feygina et al. 2010; Jylhä et al. 2016). Ideologies are sets of attitudes comprising more or less coherent belief systems that fundamentally shape people's perceptions and interpretations regarding important topics (Jost et al. 2008), such as climate change and environmental degradation (McCright et al. 2016). *System justification*, the tendency to justify and defend the status quo, is one important ideological driver of resistance to climate

change information (Feygina et al. 2010). The dual-process model of ideology (Duckitt 2001) describes *social dominance orientation* (SDO, Pratto et al. 1994) and *right-wing authoritarianism* (RWA, Altemeyer 1981) as key ideological beliefs. People high on SDO typically endorse hierarchical structures and legitimize inequalities, while people high on RWA are typically resistant to change and motivated to maintain the status quo. Both RWA and SDO are strong negative predictors of various socio-political outcomes such as willingness to act against global inequality, appreciating attitudes toward outgroups, or support of human rights measures (McFarland 2010; Reese et al. 2014). They typically correlate negatively with pro-environmental attitudes and intentions (Stanley & Wilson 2019). *Human dominance over nature* captures the belief that humans are superior to nature (Milfont et al. 2013). It is associated with striving to maintain the status quo and climate denial (Jylhä et al. 2020). If people with high scores on system justification, SDO, RWA, and human dominance over nature tend to deny climate change, they may not report climate anxiety because that would in turn mean they would acknowledge the existence of climate change or its emotional consequences on the self. Correspondingly, one could expect similar relations for people with a right-wing rather than left-wing political orientation, given that the former deny climate change more than the latter (e.g., Häkkinen & Akrami 2014). Based on the empirical findings on ideological beliefs and climate denial and the negative proposed relationship between climate anxiety and climate denial, we expected:

> *Climate anxiety correlates negatively with certain ideological beliefs (i.e., system justification, SDO, RWA, human dominance over nature, and right-wing political orientation; H3).*

2.2.3 Needs and aspirations

Further potential correlates of climate anxiety are basic psychological needs, as basic psychological need frustration is often associated with anxiety and various forms of ill-being. Self-determination theory (Deci & R.M. Ryan 2000; R.M. Ryan & Deci 2017) is a humanistic, organismic-dialectical theory of human motivation. It proposes that the universal, innate basic psychological needs for relatedness (belonging), competence (efficacy), and autonomy (self-determination) have to be satisfied to experience mental health and well-being and to cope with stressors and threat proactively. People whose basic psychological needs are satisfied are more likely to act pro-environmentally (see Wullenkord (2020) for an overview). Need frustration is, in contrast, associated with inner conflicts, reduced human functioning, ill-being, and defensiveness (Benita et al. 2019; Heissel et al. 2018; Hodgins et al. 2006; R.M. Ryan & Deci 2017; Vansteenkiste & R.M. Ryan 2013). For example, first findings in the climate context suggest that basic psychological need frustration is associated with climate denial (Wullenkord 2019). Severe and ongoing need frustration can lead to non-optimal human functioning and psychopathology (Deci & R.M. Ryan 2000). For example, need frustration is associated with depressive symptoms (Heissel et al. 2018) and anxiety among adolescents (Kearns 2017), in dental patients (Halvari et al. 2019), and in many other populations (Deci & R.M. Ryan 2000; Vansteenkiste & R.M. Ryan 2013). In particular, *satisfied autonomy* needs predicted lower general anxiety for rheumatoid arthritis patients (S. Ryan & McGuire 2016), while *frustrated autonomy* needs predicted worry and sleep disruption in times of uncertainty (Howell & Sweeny 2019). Furthermore, helplessness and powerlessness are typical anxious experiences that represent diminished efficacy and control beliefs (Grupe & Nitschke 2013), in other words,

thwarted needs for competence. Brenning et al. (2021) found need frustration to partially mediate the relationship between dysfunctional emotion regulation and internalizing problems in a sample of adolescents. Based on these empirical findings and theoretical considerations, we expected:

Climate anxiety correlates positively with need frustration and negatively with need satisfaction (H4).[1]

Closely related to basic psychological needs and indicative of well-being are aspirations, namely, life goals. Goal contents theory (Kasser & R.M. Ryan 1996; R. M. Ryan & Deci 2017), a sub-theory of self-determination theory, classifies people's aspirations into intrinsic aspirations (pursuit of personal growth, meaningful relationships, and contribution) and extrinsic aspirations (financial success, popularity, and image). Extrinsic aspirations are less likely to satisfy basic psychological needs than intrinsic aspirations. R.M. Ryan et al. (1996) showed that extrinsic aspirations were related to anxiety and depressive symptoms. Based on these findings, we expected:

Climate anxiety correlates positively with extrinsic aspirations and negatively with intrinsic aspirations (H5).

2.2.4 Pro-environmentalism

Instead of a self-protective response, people can also acknowledge their emotions in the context of climate change (Reser et al. 2012). A so-called practical anxiety can trigger information-seeking tendencies and coping with the threat (Kurth 2018). Accordingly, the perception of threat and worry about climate change can motivate support of climate action and policies (Leiserowitz 2006; Mayer et al. 2017; Smith & Leiserowitz 2014), through an increase in perceived personal responsibility (Bouman et al. 2020). Furthermore, being a bystander to severe collective climate damage could intensify anger and motivate people to take personal responsibility (Kleres & Wettergren 2017; Stanley et al. 2021).

Nevertheless, Clayton and Karazsia (2020) found climate anxiety and pro-environmental behavior to be unrelated. Kapeller and Jäger (2020) showed that more anxiety is not necessarily associated with more pro-environmental behavior. In fact, relations between reported anxiety and pro-environmental behavior may not be straightforward. Perceiving severe threat and fear can be overwhelming and lead to apathy, especially when one feels incapable to deal with the threat (Kapeller & Jäger 2020; Miller et al. 2009). General emotion management also depends on people's cultural backgrounds and socio-material contexts. For instance, Kleres and Wettergren argue that people in the Global North "embrace" feelings of fear internally but reject them externally because "a general fear culture in the north voids the mobilizing power of fear" (2017, p. 11). This likely influences our study because we analyze individuals living in a northern liberal culture. Furthermore, if people are able to resolve their anxiety by acting pro-environmentally (Kapeller & Jäger 2020), they may as a consequence experience more hope and report less anxiety (Kleres

[1] This hypothesis differs from our pre-registration. Originally, we assumed an interaction between climate anxiety and basic psychological needs to predict pro-environmental behavior and policy support. However, in this paper, we focus on the basic correlation assumption. We report on the interaction hypothesis in Supplementary Materials S2 and S3.

& Wettergren 2017; Ojala 2012). Given these mixed findings on the relationship between fear, worry, anxiety, and pro-environmentalism, and the finding by Clayton and Karazsia (2020) upon which we built our study, we expected:

> *Climate anxiety is uncorrelated with pro-environmental behavioral intentions and policy support (H6).*

3 Method

The current study was part of a larger project initially designed to study the interrelations of climate denial, basic psychological needs, and ideology (see our pre-registration[2] and Wullenkord (under review)). Here, we use the complete data to contribute to a better understanding of climate anxiety by validating the two core dimensions of the CAS (Clayton & Karazsia 2020) in a German-speaking quota sample and assessing potential correlates of climate anxiety.

3.1 Sample and procedure

We collected 1134 complete datasets of German-speaking participants through the online-access panel provider Respondi AG.[3] The study was hosted on the platform SoSci-Survey (Leiner 2020). Participants gave their informed consent and then answered questions about their climate anxiety and potential correlates. As an incentive, participants received *mingle points*, which they could exchange for money, shopping vouchers, or donations to several organizations. This study was approved by the local ethics committee (293_2020) and was in line with the Declaration of Helsinki. We pre-registered our hypotheses (see footnote 2). After outlier detection,[4] the final sample consisted of $N = 1011$ participants. The sample was stratified for age ($M = 43.91$, $SD = 13.97$, range: 18–69) and gender (51.14% female), based on 2011 census data retrieved from the European Statistical System (2020). We also assessed education (26.31% had university entrance qualification, and 29.48% had a university degree) and monthly income (on average, people earned between 1500 and 2500€).

3.2 Measures

When no validated German translations were available, we used back-translation to translate the measures. If not otherwise indicated, participants responded to all measures on 7-point Likert scales from 1 (*strongly disagree/does not apply at all*) to 7 (*strongly agree/applies completely*). Psychometric properties are summarized in Table 1.

Climate anxiety We used the factors *cognitive-emotional impairment* (e.g., "Thinking about climate change makes it difficult for me to concentrate") and *functional impairment*

[2] https://aspredicted.org/blind.php?x=js5pc4

[3] Data are available upon request.

[4] We excluded speeders ($RSI \geq 2$, $N = 32$, Leiner 2019), straightliners ($N = 19$, Kim et al. 2019), those with inconsistent answers on several item pairs ($N = 61$), and multivariate outliers ($N = 11$, Tabachnick & Fidell 2013). Please find more detailed information in Supplementary Materials S2 and S3.

Table 1 Descriptive statistics of study variables

Variable	Items	*M*	*SD*	Min	Max	Skewness	Kurtosis	α [95% CI]
Climate anxiety	13	1.81	.82	1	5.42	1.22	1.16	.89 [.87, .90]
Anxiety and depressiveness	4	1.67	.72	1	4	1.29	1.27	.88 [.87, .89]
Climate denial	30	2.97	1.06	1	6.40	.55	− .17	.95 [.95, .96]
Rationalization	7	3.18	1.46	1	7	.54	− .20	.92 [.92, .93]
Avoidance	8	3.04	1.18	1	6.75	.09	− .57	.89 [.88, .90]
Denial of personal outcome severity	4	2.35	1.21	1	7	.85	.29	.87 [.86, .89]
Denial of global outcome severity	3	2.58	1.59	1	7	1.00	.22	.91 [.90, .92]
Denial of guilt	4	3.92	1.39	1	7	.38	− .46	.83 [.82, .85]
Literal denial	4	2.45	1.55	1	7	1.14	.61	.94 [.93, .95]
Ideological beliefs								
System justification	8	3.94	1.09	1	7	− .25	− .13	.83 [.82, .85]
Social dominance orientation	8	2.93	1.03	1	6.62	.35	.22	.80 [.78, .82]
Human dominance over nature	10	2.51	1.14	1	7	.63	− .03	.89 [.88, .90]
Right-wing authoritarianism	12	3.53	1.03	1	6.50	− .13	− .47	.82 [.82, .84]
Political orientation	1	44.59	18.8	1	101	− .02	.18	
Basic psychological needs								
Relatedness satisfaction	3	5.39	1.17	1	7	− .83	.83	.84 [.82, .85]
Relatedness frustration	3	2.63	1.43	1	7	.69	− .27	.80 [.78, .82]
Competence satisfaction	3	4.37	1.3	1	7	− .25	− .24	.78 [.76, .81]
Competence frustration	3	2.66	1.34	1	7	.56	− .55	.77 [.74, .79]
Autonomy satisfaction	3	5.01	1.1	1	7	− .51	.07	.79 [.77, .81]
Autonomy frustration	3	3.12	1.43	1	7	.29	− .69	.75 [.72, .77]
Aspirations—importance	18	− 2.09	1.09	− 5.38	1.15	. − 07	− .24	.81 [.79, .83]
Aspirations—likelihood	18	− 1.26	0.96	− 4.10	1.85	− .32	− .04	.87 [.86, .88]
Pro-environmentalism								
Policy support	2	71.35	20.88	1	101	− .86	.83	.67[a][.63, .74]
Intentions	3	3.49	1.26	1	7	.26	− .26	.74 [.71, .77]
Age	1	43.91	13.97	18	69	− .07	− 1.10	

Note. [a]Spearman's rho

(e.g., "My friends say I think about climate change too much") of the *CAS* to measure climate anxiety as operationalized by Clayton and Karazsia (2020). According to Clayton and Karazsia, these two factors "constitute the climate anxiety scale" (p. 4). In their original study, Clayton and Karazsia also assessed the factors *experience of climate change* (e.g., "I have been directly affected by climate change") and *behavioral engagement* (e.g., "I recycle"). In line with their interpretation, we regard these factors not as indicative of climate anxiety per se but rather as potential correlates. In our study, two authors independently translated the original English items into German and resolved disagreement in discussion. The German items were then back-translated into English by two other researchers, who

were not aware of the original scale. Afterwards, we determined the final wording of the German item (see Supplementary Material S4, $\alpha = 0.89$).

Anxiety and depressiveness We used the *PHQ-4* (Kroenke et al. 2009, $\alpha = 0.88$) that screens for general anxiety and depressiveness (e.g., "feeling nervous, anxious, or on edge") within the past two weeks on a 4-point Likert scale from 1 (*not at all*) to 4 (*nearly every day*).

Climate denial We used the *Climate Self-Protection Scale* (Wullenkord & Reese 2021), consisting of five subscales for interpretive (3, 4) and implicatory denial (1, 2, 5): (1) rationalization (e.g., "How I behave toward the environment has minimal impact on climate change," $\alpha = 0.92$), (2) avoidance (e.g., "I try to avoid negative thoughts about climate change in my everyday life," $\alpha = 0.89$), (3) denial of personal outcome severity (e.g., "I expect climate change to affect other regions but not to burden me," $\alpha = 0.87$), (4) denial of global outcome severity (e.g., "I believe that climate change won't be as severe as expected in the future," $\alpha = 0.91$), and (5) denial of guilt (e.g., "I don't need to make climate change a matter of conscience," $\alpha = 0.83$). We added four items on (6) literal climate denial (two own items; two taken from Jylhä et al.'s (2016), own translation; $\alpha = 0.94$).

Ideological beliefs We used the *System Justification scale* (Kay and Jost (2003); German adaptation by Ullrich and Cohrs (2007); e.g., "Most political decisions serve the benefit of all people.," $\alpha = 0.83$), the $SDO_{7(8)}$ *scale* (Ho et al. 2015; own translation; e.g., "Some groups of people are simply inferior to other groups.," $\alpha = 0.80$), the RWA^3D *scale* (Funke 2003; "The true key for the 'good life' are obedience, discipline, and virtue.," $\alpha = 0.82$), and as a measure of human dominance over nature subscale nine of the *Environmental Attitudes Inventory* (Milfont & Duckitt 2010; German translation by Markey 2013, items 5–8 own translation; e.g., "Humans were meant to rule over the rest of nature.," $\alpha = 0.89$). Additionally, we assessed political orientation using a slider bar ranging from 1 (*left-wing*) to 101 (*right-wing*).

Basic psychological needs We used the *Balanced Measure of Basic Psychological Needs Scale* (Sheldon & Hilpert 2012, German translation by Neubauer & Voss 2016) to assess both satisfaction and frustration of autonomy (e.g., "I was free to do things my own way," $\alpha_{sat} = 0.79$, $\alpha_{frus} = 0.75$), competence (e.g., "I took on and mastered hard challenges," $\alpha_{sat} = 0.78$, $\alpha_{frus} = 0.77$), and relatedness (e.g., "I felt close and connected with other people who are important to me," $\alpha_{sat} = 0.84$, $\alpha_{frus} = 0.80$) during the last month.

Aspirations We assessed importance and likelihood of intrinsic and extrinsic aspirations using a short version of the *Aspiration Index* (Grouzet et al. 2005; German translation by Matthey & Kasser 2013; e.g., "In the future, I will have a job that pays well."). We then calculated a relative intrinsic vs. extrinsic value orientation score for both importance and likelihood (recommendations by Kasser (2019)), with negative scores indicating relative intrinsic value orientation (max −6) and positive scores indicating relative extrinsic value orientation (max 6).

Pro-environmental behavioral intentions We used three items based on Wullenkord et al. (2020) to assess participants' pro-environmental intentions with respect to political and activist engagement ("I plan to become involved in *politics/activism* in the future to

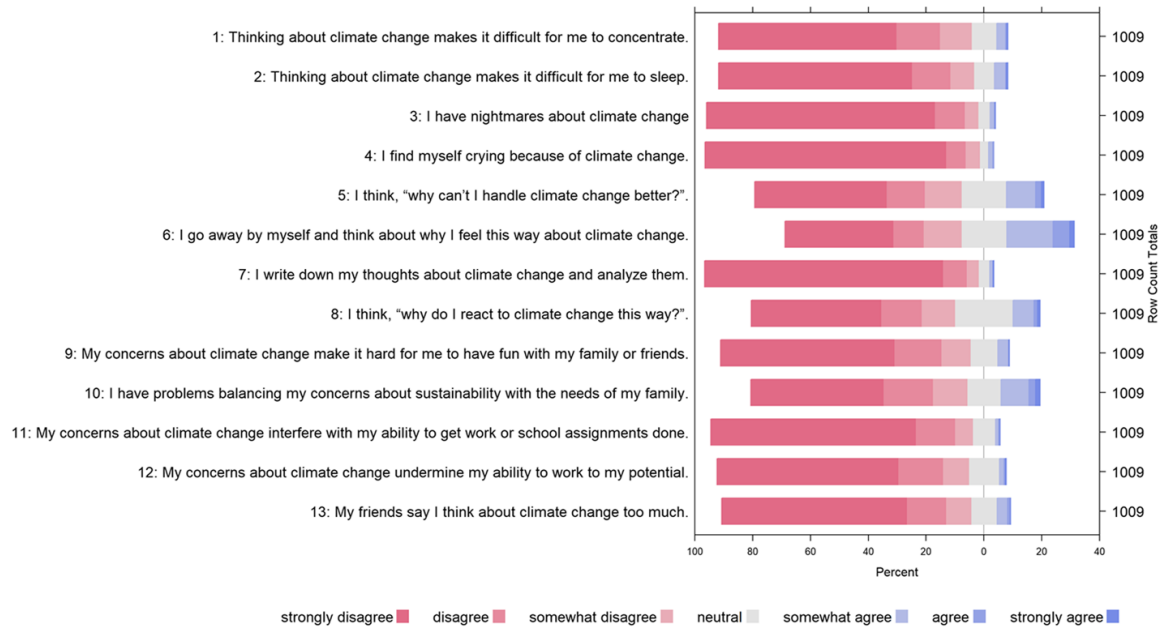

Fig. 1 Diverging stacked bar chart of responses to the Climate Anxiety Scale. This figure shows the distribution of participant responses to the individual items of the Climate Anxiety Scale and the scale as a whole. Red signifies disagreement and blue agreement with the items

limit the consequences of climate change"), and changes in everyday life ("I plan to act in an environmentally protective way in my *everyday life* in the future to limit the consequences of climate change"; $\alpha = 0.74$).

Policy support Inspired by the European Election Studies (Schmitt et al. 2016), participants indicated their personal views on investments in climate protection measures and taxes on slider bars ranging from 1 to 101.

4 Results

We used the statistical environment R, version 4.0.3 (R Core Team 2020). Supplementary Material S1 contains results not outlined here in a clear and concise format. In Supplementary Material S2, we report detailed results of all analyses. In Supplementary Material S3, we explicate exclusion criteria, data analyses using the entire dataset without exclusions, and analyses without covariates.

4.1 Validating the Climate Anxiety Scale

To validate the core of the original CAS, we explored its structure and relations with sociodemographic variables.

4.1.1 Structure of the Climate Anxiety Scale

We first ran a confirmatory factor analysis (CFA) to investigate whether a 2-factorial structure of the CAS inspired by Clayton and Karazsia's work, with the subscales *cognitive-emotional impairment* and *functional impairment*, could be confirmed in our sample, using

the R-package *lavaan*, version 0.6–7 (Rosseel 2012). The dataset contained no missing data. The 13 items of the CAS were not normally distributed but displayed significant floor effects (see Fig. 1) and multivariate non-normality, as revealed by histograms, Q-Q-plots, skewness, kurtosis, and the Doornik-Hansen test ($E[26] = 2144.40$, $p < 0.001$). We used robust maximum likelihood estimation with Satorra-Bentler correction (Finney & DiStefano 2013) to account for multivariate non-normality. We constrained latent factors with a mean of 0 and variance of 1. The dataset was sufficiently large to ensure high statistical power (*N:q* ratio was 37:1). A graphical representation of the model including (un)standardized parameter estimates, standardized residuals, squared multiple correlation coefficients, and empirical and model-implicated variance–covariance-matrices can be found in Supplementary Material S2.

The hypothesized model was identified but did not have satisfactory fit (Hair et al. 2019; Hu & Bentler 1999), Satorra-Bentler χ^2 (64, $N = 1011$) = 321.34, $p < 0.001$, Robust Comparative Fit Index (CFI) = 0.91, Robust Tucker-Lewis Index (TLI) = 0.89, Akaike Information Criterion (AIC) = 38,004.51, Robust Root Mean Square Error of Approximation (RMSEA) = 0.084, 90% CI [0.075, 0.093], and Standardized Root Mean Square Residual (SRMR) = 0.052. While the Robust CFI was acceptable, the Robust TLI was rather low, and the χ^2:df ratio was > 3 indicating bad fit (see Bollen 1989). We interpret this as evidence that the existence of the subscales *cognitive-emotional impairment* and *functional impairment* does not fit our German quota sample. A one-dimensional model had slightly worse fit (Satorra-Bentler χ^2 [65, $N = 1011$] = 325.72, $p < 0.001$; Robust CFI = 0.91; Robust TLI = 0.89; AIC = 38,012.38; Robust RMSEA = 0.084, 90% CI [0.075, 0.093]; SRMR = 0.052; χ_{diff}^2[1, $n = 1011$] = 4.51, $p = 0.034$). However, the difference between models was marginal.

We therefore ran an exploratory main axis analysis with oblique rotation to explore whether individual items clustered into different interpretable subscales in our sample. Items were well-suited for factor analysis (KMO = 0.93). No items needed to be excluded because of high inter-item correlations ($r > 0.80$, recommendations by Tabachnick and Fidell (2013)). According to Horn's (1965) parallel analysis, items distributed over four factors (Eigenvalues = 0.14–5.23, 51% cumulative explained variance). After inspection of the scree plot with an elbow point after two factors and due to difficulty in meaningfully interpreting four factors, we enforced a two factor solution (Eigenvalues = 0.44–5.23). One item ("I go away by myself and think about why I feel this way about climate change.") had both a very low factor loading (< 0.30) and low commonality ($h^2 = 0.21$). Given that it was an outlier when inspecting correlations of single items with study outcomes and did not directly assess anxiety in our interpretation, we re-analyzed the scale without it. The 12-item measure was well-suited for factor analysis (KMO = 0.93). Again, items are distributed over four factors (Eigenvalues = 0.14–5.01, 53% cumulative explained variance), but we enforced a two-factor solution (Eigenvalues = 0.44–5.01) based on inspection of the scree plot (see Supplementary Material S1 for item statistics, factor loadings after oblique rotation, communalities, Eigenvalues, and explained variance of the factors). The two-factor solution explained 47% of sample variance. All items loaded exclusively on their target factor with factor loadings > 0.30, except for one item with factor loadings < 0.30. Communalities were acceptable with $h^2 > 0.30$, except for one item with $h^2 = 0.29$. We interpreted the resulting factors as follows: *behavioral symptoms* (9 items on sleep, concentration, and emotional expression, etc., e.g., "I find myself crying because of climate change.") and *cognitive consequences* of climate anxiety (3 items, e.g., "I think, 'why do I react to climate change this way?'"). The second factor had an Eigenvalue < 1 and a one factor-model without the problematic item (Satorra-Bentler χ^2 [54, $N = 1011$] = 260.35, $p < 0.001$;

Robust CFI = 0.92; Robust TLI = 0.90; AIC = 34,185.63; Robust RMSEA = 0.085, 90% CI [0.074, 0.095]; SRMR = 0.051) had better model fit than the original two factor-model (χ^2 [10, $n = 1011$] = 69.81, $p < 0.001$, see Table S1 in Supplementary Material 1 for an overview over all factor analyses). Even though we evaluate neither model to be satisfactory, we decided to use a single score of climate anxiety in the following analyses. Using the simpler model eases interpretability of our results.

4.1.2 Climate anxiety and socio-demographics

On average, participants reported low climate anxiety ($M = 1.81$). They reported low levels of general anxiety and depressiveness, medium–low levels of climate denial, medium levels of right-wing ideological beliefs, medium–high levels of basic psychological need satisfaction, relatively intrinsic value orientations, high policy support, and medium pro-environmental intentions. An inspection of scatter plots and bivariate correlations revealed climate anxiety not to differ with age. A Welch two sample *t*-test revealed people identifying as female to report significantly more climate anxiety than people identifying as male, $t(1009) = -2.96$, $p = 0.003$, $d = 0.19$, 95% CI of group difference $(-0.25, -0.05)$, $M(SD)_{\text{female}} = 1.88(0.83)$, $M(SD)_{\text{male}} = 1.73(0.80)$. A Kruskal–Wallis test indicated no differences in climate anxiety between levels of education, $H(7) = 8.93$, $p = 0.258$. Climate anxiety was unrelated to income in our sample.

4.2 Potential correlates of climate anxiety

We display descriptive statistics of the main study variables in Table 1 and Spearman correlations between the main variables in Tables 2 and 3. To ease interpretation, we also report correlation coefficients in writing. Supporting H1, the overall mean score of climate anxiety was related to general anxiety and depressiveness in our sample ($r = 0.25$). Supporting H2, climate anxiety was negatively correlated with most types of climate denial. People reporting higher climate anxiety reported less literal climate denial, denied global consequences of climate change less, rationalized climate change less, and reported less denial of guilt for climate change ($r's = -0.37$ to -0.13). However, they reported more avoidance of climate change in their everyday lives ($r = 0.17$). Denial of personal outcome severity was not correlated with climate anxiety. Contrary to H3, climate anxiety was unrelated to the examined ideological beliefs of system justification, SDO, and RWA and correlated slightly positively with human dominance over nature ($r = 0.08$). In line with H3, we found a weak negative correlation with political orientation ($r = -0.11$), such that people reporting a more left-wing political orientation reported more climate anxiety. Mostly supporting H4, climate anxiety correlated negatively with the satisfaction of basic psychological needs for relatedness ($r = -0.10$) and autonomy ($r = -0.14$) but not competence and positively with frustration of relatedness ($r = 0.27$), autonomy ($r = 0.20$), and competence ($r = 0.29$). Supporting H5, climate anxiety was weakly related with the importance ($r = 0.13$) and the likelihood ($r = 0.09$) of aspirations: The more important people rated extrinsic relative to intrinsic aspirations, the more climate anxiety they reported. Contrary to H6, we found a weak positive correlation between climate anxiety and policy support ($r = 0.17$) and a medium positive correlation between climate anxiety and pro-environmental behavioral intentions ($r = 0.44$).

Additionally, we examined the relative explanatory value of all potential correlates of climate anxiety in an exploratory regression model. This is important because testing

Table 2 Spearman correlations of climate anxiety with well-being correlates

	1	2	3	4	5	6	7	8	9
1. Climate anxiety	-								
2. General anxiety and depressiveness	.25**	-							
3. Relatedness satisfaction	−.10**	−.30**	-						
4. Relatedness frustration	.27**	.45**	−.41**	-					
5. Competence satisfaction	.01	−.21**	.28**	−.02	-				
6. Competence frustration	.29**	.55**	−.32**	.65**	−.12**	-			
7. Autonomy satisfaction	−.14**	−.35**	.44**	−.34**	.29**	−.38**	-		
8. Autonomy frustration	.20**	.47**	−.28**	.63**	.03	.61**	−.48**	-	
9. Importance of aspirations	.13**	.03	−.15**	.20**	.11**	.15**	−.14**	.14**	-
10. Likelihood of aspirations	.09**	.13**	−.20**	.22**	.02	.20**	−.20**	.22**	.59**

Note. $N = 1011$

$^{\dagger}p < .10$

$^{*}p < .05$

$^{**}p < .01$

Table 3 Spearman correlations of climate anxiety with environmental and ideological correlates

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Climate anxiety	-												
2. Rationalization	−.17**	-											
3. Avoidance	.17**	.44**	-										
4. Denial of global outcome severity	−.05†	.61**	.45**	-									
5. Denial of personal outcome severity	−.15**	.65**	.42**	.72**	-								
6. Denial of guilt	−.37**	.57**	.10	.46**	.57**	-							
7. Literal denial	−.13**	.61**	.37**	.63**	.83**	.53**	-						
8. System justification	.04	−.18**	−.06†	−.02	−.14**	−.20**	−.18**	-					
9. Social-dominance orientation	−.03	.34**	.22**	.34**	.35**	.25**	.34**	.06†	-				
10. Right-wing authoritarianism	.00	.34**	.27**	.31**	.39**	.33**	.40**	−.18**	.45**	-			
11. Human dominance over nature	.08*	.34**	.25**	.38**	.37**	.22**	.34**	.07*	.34**	.31**	-		
12. Political orientation	−.11*	.34**	.14**	.29**	.36**	.32**	.34**	−.04	.41**	.46**	.23**	-	
13. Policy support	.17**	−.42**	−.27**	−.46**	−.56**	−.40**	−.54**	.04	−.33**	−.30**	−.38**	−.36**	-
14. Pro-environmental intentions	.44**	−.49**	−.27**	−.38**	−.44**	−.40**	−.39**	.07	−.27**	−.26**	−.17**	−.33**	.40**

Note. $N = 1011$, except for correlation with policy support ($n = 973$)

†$p < .10$

*$p < .05$

**$p < .01$

multiple bivariate correlations in a large sample might lead to random significant findings. We controlled for gender, age, and income. Our sample was sufficiently large (required sample size to detect a small effect of $f^2 = 0.03$ with $\alpha = 0.05$ and $1\text{-}\beta = 0.90$ was $N = 965$, G*Power 3, Faul et al. 2007). We found no evidence for multicollinearity and singularity (VIF < 10). Because climate anxiety was not normally distributed, we used log-transformed data where appropriate. The model explained 40% of the variance in climate anxiety ($F[25, 947] = 25.62$, $p < 0.001$, $R^2 = 0.40$, $R^2_{\text{adjusted}} = 0.39$). Pro-environmental intentions ($\beta = 0.43$, $p < 0.001$, 95% CI [0.41, 0.45]) emerged as the strongest correlate. Further significant correlates were avoidance ($\beta = 0.21$, $p < 0.001$, 95% CI [0.19, 0.23]), denial of personal outcome severity of climate change ($\beta = 0.08$, $p < 0.041$, 95% CI [0.02, 0.14]), human dominance over nature ($\beta = 0.11$, $p < 0.001$, 95% CI [0.09, 0.13]), general anxiety and depressiveness ($\beta = 0.10$, $p = 0.004$, 95% CI [0.03, 0.17]), competence frustration ($\beta = 0.09$, $p = 0.026$, 95% CI [0.06, 0.11]), right-wing political orientation ($\beta = 0.06$, $p = 0.049$, 95% CI [0.06, 0.06]), and age ($\beta = 0.15$, $p < 0.001$, 95% CI [0.15, 0.15]). However, given the absence of a bivariate correlation between age and climate anxiety and a correlation of *left*-wing political orientation and climate anxiety, relations with age and political orientation should be interpreted cautiously. Denial of guilt ($\beta = -0.26$, $p < 0.001$, 95% CI $[-0.34, -0.18]$) was negatively related to climate anxiety.

5 Discussion

Understanding people's emotional responses to the climate crisis and its devastating consequences is vital. This is the first study to investigate climate anxiety in a well-powered German-speaking quota sample. Overall, people only reported low levels of climate anxiety. Those who reported higher levels of climate anxiety, however, reported more general anxiety and depressiveness (supporting H1). People with higher climate anxiety also denied climate change to a smaller extent (supporting parts of H2) and experienced lower basic psychological need satisfaction (supporting H4). They expressed stronger pro-environmental intentions and supported climate-relevant policies more than those scoring low on climate anxiety (contradicting H6). Less intuitively, climate anxiety in this sample related positively yet slightly to beliefs in human dominance over nature and was unrelated to system justification, SDO, and RWA (contradicting parts of H3). The more climate anxiety people reported, the more they supported extrinsic values (supporting H5). Furthermore, we found no evidence for the factors *cognitive-emotional* and *functional impairment* as proposed by Clayton and Karazsia in the original study (2020).

In the following, we discuss our initial evidence of correlates of climate anxiety in relation to previous findings. Then, we critically review the CAS as an instrument and reflect on our own learning process while conducting the study. We finish with limitations and recommendations for future research.

5.1 Initial evidence of correlates of climate anxiety

Our results both confirm and contradict existing research. Similar to findings in the USA (Clayton & Karazsia 2020), high levels of climate anxiety were not very common in our German-speaking quota sample. On average, people reported low levels of climate anxiety, and there were significant floor effects. Replicating literature that generally finds women to experience more climate-related anxiety and worry (Clayton & Karazsia 2020; Searle

& Gow 2010), women in our sample reported more climate anxiety. Our results regarding age are inconclusive. While younger people reported more climate anxiety and concern in prior research (Milfont et al., 2021), we found no bivariate correlation with age, and a positive relation in the regression analysis accounting for all assessed variables, indicating that rather older people were more anxious about climate change.

As predicted, the more climate anxiety people experienced, the less climate denial they expressed. This confirms findings by Kapeller and Jäger (2020) who showed climate anxiety and denial to be negatively related in a simulation study. One exception in our study is avoidance: People with climate anxiety tended to avoid engaging with climate change information in their everyday lives. In line with Norgaard (2011), people who avoid information about climate change may acknowledge climate change as a severe problem and may experience uncomfortable emotions when they are confronted with it. An avoidance of the trigger in everyday life may calm this experience. This is in line with findings by Epstein (1972) showing that people who feel anxious often feel overwhelmed and tend to avoid engaging with the subject matter of their anxiety.

Contrary to our predictions, climate anxiety was unrelated to most ideological beliefs in our sample and was slightly positively related to beliefs of human dominance over nature. One explanation could be that the climate change debate is less polarized along political ideology in Germany than in the USA (Hornsey et al. 2018). Moreover, emotional reactions to the climate crisis might not yet be perceived as part of the political climate change debate and may thus not activate people's political identities. Given that risk perception and coping with climate change are also socially constructed (Lamb et al. 2020; Norgaard 2006b), ideological beliefs are only one factor that influences how likely people acknowledge and report climate anxiety (see Lertzman 2015). Regardless of ideological beliefs, one may feel deeply troubled in the face of climate change. This may explain the absence of respective relations in our study.

Supporting H4, the less satisfaction of their basic psychological needs for autonomy, competence, and relatedness people experienced, the more climate anxiety they reported. Our result is in line with the theoretical underpinnings of self-determination theory (Deci & R.M. Ryan 2000) and replicates previous findings on need frustration and anxiety (Halvari et al. 2019; S. Ryan & McGuire 2016), worry (Howell & Sweeny 2019), and depressiveness (Heissel et al. 2018). People who indicated that extrinsic values were relatively more important for them reported higher climate anxiety. They may feel more threatened because climate change impairs the pursuit of extrinsic aspirations such as the pursuit of status.

5.2 Validity and reflections on the Climate Anxiety Scale

We were not able to reproduce the factors *cognitive-emotional impairment* and *functional impairment* of the CAS in our sample. We interpreted the factors emerging from an exploratory factor analysis in our sample as *behavioral symptoms* and *cognitive consequences* of engaging with climate change. However, rather than recommending the use of the scale and interpretation of these factors, we raise a general discussion of the CAS, specifically with regard to the content and the clinical significance of climate anxiety as assessed in this scale.

5.2.1 What does the Climate Anxiety Scale measure?

Studying the scale and its constituent items more closely when analyzing the data, we became skeptical as to whether the scale actually captures the emotional core of climate anxiety that would differentiate it from other emotions. Many of its items are based on a measure of rumination, which is a typical symptom of depression (see Clayton and Karazsia (2020)). It may thus be misleading to talk about climate anxiety in this case. A more accurate term could be climate-related *emotional impairment* as a consequence of climate-related distress. Therefore, our results may be interpreted with care in the sense that we may not be able to talk about correlates of climate anxiety per se. We consider the CAS as a measure that summarizes different possible impairments resulting from the climate crisis. However, it does not capture emotional experiences of climate anxiety. This should be targeted in the future by more complex and multi-faceted assessments. The current CAS could be used to measure climate-related emotional impairment as part of such an instrument but needs further development to capture gradations and degrees of severity of climate anxiety. Based on our findings and interpretation, we suggest to rework the scale by (1) including an emotional factor that assesses a range of anxiety-related feelings, such as worry, fear, and anxiety; (2) including "classic ingredients in anxiety" such as "difficult feelings of uncertainty, unpredictability, and uncontrollability" that climate change produces (Pikhala 2020, p. 2); and (3) extending the cognitive factor to better grasp the definition of climate anxiety as "the generalized sense that the ecological foundations of existence are in the process of collapse" (Albrecht 2012, p. 250).

5.2.2 Is climate anxiety clinically relevant?

While we understand climate anxiety to be an adaptive response to the existential threat of climate change, we see value in discussing whether it may indeed require clinical support. In fact, some authors (Clayton & Karazsia 2020; Cunsolo et al. 2020) argue that this may potentially be the case, especially for people with underlying symptoms of anxiety, depression, or stress (Searle & Gow 2010). In our sample, the correlations of climate anxiety with general anxiety and depressiveness were significant but low. Clayton and Karazsia (2020) report higher correlations, indicating that the reported climate anxiety may be more clinically significant in their US sample than in our German-speaking sample.

Furthermore, our study shows that people reporting higher climate anxiety avoid information about climate change in their everyday lives, perhaps to protect themselves from experiencing even more troubling emotions. This might be a relatively adaptive self-protective response to anxiety, as it avoids stimulating the anxiety in everyday life and thereby avoiding its potentially debilitating effects (Salander & Windahl 1999).

In the case of pathological anxiety, people likely are unable to act (Barlow 2002). "Pathological" refers to human experiences that derive from a manifested disease, not an adaptive response to an existential crisis. Contradicting the findings of the original study (Clayton & Karazsia 2020), people in our study with higher climate anxiety reported more pro-environmentalism. For example, people reporting climate anxiety also reported higher support for climate-mitigation policies. This may indicate a deep understanding in this group of people that climate mitigation also requires structural measures that go beyond individual behaviors. Perceiving government action as insufficient (i.e., absence of effective climate-supportive legislation) and associated feelings of uncontrollability or

hopelessness may perpetuate the anxiety and associated impairments. This is in line with former results, showing *climate change distress* (i.e., anxiety, sorrow, loss) to be a predictor of pro-environmentalism (Kleres & Wettergren 2017; Reser et al. 2012). This may indicate that the reported impairment (and possible underlying climate anxiety) is not pathological but adaptive (Verplanken et al. 2020). It may be a practical anxiety (Kurth 2018)—an activating emotion that moves people to remove the threat and behave pro-environmentally when the anxiety does not become too overwhelming. Thus, we interpret our study in line with Pikhala's (2020) summary of a multitude of disciplines that describe *eco-anxiety* as a non-pathological phenomenon.

Nevertheless, no one in our sample reported high levels of climate-related emotional impairments. It may be possible that an underlying anxiety about the climate crisis—a rational fear—may cause levels of impairment that may require therapeutic support to cope and maintain or regain functioning. However, based on this research, we can only speculate on relations with behavior and the requirement of clinical support. Given that climate anxiety will likely increase in the future (e.g., Cunsolo et al. 2020), future research should recruit "extreme groups" that report higher levels of climate anxiety to understand the genesis, complexity, and functionality of climate anxiety and requirement of therapeutic interventions. Similar to relations of stress or other forms of anxiety with behavior, relations of climate anxiety and different outcomes may be non-linear (see Yerkes & Dodson 1908), such that very low and very high climate anxiety may be related to absence of behavior, whereas medium levels of anxiety may be related to higher levels of behavior. Larger variance in the data would allow to uncover such relations.

5.3 Limitations and future directions

Our study has two strengths that set it apart from other studies in the field. First, it is the first empirical psychological study investigating climate anxiety in a well-powered German-speaking quota sample, stratified for age and gender. Second, it provides a theoretically sound analysis of potential psychological correlates of climate anxiety. Nevertheless, we cannot draw conclusions representative for the German population, as this would have required a random sampling procedure. Moreover, one needs to be cautious in terms of generalizing the current findings to other contexts. Different emotional responses to the climate crisis are normative in and contingent on different cultures (see Kleres & Wettergren 2017; Norgaard 2011). Germany represents a different cultural context than the USA, where the original measure was developed, even though both are industrialized Western nations. Even though we do not expect that it significantly influenced our findings, our measurement of climate anxiety differs from that of the original study (Clayton & Karazsia 2020) because we only included the two core dimensions of the CAS.

Furthermore, we used self-report measures. Besides common difficulties inherent in self-report measures (e.g., Kormos & Gifford 2014), something as complex, sensitive, and deeply contextualized as climate anxiety may simply not be fully captured using a self-report measure (Lertzman 2015). This research is thus inherently limited to the conscious perception and explicit acknowledgment of climate anxiety. Finally, our study is limited by its cross-sectional design. Processes underlying climate anxiety, for instance, different coping strategies people use to reduce their anxiety over time, cannot be uncovered in cross-sectional designs. Future studies should thus employ mixed methods, longitudinal approaches to capture the development, complexity, contradictions, salience, and unconsciousness of climate anxiety. One approach may be to create and investigate protected spaces, in which people can fully

express, acknowledge, and work through their climate-related emotions in a supportive group (perhaps similar to death cafés, e.g., Miles and Corr (2017), or work on grief and active hope, Macy and Johnstone (2012)). Another could be to combine in-depth interviews about the climate crisis with psycho-physiological measurements.

6 Conclusion

This study is the first to systematically investigate correlates of climate anxiety in a German-speaking quota sample. We found that basic psychological need frustration, left-wing political orientation, and absence of climate denial are related to climate anxiety. Given that we could not satisfactorily replicate the original factor structure of the CAS, we recommend to rework the scale by including the emotional core of the anxious experience and use this extended measure in creative, mixed-methods approaches. This would aid not only our understanding of climate anxiety but also contribute to productive ways of working with this anxiety in a world that faces the climate crisis and is in dire need of a socio-ecological transformation to ensure a livable planet.

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Availability of data and material The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Code availability Code used to analyze the data presented in this article is available on request.

Declarations

Ethics approval This study was approved by the local ethics committee (293_2020) and was in line with the Declaration of Helsinki.

Consent to participate All participants provided their informed consent before participating in this study.

Consent for publication All participants consented to the results of the study being published in a scientific publication.

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Manuscript 5

From Denial of Facts to Rationalization and Avoidance: Ideology, Needs, and Gender Predict the Spectrum of Climate Denial and Self-Protection

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Abstract:

Denying climate change can take many forms, ranging on a spectrum from the outright denial of facts (literal denial), to the re-interpretation or distortion of facts (interpretive denial, e.g., denial of personal and global outcome severity), to the acknowledgement of facts but denial of their implications (implicatory denial, e.g., avoidance, denial of guilt, rationalization of own involvement). This study aimed at 1) exploring potential distinct profiles within the spectrum of climate denial and self-protection and 2) investigating relations with right-wing ideological conviction and gender (established predictors) but also need satisfaction and value orientation. Analysis of a German quota sample (N=1007) revealed the following: Participants differed in the extent to which they endorsed all types of climate-denial and self-protection but there were no distinct profiles of climate denial and self-protection in the data, according to latent profile analysis. Structural equation modelling revealed that people who reported right-wing ideological convictions reported more climate denial and self-protection along the spectrum of denial but especially literal and interpretive denial. Absence of need satisfaction and male gender were significant additional but weaker predictors of implicatory denial. Future research should employ longitudinal, experimental, mixed-methods designs to further disentangle the underlying mechanisms and functionality of climate denial.

Keywords: climate change; psychological needs; climate denial; defensiveness; self-protection; ideology; gender

1 Introduction

"Not our climate is in jeopardy – our freedom is"

— slogan of EIKE (European Institute for Climate and Energy[1]), Germany's biggest lobby for systematic climate denial

It is an established finding that right-wing ideological conviction and male gender predict agreement with such statements (e.g., Feygina et al., 2010; Jylhä et al., 2016; McCright & Dunlap, 2011; Milfont et al., 2021). Most studies thus far have considered climate denial to be relatively literal – the outright denial of the fact that the Earth's climate is warming due to anthropogenic emission of carbon into the atmosphere. However, climate denial is more than outright denial of facts. It exists on a spectrum, ranging from literal denial over interpretive denial (i.e., the re-interpretation or distortion of facts) to implicatory denial (i.e., the acknowledgement of facts and denial of their implications; Cohen, 2001; Norgaard, 2019). From a psychological perspective, it fulfills the function of protecting the self from threat and uncomfortable emotions (Cohen, 2001; Norgaard, 2006). This research aims at investigating the spectrum of climate denial and self-protection more closely, explores potential distinct profiles within it, and investigates relations with right-wing ideological conviction and gender but also need satisfaction and value orientation.

1.1 Climate Denial and Self-Protection on a Spectrum

Norgaard (2019) describes a political spectrum of climate denial, ranging from literal forms of outright denial of the facts on the right to implicatory denial on the left. While the manifested shape of the denial is different, the function it serves is similar across the spectrum: It is a reaction to (psychological) threat and ultimately entails of a reinforcement of social structures and solidification of power relations – a means to protect the self from threat (Norgaard, 2006). Similarly, Stoll-Kleemann and O'Riordan (2020) found that more implicatory forms of denial (here denial of responsibility) replaced more literal forms of denial in a large German

[1]https://www.eike-klima-energie.eu/, last accessed 05/07/2021

sample over time. *The Climate Self-Protection scale* (Wullenkord & Reese, 2020) measures different forms of climate denial and self-protection. This validation study suggested that people use strategies such as denial of the global and personal consequences of climate change (interpretive denial), rationalization of one's own involvement (similar to denial of responsibility), denial of guilt, and avoidance of the problem (implicatory denial). In line with predictions that denial leads to inactivity (Cohen, 2001), those strategies were negatively associated with environmental outcomes, such as environmental awareness, autonomous motivation to protect the environment, and self-reported pro-environmental behavior (see also Homburg et al., 2007; Ojala, 2012).

In the present study, I assessed climate denial and self-protection along the spectrum of denial using a German quota sample (see right side of Figure 1 for operationalization) and explored whether there were distinct profiles of climate denial and self-protection in the data. As pre-registered[2], I hypothesized that:

- *H1: Climate denial and self-protection are negatively associated with policy support and pro-environmental intentions.*

1.1.1 Right-Wing Ideological Conviction and Male Gender

Most studies investigating climate denial focus on denial in its literal and interpretive sense, without explicitly distinguishing between different forms of denial. Right-wing political conviction has been identified as a major predictor of literal climate denial (e.g., Feygina et al., 2010; Jylhä et al., 2016; McCright & Dunlap, 2011; Milfont et al., 2021). Most studies considered the following indicators: 1) Right-wing authoritarianism: The adherence to conservative norms and values, a preference for obedience to authorities, strict laws, and harsh punishments (RWA; Altemeyer, 1981; Stanley et al., 2017); 2) Social dominance orientation: The preference for group-based social hierarchies and support for dominance and devaluation of low-status groups (SDO; Jylhä et al., 2016; Pratto et al., 1994); 3) Human dominance over nature: The belief that humans are distant from and superior to nature and have the right to control it for

[2]All hypotheses were pre-registered at https://aspredicted.org/blind.php?x=js5pc4

their own benefit (ND, Jylhä & Akrami, 2015; Milfont et al., 2013); 4) System justification: The desire to rationalize, legitimize, and defend the status quo (Feygina et al., 2010; Jost & Banaji, 1994); and 5) Political left-right orientation (Norgaard, 2019). In the present study, I assess the combined and unique contributions of these indicators of right-wing ideological conviction to investigate their general relations with different forms of climate denial and self-protection along the spectrum of denial. Another consistent predictor of climate denial and self-protection is male gender (Hultman & Pulé, 2018; Jylhä et al., 2016; McCright & Dunlap, 2011; Nelson, 2020). Climate denial may be an expression of system-justifying ideologies that serve as a protection of male privilege (see Jylhä et al., 2016). I therefore hypothesized that:

- *H2: Right-wing ideological conviction is positively associated with climate denial and self-protection, especially literal and interpretive denial.*
- *H3: Male gender predicts climate denial and self-protection, especially literal and interpretive denial.*
- *H4: Right-wing ideological conviction mediates the association between gender and climate denial and self-protection.*

1.1.2 Basic Psychological Need Satisfaction and Relative Value Orientation

The literature on implicatory denial is less straightforward. Ideological conviction may also explain the use of implicatory denial but associations are likely weaker than for literal and interpretive denial (see Norgaard, 2019). This warrants considering a more fundamental indicator of defensiveness and human functioning, such as the satisfaction of basic psychological needs (henceforth *needs*) as proposed in self-determination theory (SDT, Ryan & Deci, 2017). SDT as a humanistic, dialectical theory of human motivation assumes that humans become defensive and self-protect if their needs for autonomy (agency), competence (efficacy), and relatedness (belongingness) are frustrated (Vansteenkiste & Ryan, 2013). It is theoretically feasible to apply it to human responses to the climate crisis (Wullenkord, 2020). Various studies show that need satisfaction is associated with pro-environmentalism (e.g., Cooke et

al., 2016; Kaplan & Madjar, 2015; Tröger et al., 2021), and there is first empirical evidence showing that absence of need satisfaction in fact predicts both interpretive and implicatory climate denial and self-protection (Wullenkord, under review).

One influence on need satisfaction is the endorsement of values. According to goal contents theory (Kasser & Ryan, 1996; Ryan & Deci, 2017), the pursuit of intrinsic values that "are expressive of desires congruent with actualizing and growth tendencies natural to humans" (e.g., community feeling, affiliation, self-acceptance, Kasser & Ryan, 1996, p. 280) satisfies needs. The pursuit of extrinsic values that "depend on the contingent reactions of others (and usually serve) as means to another end" (e.g., financial success, popularity, image, Kasser & Ryan, 1996, p. 280), however, frustrates needs. All humans strive for both intrinsic and extrinsic values but differ in the extent to which they endorse them. Given that industrial capitalism promotes a relatively extrinsic value orientation (Kasser & Ryan, 1996), people with a relatively extrinsic value orientation may try to defend the system and thus deny climate change. I hypothesized that:

- *H5: Need satisfaction is negatively associated with climate denial and self-protection.*
- *H6: Relative intrinsic value orientation is negatively associated with climate denial and self-protectio mediated by need satisfaction.*
- *H7: Relative extrinsic value orientation is positively associated with need frustration and right-wing ideological conviction.*

1.2 The Present Study and Analytical Approach

In previous studies investigating climate denial and self-protection and their relations with different indicators of environmentalism, some findings were contradictory (e.g., regarding denial of guilt, Wullenkord & Reese, 2020). Furthermore, effect sizes were small, indicating unobserved variance in the results. This unexplained heterogeneity may indicate that some self-protective strategies may in fact be healthier and more proactive strategies than others,

not hindering pro-environmentalism from occurring. One possible explanation for higher unobserved variance may be the existence of latent subgroups in the population, yielding different environmental relations depending on subgroup belongingness (i.e., different profiles of climate denial and self-protection may be more or less adaptive and may thus be associated with more or less pro-environmentalism). However, environmental psychology primarily employs variable-centered analytical approaches. These are limited because they cannot analyze the data for the existence of latent subgroups, often become disproportionately complex, and require disproportionately high power if all relevant interaction terms are included in traditional models, such as moderated regression analysis.

The present study thus combines variable- and person-centered approaches: Firstly, it aimed at exploring whether distinct profiles of climate denial and self-protection could be identified in a German quota sample (person-centered approach), using latent profile analysis (LPA, Collins & Lanza, 2010). Secondly, it aimed at investigating how different forms of climate denial and self-protection relate to need satisfaction, value orientation, ideological conviction, and gender. This is a variable centered approach. To my knowledge, this is the first study that combines person- and variable-centered analytic approaches to investigate climate denial and self-protection, its psychological predictors, and pro-environmental outcomes in a German quota sample.

2 Methods

2.1 Participants and Procedure

A German quota sample (N=1134, stratified for age and gender, analyzed sample size after data cleaning[3] N=1007) participated in an online study hosted on the platform SoSci-Survey (Leiner, 2020). Participants were recruited through the online-access panel provider Respondi AG. Age ranged from 18 to 69 (M=43.91, SD=13.97) and 51.14% of the participants were female. Educational level was slightly above average: 26.31% had university entrance quali-

[3]See details in supplementary materials S2 and S3.

fication and 29.48% had a university degree, and on average participants reported a monthly income between 1500 and 2500€. After giving their informed consent, participants answered questions about six types of climate denial and self-protection (avoidance, denial of guilt, rationalization of own involvement, denial of personal outcome severity, denial of global outcome severity, literal denial), ideological conviction (RWA, SDO, ND, system justification, political orientation), need satisfaction, value orientation, pro-environmental intentions, policy support, and socio-demographic variables (age, gender, education, income). Materials used are described in detail in supplementary material S1. Further variables and preparation of the raw data are detailed in Wullenkord et al. (2021), where we focused on analyzing climate anxiety and its correlates. The local ethics committee granted ethical approval for the study in line with the DGPS and Helsinki declarations (293_2020).

2.2 Statistical Analysis

I used R, version 4.0.3 (R Core Team, 2020) for all analyses: First, I performed an LPA to explore the data for discrete profiles of climate denial and self-protection. LPA is large sample method. Based on Monte-Carlo simulations, Tein et al. (2013) suggest that for an LPA with Cohen's d=.8 and 10 indicators of class membership, sample size should be at least 500 (see Nylund et al., 2007 for similar recommendations). I therefore aimed for recruiting at least N=1000 participants to perform analyses with sufficient power. This data set was large enough to randomly split it in half and to replicate and thus validate the solution in the second half of the data. Second, I used structural equation modelling to investigate variable-centered hypotheses. Please refer to supplementary materials S2 and S3 for detailed results of the whole data analysis both with (S2) and without exclusion of outliers (S3).

3 Results

See Table 1 for descriptive statistics and correlations of study variables. Most people reported medium-low levels of climate denial and self-protection, slightly higher levels of right-

wing ideology, stronger need satisfaction than frustration, relatively intrinsic value orientation, medium pro-environmental intentions, and high policy support. Correlation analyses revealed that need satisfaction was weakly negatively related to most types of climate denial and self-protection (there was only a trend for denial of global outcome severity and a positive relation with denial of guilt). There were weak to medium associations between relative extrinsic value orientation and all types of climate denial and self-protection (except for denial of guilt, which was unrelated) and ideology (except for system justification, which was unrelated). All indicators of right-wing ideology (except for system justification, which was unrelated or negatively related) were medium positively related to all types of climate denial and self-protection. Male gender was weak to medium positively related to all types of climate denial and self-protection (except for avoidance, which was unrelated). Finally, all types of climate denial and self-protection were medium negatively related to pro-environmental intentions and policy support.

3.1 Profiles of Climate Denial and Self-Protection

I used the R-packages mclust (Scrucca et al., 2016) and tidyLPA (Rosenberg et al., 2018) to perform an LPA that analyzed whether there were discrete profiles of climate denial and self-protection in the sample. LPA is a probability-based mixture modelling approach aiming at identifying latent profiles within large, heterogeneous populations on the basis of observed continuous indicator variables (Collins & Lanza, 2010). The identified profiles have different configurations, which are either qualitatively different (i.e., difference in shape) or quantitatively different (i.e., difference in levels), and properties in relation to both antecedents and outcome variables.

The six types of climate denial and self-protection served as indicators. There were no missing data and multivariate outliers were removed based on Mahalanobis distance with a cutoff of $p<.001$ when cleaning the data (see supplementary material S2), as multivariate outliers can distort the results of LPA when extreme cases inform profiles. Finally, I randomly split the data set in half, with the first half of the data set comprised n_1=515 cases and the second half comprising n_2=496 cases.

Table 1

Spearman Correlations and Descriptive Statistics of Study Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	*M*	*SD*
1) Avoidance	.89												3.04	1.18
2) Denial of guilt	.10**	.83											3.92	1.39
3) Rationlization of own involvement	.44**	.57**	.92										3.18	1.46
4) Denial of personal outcome severity	.45**	.46**	.61**	.87									2.35	1.21
5) Denial of global outcome severity	.42**	.57**	.65**	.71**	.91								2.58	1.59
6) Literal denial	.37**	.53**	.61**	.63**	.83**	.94							2.45	1.55
7) Basic psychological need satisfaction	-.19**	.10**	-.08*	-.07*	-.06†	-.06*	.87						5.06	0.87
8) Relative extrinsic value orientation	.21**	.02	.19**	.19**	.15**	.12**	-.24**	.89					-1.26	0.95
9) Right-wing authoritarianism	.27**	.33**	.32**	.29**	.38**	.38**	.04	.19**	.86				3.90	1.32
10) Social dominance orientation	.21**	.20**	.30**	.34**	.34**	.32**	-.05	.22**	.35**	.75			2.45	1.00
11) Human dominance over nature	.25**	.22**	.33**	.37**	.37**	.34**	-.03	.17**	.27**	.32**	.88		2.64	1.24
12) System justification	.00	-.15**	-.13**	.02	-.10**	-.12**	.17**	-.04	-.06	.15**	.12*	.82	3.98	1.16
13) Gender (1=female)	.00	-.14**	-.22**	-.11**	-.12**	-.09**	-.04	-.09*	-.08*	-.07*	-.15**	.04		

Note. $^{\dagger}p<.10$, $^{*}p<.05$, $^{**}p<.01$

I estimated solutions comprising one to nine different profiles (see supplementary materials for model estimations and visualizations). A solution with nine profiles had best fit indices (Tein et al., 2013), Bayesian information criterion (BIC)=6999.41, Sample size-adjusted BIC=6783.57, Akaike information criterion (AIC)=6710.94. Bootstrapped sequential likelihood ratio test (McLachlan & Peel, 2000) for the number of mixture components indicated a six profile solution to perform significantly better than a seven profile solution, BLRT=52.03, $p<.001$. Inspection of the elbow point (Nylund-Gibson & Choi, 2018) suggested a solution with four profiles to be most feasible. These results were replicated using the second half of the data. Nevertheless, none of the configurations revealed discrete profiles but rather separated participants based on levels of responses to the indicator variables: Profile 1 was low on all types of climate denial and self-protection, higher profiles were higher on all types of climate denial and protection, and there was significant overlap between profiles. This information can also be deduced from correlation analyses: All types of climate denial and self-protection had relatively high inter-correlations, rendering a variable-centered analytical approach was deemed more appropriate for further analyses.

3.2 Structural Equation Model Predicting Climate Denial and Self-Protection

I employed the R-package lavaan, version 0.6-3 (Rosseel, 2012) to estimate a structural equation model predicting climate denial and self-protection.

3.2.1 Hypothesized Model and Assumptions

Given multivariate non-normal distribution of variables, $E(14)=1540.76$, $p<.001$, I used robust maximum likelihood estimation with Satorra-Bentler correction (Finney & DiStefano, 2013) for model estimation. As pre-registered, I hypothesized paths from need satisfaction, value orientation, right-wing ideology, and gender to all types of climate denial and self-protection. Furthermore, I estimated paths from gender to ideology, from ideology to value orientation, and from value orientation to need satisfaction. See Figure 1 for a visualization of

the model with significant path coefficients and see supplementary materials for standardized residuals and empirical and model-implicated variance-covariance-matrices. I defined a latent variable for ideology using mean scores of RWA, SDO, ND, and system justification[4] as indicator variables and a latent variable for need satisfaction using mean scores of relatedness, autonomy, and competence satisfaction as indicator variables. The analysis was well-powered, with N=1007 and 62 free parameters, N/q=16.51. The model was identified.

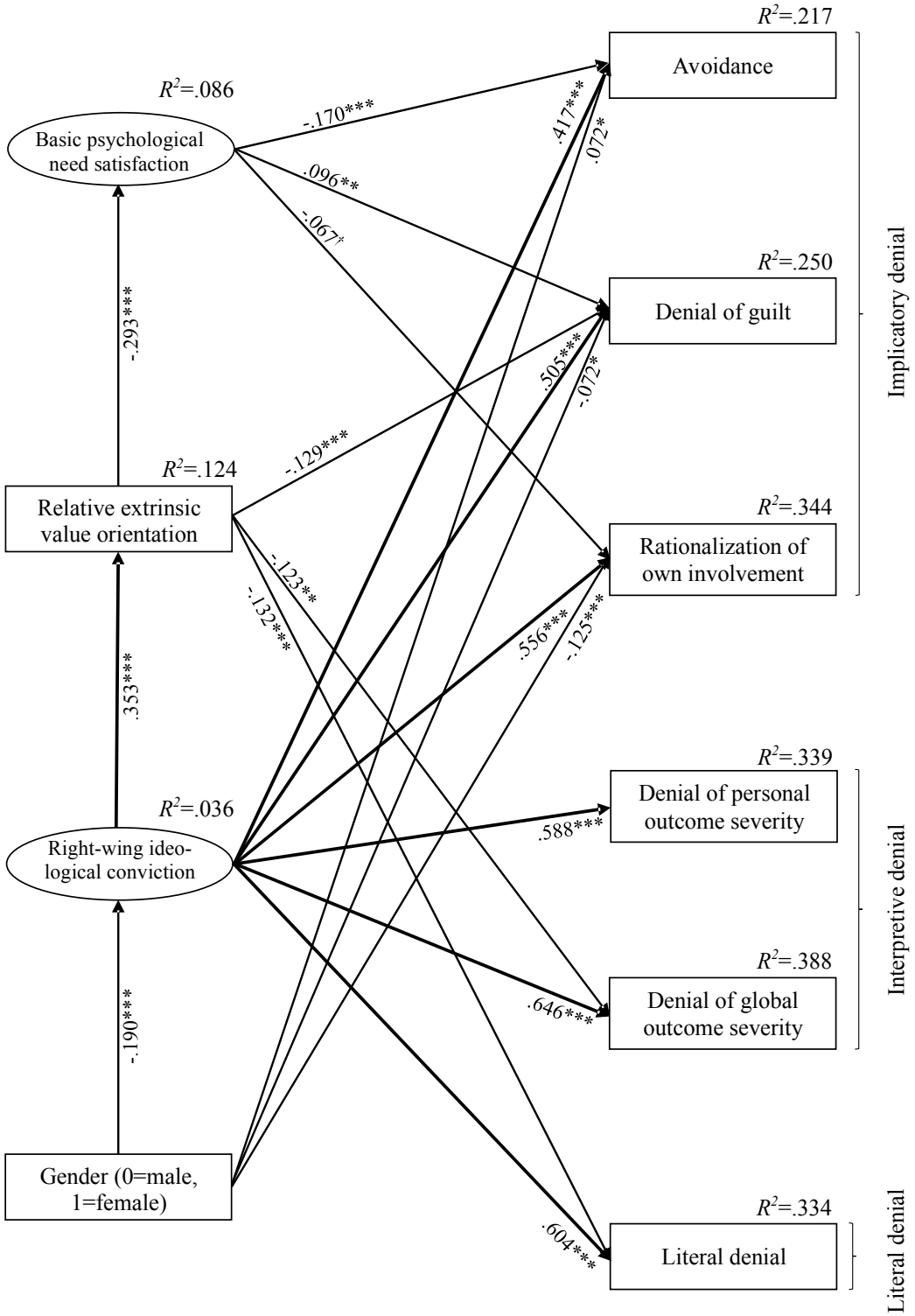
3.2.2 Model Estimation

Fit indicators indicated good fit of the hypothesized model to the data (Hu & Bentler, 1999): Satorra-Bentler $\chi^2(56, N=1007)=267.09$, $p<.001$, Robust Comparative Fit Index (CFI)=.957, AIC=40162.46, Robust Root Mean Square Error of Approximation (RMSEA)=.066, 90%CI[.058, .074], Standardized Root Mean Square Residual (SRMSR)=.051. Because the latent ideology variable explained no variance in system justification (R^2=.001), I estimated another model without system justification. The adapted model fit the data well: Satorra-Bentler $\chi^2(43, N=1007)=123.66$, $p<.001$, Robust CFI=.983, AIC= 37000.43, Robust RMSEA=.046, 90%CI[.037, .056], SRMSR=.035. It had better fit than the hypothesized model, $\chi^2_{\text{diff}}(13, N=1007)=140.40$, $p<.001$. Need satisfaction negatively predicted avoidance, and rationalization of own involvement, and positively predicted denial of guilt; surprisingly relative intrinsic value orientation predicted denial of guilt, denial of global outcome severity, and literal denial; right-wing ideology predicted all types of climate denial and self-protection; male gender predicted denial of guilt and rationalization, and female gender predicted avoidance. Male gender predicted right-wing ideological conviction, right-wing ideological conviction predicted relative extrinsic value orientation, and relative intrinsic value orientation predicted need satisfaction.

[4]Given that some items assessing ideological beliefs had strong overlap between constructs, I performed an exploratory main axis analysis over all items assessing ideology (i.e., items comprising the RWA, SDO, ND, and system justification measures, and political orientation). Horn's parallel analysis yielded four clearly interpretable factors after exclusion of cross-loading items and items with factor loadings <.3 (see supplementary materials S2 and S3).

Figure 1

Structural Equation Model Predicting Climate Denial and Self-Protection from Basic Psychological Need Satisfaction, Value Orientation, Ideological Conviction, and Gender



Note. Displayed are standardized parameter estimates for significant paths. Thicker paths represent stronger relations. †$p<.10$, *$p<.05$, **$p<.01$, ***$p<.001$

4 Discussion

This the first study that considers a spectrum of climate denial and self-protection and relates it to a range of predictors, namely ideological conviction, need satisfaction, value orientation, and gender. Participants differed in the extent to which they endorsed all types of climate-denial and self-protection but there were no distinct profiles of climate denial and self-protection in the data. People who reported right-wing ideological conviction also reported more climate denial and self-protection along the spectrum of denial but especially literal and interpretive denial. Need satisfaction and gender were significant additional but weaker predictors of implicatory denial: People whose needs were less satisfied reported more avoidance and rationalization of their own involvement but less denial of guilt. Men reported more denial of guilt and rationalization of their own involvement, while women reported more avoidance.

These findings are only partly in line with the idea of a political spectrum of denial (Norgaard, 2019). Here, right-wing ideological conviction predicted all types of climate denial and self-protection, even if it was a stronger predictor for literal and interpretive denial. Nevertheless, most research on climate denial has been conducted in the US and even though part of the Global North, may not generalize to Germany (Hornsey et al., 2018). Furthermore, right-wing ideological conviction as operationalized in this study may differ from identifying as right-wing on a simple left-right spectrum.

Notably, system justification was uncorrelated with RWA and only weakly related to SDO and ND. Even across the Global North, there are vast differences in how just systems are and how normalized it is to hold certain (political) views. In Germany, living standards tend to be relatively high for all people. System justification as assessed in this study may not be an ideological position reflecting meritocratic beliefs and a right-wing ideology serving to maintain one's own privilege. Instead, it may be a more or less rational estimation of the system as providing a social safety net for most and averting major social injustices. Findings that system justification is a weaker predictor of climate denial in the Swedish context (Jylhä & Akrami, 2015) and that it was uncorrelated with RWA (in contrast to findings in the US context, Feygina et al., 2010) may mirror this interpretation. In line, the items used in this

study may not have captured the underlying ideology justifying the power structures industrial capitalism produces and maintains (in contrast to items measuring SDO), along with all the associated consequences for (climate) justice.

4.1 Limitations and Future Directions

The present study employed a large quota sample and is the first to investigate a spectrum of climate denial and self-protection, thereby extending both previous research that has relied on non-representative populations or did not differentiate different forms of climate denial and self-protection. Nevertheless, this study was cross-sectional and thus only gives a glimpse into the functionality and underlying mechanisms of climate denial and self-protection. Longitudinal and experimental designs are warranted to further understand the "why" and "how" of climate denial and self-protection. A possible approach could be to implement need-based interventions targeting the different profiles of denial. These could aim at disentangling further what needs are met with right-wing ideological convictions and consequent climate denial and self-protection, reducing climate denial and self-protection, and increasing pro-environmental action. For instance, need-based communication is less threatening because needs are being satisfied, providing people with psychological resources to face information that is difficult in itself.

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Awards & scholarships

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11/2015 – present	Initiative Psychologie im Umweltschutz e.V. (Initiative Psychology in Environmental Protection) 11/2015 – 05/2016: Conference organization 06/2017 – today: working group teaching: Creation of the online lecture "Psychology of Socio-Ecological Change" & associated handbook
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Other	Experience in facilitation

Publications

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Wullenkord, M. C. (2019). Denial, rationalization, and suppression – How our basic psychological needs may influence why we do not act in the face of climate change. *BfN-Skripten*, 529, 43-52. https://www.bfn.de/fileadmin/BfN/service/Dokumente/skripten/Skript529.pdf

Preprints & manuscripts under review

Wullenkord, M. C. (under review). Basic psychological needs and autonomous motivation: A humanistic perspective on environmental behaviour change. In B. Gatersleben & N. Murtagh (Eds.), *Handbook on Pro-Environmental Behaviour Change.* Edward Elgar Publishing.

Wullenkord, M. C. (under review). Looking the other way: Basic psychological need satisfaction negatively predicts defensive self-protection in the face of the climate crisis. *Journal of Environmental Psychology*.

Wullenkord, M. C. (2021). From denial of facts to rationalization and avoidance: Ideology, needs, and gender predict the spectrum of climate denial and self-protection. In *PsyArXiv*. https://doi.org/10.31234/osf.io/w49t8

Invited talks

Wullenkord, M. C. (2021, planned for December). *The Individual in the Great Transformation toward Socio-Ecological Sustainability - Integrating Psychology and Socio-Ecological Transition Research*. Invited talk at CESSS – Center for Environmental and Sustainability Social Science Research, University of Örebro, Sweden.

Wullenkord, M. C. (2021, planned for November). *Von Klimawandelleugnung, Umweltmotivation und psychologischen Bedürfnissen - Einblicke in die Umweltpsychologie [On climate change denial, environmental motivation and psychological needs - insights into environmental psychology].* Invited talk in the lecture series „Adventure Psychology", University of Würzburg, Germany.

Wullenkord, M. C. (2021, August & September). *Die Wissens-Verhaltens-Lücke (überwinden) – von Leugnung, Motivation und psychologischen Bedürfnissen [(Overcoming) The knowledge-behavior gap - on denial, motivation and psychological needs.]*. Two invited talks in the seminar „Sustainable land and protected areas management", University of Greifswald, Germany.

Wullenkord, M. C. (2021, August). *Einführung in die Umweltpsychologie – Impulsvortrag [Introduction to Environmental Psychology - Impulse Lecture]*. Invited talk, Rotaract Essen, Germany.

Wullenkord, M. C. (2021, July). *Wie wir im Angesicht der Klimakrise unser Selbst schützen: ein Bedürfnis-orientierter Erklärungsansatz psychologischer Handlungsbarrieren für Umweltverhalten [How we protect our selves in the face of the climate crisis: A need-based explanatory approach to psychological action barriers to environmental behavior].* Invited talk in the series „Krise lehrt Denken: Klimawandel und Coronapandemie im interdisziplinären Gespräch", [Crisis teaches thinking: climate change and corona pandemic in interdisciplinary conversation]. International Psychoanalytic University Berlin, Germany.

Wullenkord, M. C. (2020, July). *Steck den Kopf nicht in den Sand! Was psychologische Grundbedürfnisse mit Klimawandelleugnung zu tun haben*. *[Don't bury your head in the sand! What basic psychological needs have to do with climate change denial.]* Invited talk in the seminar „Environmental psychology", University Bayreuth, Germany.

Wullenkord, M. C., Tröger, J., & Reese, G. (2019, September). *Ohne Bedürfnisbefriedigung keine Suffizienz? Psychologische Grundbedürfnisse und Strukturen für ein suffizienzorientiertes Leben [No sufficiency without satisfaction of needs? Basic psychological needs and structures for a sufficiency-oriented life.]*. Invited keynote Division Symposium of the DGPs Environmental Psychology Division, "Beyond individuals - beyond consumerism: Psychologische Beiträge zur Entwicklung nachhaltiger Lebensstile und Wohlfahrtsmodelle [Psychological contributions to the development of sustainable lifestyles and welfare models]", Bonn, Germany.

Conference contributions

Wullenkord, M. C. (2021, October). *Between climate anxiety and denial: Basic psychological needs and political ideology predict psychological responses to the climate crisis*. Talk at the International Conference on Environmental Psychology (ICEP), Siracusa, Italy.

Wullenkord, M. C. (2021, May). *Between climate anxiety and denial.* Talk at the THINKClima Virtual Conference on "Lobbying for (in)action: Climate emergence, interest groups and denial", Universitat Pompeu Fabra, Barcelona, Spain.

Wullenkord, M. C., Tröger, J., & Reese, G. (2019, September). *Basic psychological needs in the context of climate change: Does social exclusion trigger climate change denial and serve as a barrier for sufficiency orientation?* Talk at the International Conference on Environmental Psychology (ICEP), Plymouth, England.

Wullenkord, M. C. & Reese, G. (2019, May). *Relations of basic psychological needs with defensive, self-protective strategies in the face of climate change.* Poster presentation at the 7th International Self-Determination Theory Conference, Egmond aan Zee, Netherlands.

Wullenkord, M. C. & Reese, G. (2018, August). *Basic psychological needs and self-protection in the face of climate change – First results*. Poster presentation at the 6th International Degrowth Conference, August 2018, Malmö, Sweden.

Wullenkord, M. C. & Reese, G. (2018, July). *Reviewing basic psychological needs and self-protection in the face of climate change – First results*. Poster presentation at the 25th International Association People-Environment Studies (IAPS) Conference, Rome, Italy.

Wullenkord, M. C. & Reese, G. (2018, June). *Reviewing basic psychological needs and their relations to pro-environmental behavior: The role of self-protective strategies*. Talk at the Environmental Psychology Summer School, Vilm, Germany.

Wullenkord, M. C. & Psouni, E. (2017, September). *Fathers' parenting expectations and experiences: Longitudinal links to postnatal depressive symptomatology.* Poster presentation at the Nordic Attachment Network Conference and Meeting, September 2017, Copenhagen, Denmark.

Wullenkord, M. C. & Psouni, E. (2017, June). *The role of fathers' parenting expectations and experiences in the longitudinal link between attachment avoidance and postnatal depressive symptomatology*. Poster presentation at the International Attachment Conference (IAC), London, UK.

Wullenkord, M. C. & Psouni, E. (2016, August). *Fathers' parenting expectations and experiences and their longitudinal links to postnatal depressive symptomatology*. Poster presentation at the seminar on research about the role of fathers for children's socio-emotional development, University of Copenhagen, Denmark.

12 Eidesstattliche Erklärung (Declaration of Originality)

Hiermit erkläre ich eidesstattlich, dass ich, Marlis Charlotte Wullenkord,

- die Dissertation selbst angefertigt habe und alle Hilfsmittel in der Dissertation angegeben habe,
- die Dissertation noch nicht als Prüfungsarbeit für eine staatliche oder andere wissenschaftliche Prüfung eingereicht wurde und
- die gleiche oder eine andere Abhandlung nicht bei einer anderen Hochschule als Dissertation eingereicht habe.

Bei gemeinsam verfassten Publikationen habe ich folgende individuelle Beiträge erbracht:

Manuskript 2

- Konzeptualisierung, Methode, Datenanalyse und -management, Untersuchung, Verfassen des Manuskripts, Visualisierung, Projektverwaltung

Manuskript 4

- Konzeptualisierung (75%), Methode (75%), Datenanalyse und -management, Untersuchung, Verfassen des Manuskripts (75%), Visualisierung, Projektverwaltung

Greifswald, den 25. Oktober 2021