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The effects of fear on sustainability-related behaviour of individuals in Germany

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List of Abbreviations

CAT	Conceptual Act Theory
CCAS	Climate Change Anxiety Scale
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
df	Degrees of Freedom
DIW	Deutsches Institut für Wirtschaftsforschung (German Institute for Economic Research)
DSM-V	Diagnostic and Statistical Manual of Mental Disorders
EFA	Exploratory Factor Analysis
FIML	Full Information Maximum Likelihood
GSEM	Generalised Structural Equation Modelling
HEAS	Hogg Eco-Anxiety Scale
ICD-10/12	International Statistical Classification of Diseases and Related Health Problems
IPCC	Intergovernmental Panel on Climate Change
MLR	Maximum Likelihood Estimation with Robust Standard Errors
PMM	Predictive Mean Matching
PTSD	Post-traumatic stress disorder
RMRS	Root Mean Square of Residuals
RMSEA	Root Mean Square Error of Approximation
SE	Standard Errors
SOEP	Socio-Economic Panel
SRMR	Standardised Root Mean Square Residual
TLI	Tucker-Lewis Index
WLSMV	Weighted Least Squares Mean and Variance adjusted

Abstract

The world is facing a variety of sustainability crises, not only encompassing anthropogenic climate change and damage to multiple other natural systems but also several interacting social and economic problems. Thus, a change in human behaviour and mindset is mandatory. As fear significantly influences how we act, this exploratory study aimed to analyse its association with sustainability-related behaviour. First, a systematic literature review was conducted to assess the state of research in this regard. Then, a quantitative analysis of self-reported data between 1998 and 2021 from the Socio-Economic Panel, a longitudinal survey representative of the German population, was performed. Exploratory and Confirmatory Factor Analyses were used to validate a latent construct for fear. Subsequently, Generalised Structural Equation Modelling was used to reveal the association between the latent construct and four different sustainability-related behaviours. The results revealed that the state of research is in its beginnings. In most cases, different definitions of a specific form of anxiety, eco-anxiety, have been used to demonstrate a positive influence on pro-environmental behaviour. In this study, it was found that general fear was weakly associated with less sustainability-related behaviours, except for being environmentally conscious. Further research is needed to unify different conceptualisations of fear and validate a measurement of its general forms. Also, positive psychology was identified as a concept that is central to counteract the negative impacts of fear and to enable a holistic shift towards strong sustainability. Consequently, additional resources are needed to strengthen individuals' abilities to cope with fear and engage in sustainability-related behaviours.

Keywords: Fear, sustainability-related behaviour, eco-anxiety, SOEP, positive psychology

1 Introduction

The world is facing a multitude of crises, encompassing climate change caused by the steadily increasing release of anthropogenic greenhouse gas emissions, alongside overcoming the natural limits of various other systems, such as biosphere integrity, biogeochemical flows, environmental pollution, and more (Richardson et al., 2023). The roots lie in the economic and societal systems of the modern world, which in turn are influenced by the way we think and act. Thus, understanding the human psyche and how it led us to the status quo must be considered a cornerstone of sustainability science and discourse, including understanding the interplay of cognition and emotion (e.g., Bonnes & Secchiaroli, 1995; Marcus et al., 2000).

As knowledge about the harmful anthropogenic impact on the planet is not a novelty, the resulting discourse about a necessary system transformation already has a history of its own. Often, phases of increased public interest follow influential events or publications, be these scientific, such as the IPCC reports (e.g., Lee et al., 2023), or other literary works, such as *Silent Spring* by Carson (1962). In Germany, prominent examples of events fostering a public discourse were forest diebacks and acidic rain in the 1980's, the 1986 Chernobyl catastrophe (Homburg & Matthies, 1998), and more recently, the 2011 nuclear accident in Fukushima (BASE, 2024), or the 2021 flooding in Ahrtal, Germany (Kale, 2024). The Fridays for Future climate protest movement additionally contributed to increased attention among a large proportion of the population (Fabel et al., 2022). Nowadays, 80% of the global population are calling for stronger measures from their governments to combat the climate crisis (Flynn et al., 2024).

Consequently, various frameworks have already been developed, goals have been set by international and national institutions and governments, and new ways of shaping the economy have been thought out. Still, the trajectory of change is nowhere where it ought to be when these goals should be met. For example, the progression towards the SDGs has even halted (Sachs et al., 2022), and the planetary boundaries are still under increasing pressure (Richardson et al., 2023). Pandemics, geo-political conflicts, market disruptions, and natural catastrophes are examples of additional stressors that interfere

with the goals of a sustainable transformation, and these events often exacerbate the problems that already exist.

Thus, the need to inspire a fundamental change in mindset to achieve the goals of a sustainable society is increasingly emphasised. For example, the Inner Development Goals initiative brought forward a framework of the same name to research and communicate skills for sustainable development that address issues of inner mental capacities (Jordan et al., 2021). However, its focus on a person's individually controllable inner skills lacks the perspective of psychological mechanisms that are at least in part beyond our control. Hence, it is crucial to understand the more subtle mechanisms that influence how we think and behave. Fear, at an individual level, but also collective fear, plays an important role in influencing individual behaviour (Chanel & Chichilnisky, 2009; Kligyte et al., 2013; Wagner & Morisi, 2019), which in turn has consequences on the way the society develops. There is no question that human behaviour must change in order to achieve sustainability goals (Fischer et al., 2012).

This need is further accentuated by the fact that people experience increasing levels of fear in relation not only to climate change (Hunecke, 2022), but towards the entire state of the world. Two-thirds of 10,000 young people from multiple countries reported feeling afraid due to climate change, with even higher levels being frightened of the general future. 56% even thought that humanity is doomed (Hickman et al., 2021). Similar findings have been reported, also regarding the general population, in several studies in German (Albert et al., 2019) and international contexts (Baker et al., 2021; Leiserowitz et al., 2020; Ojala, 2012; Steentjes et al., 2017). The list of fears among young people in Germany is now led by fears of war in Europe, fear of poverty, fear of environmental degradation, and the fear of increased hostility between humans (Albert et al., 2024). The degradation of global mental well-being is further fuelled by megatrends, such as an insecure digital world, social exclusion, and inequality between generations. Additionally, many of those stressors are increasingly internalised rather than processed externally (McGorry et al., 2024).

Instrumentalising fear has been a political tool for millennia to manipulate the masses (Taras, 2015). In light of the climate crisis, some activist groups argue that experiencing fear has a motivating effect (Letzte Generation, 2024; Raile, 2021). However, playing into people's fears has long been a method of right-wing populists, representing a challenge not least for the sustainability agenda (Lockwood, 2018). Also, there are indications that a targeted spread of fear through disinformation as a destabilisation measure against democracy is being used by certain regimes (Blum et al., 2024).

Therefore, it is essential to determine how fear interacts with the sustainability agenda and how acknowledging its existence can be integrated into the development of narratives, frameworks, and strategies for a sustainable future.

1.1 Theoretical background

1.1.1 Sustainability-related behaviour

Sustainability has become a widespread notion with many different interpretations. Thus, the following section provides an understanding of sustainability-related behaviour used throughout this study.

Therefore, the notion of strong sustainability was operationalised as the desired principle for a sustainable transformation (Holland, 2008; Neumayer, 2013; Nussbaum, 2006; Ott, 2003, 2014). While weak sustainability describes the three dimensions, the social, the economic, and the ecological element, as three separate pillars, they are conceptualised as nested spheres in strong sustainability. Thus, instead of an assumed substitutability, a clear hierarchy is described in which the economic system is nested in the social sphere, and both are nested in the biosphere. The integrity of the biosphere, or the ecological sphere, is considered a prerequisite for a functional human social and economic systems. Consequently, natural capital cannot be substituted with human or material capital. Therefore, natural resources may only be utilised to the extent that they can be regenerated, and finite resources should not be used (Neumayer, 2013; Ott, 2003). Furthermore, the integrity of natural systems should not be harmed (Richardson et al., 2023; Rockström et al., 2009).

However, the sole pursuit of renunciation and efficiency strategies proclaimed by some advocates of strong sustainability (see Steurer, 2001) must be considered with care. On the one hand, efficiency is only purposeful if a system's basic principle is designed for a positive benefit or a symbiotic relationship with the natural system. Otherwise, the result is merely a slower process of damage to the environment, which can still ultimately lead to the collapse of the biosphere. Such a system would not be truly sustainable in the literal sense. On the other hand, psychological aspects play a role that affect the self-understanding of humankind. First, only if humans come to a collective understanding of being part of a vulnerable natural system that we depend on can we break free from those destructive systems that humans have created. Integrating that into value systems, norms, and ultimately, behaviour is therefore necessary. Second, if humans follow a sustainable paradigm in the future, a logic that regards us as pests for the planet will likely be detrimental to mental health. Such a situation cannot last for long and would probably only lead to reverting to the original behaviour, making that logic not genuinely sustainable. Thus, the aspect of positive psychology (Corral Verdugo, 2012) needs to be integrated into a holistic concept of strong sustainability. Overall, this study was aimed to contribute to an understanding of those issues that lie at a deep level of leverage points (Abson et al., 2017; Meadows, 1999).

Generally, one strength of strong sustainability lies in the inclusion of the different dimensions of ecological, social, and economic sustainability. Therefore, the definition of sustainability-related behaviour used in this study differs from the commonly found notion of pro-environmental behaviour (e.g., Ágoston, Urbán, et al., 2022; Chan et al., 2024; Hogg et al., 2024; Ogunbode et al., 2022). Whereas the latter was often defined as behaviour minimising negative and occasionally promoting positive impacts on the environment (Leite et al., 2023), sustainability-related behaviour here refers to any behaviour that promotes ecological, social, or economic sustainability in the sense of strong sustainability, while it does not have to be the primary intention of the person acting to pursue sustainability. The formulation of sustainable behaviour was deliberately avoided for the following reasons: a) speaking of sustainability-related behaviour allows for the inclusion of actions that vary regarding their degree of impact,

better capturing the diversity of potential links to sustainability; b) sustainable behaviour implies a universal standard, falling short of acknowledging that sustainability is complex and context-dependent; and c) sustainability-related behaviour better reflects the dynamic nature of the shift towards a sustainable society, integrating the need to regularly adapt any behaviour, rather than assuming that sustainability is an end-state.

Furthermore, as sustainability-related behaviour encompasses a wide range of possible behaviours, analysing it in an aggregated form comes with a disadvantage (Gatersleben, 2013; Homburg & Matthies, 1998). For example, the antecedents and moderating variables, such as age (Ágoston, Balázs, et al., 2024), can differ significantly depending on whether voting behaviour, recycling behaviour, or participation in environmental protests is observed. One form of disaggregation, which nevertheless enables a method of grouping, consists of the separation into private sphere (e.g. recycling), public sphere (e.g. voting), and radical sphere (e.g. civil disobedience) behaviours (cf. Pittaway et al., 2024). However, in this study, all sustainability-related behaviours were analysed separately.

1.1.2 Conceptualisation of fear

Before coming to an understanding of fear that can be operationalised for this study, it is essential to be aware of the disciplinary context that has shaped the contemporary theories and methods of its investigation. Psychology, as the science of human consciousness and behaviour, has produced a sub-discipline, environmental psychology, "that deals with interactions between humans and their physical and socio-cultural environments" (Hellbrück & Kals, 2012, p. 13). The discipline had many different contributors but has its roots mainly because of architectural interests paired with psychological methods (Bonnes & Secchiaroli, 1995; Mehrabian & Russell, 1974; Steg et al., 2013b). Since it has matured from its beginnings, there is now also an understanding of environmental psychology as a field that deals with the relationship between human behaviour and an endangered environment (Amedeo et al., 2009; Homburg & Matthies, 1998). As such, it is intertwined with the research goal of the study.

However, the science of emotions and fear also has a considerable history, which dates back to ancient Greece (Taras, 2015) and was shaped mainly by philosophical and psychological discourse (Adolphs, 2013; Barrett, 2012). Only more recently, with the advancement of evolutionary theory and later neuroimaging technology, has the discipline of biology contributed to the understanding of emotions (Adolphs, 2013). Consequently, due to the interdisciplinarity and a lack of consensus on operationalisations and methods, the field of research on emotions is still fragmented (Adolphs, 2013; Wagner & Morisi, 2019). Still, the number of studies is increasing, partly due to the heightened interest in anxiety disorders (Adolphs, 2013).

Thus, it is necessary to create transparency about the theoretical foundation of the conceptualisation of fear to enable a meaningful scientific discussion. Accordingly, this study draws on several concepts. First, the Conceptual Act Theory (CAT) was employed as it combines physiological and psychological aspects of emotions, specifically fear. It can be seen as an extension of classical appraisal theory, which claims that emotions are caused and shaped by an individual's appraisal of the personal significance of a situation based on different criteria (Scherer, 1999). According to CAT, experiencing and communicating fear and other emotions is part of a cognitive synthesis. The initiation of the process is caused by a core affective state, potentially only distinguishable by means of arousal and valence. It is then compared to interoceptive and somatic knowledge, memories and culturally acquired information such as language. Thus, the experience of an emotion is formed by conceptualising a context-dependent affective state, categorising it based on experience and socially constructed knowledge of information (Barrett, 2006, 2012; Barrett et al., 2007). Perception as "the process by which sensory impressions of stimuli in the environment are translated into mental representations" (Veitch & Arkkelin, 1995, p. 76) plays a key role here, shaping how environmental information is processed and formed into the basis for interactions with it. The result of the process described by CAT is a flexible system that is able to account for fine variations of individual emotional experience, different cultural influences, and the overall diversity of human emotions (Barrett, 2012). The framework has close parallels to the theory of Affective Intelligence which describes the interaction between intelligence and emotion

and the consequences for living in a society. Here, affect and reason are seen, contrary to a widespread belief, as complementary and not as counteracting components. The concept views them as existing in an intricate, interactive balance, signalled by two overlapping mechanisms (Marcus et al., 2000). Although the theory is yet to be empirically validated, recent discoveries from neurosciences show that emotions are the result of two physiological subsystems in the brain that are linked but work independently to a certain degree. Concludingly, it is assumed that emotional evaluations often occur before conscious awareness and that a lot of emotional processing happens at a subconscious level. Thus, emotions that reach the conscious level could then be related to the concept of feelings, expressed through subjective labels of "worry", "joy", "anger", "fear", and so on (Marcus et al., 2000).

Through this conceptualisation, the connection to a biophysical understanding of fear becomes possible. In this context, fear can be understood as "an intervening variable between sets of context-dependent stimuli and suites of behavioral response" to avoid or cope with a threat (Adolphs, 2013, 79). This understanding corresponds to functional categories rather than referring to the conscious feeling of being afraid. The legitimacy of this view of fear as a functional central state is provided by findings that indicate similar neurobiological processes across different species. Here, it can be fruitful to consider fear from the perspective of its evolutionary functionality. It is seen to be usually always present, in more or less pronounced forms, and also in the animal kingdom (Blanchard et al., 2001; Morschitzky, 2009). A total absence can potentially be fatally dangerous, e.g., by neglecting the dangers of a strong current or an approaching car. Strong fearful reactions to things like thunder, darkness, fire, snakes, etc., are signs of the remnants of the evolutionary biological processes behind fear (Morschitzky, 2009). However, Adolphs (2013) emphasised that fear is embedded in a network of multiple cognitive processes, indicating the complexity of specifying stimuli eliciting fear, as well as behavioural, autonomic, endocrine, and cognitive responses. This neuro-scientific perspective can help to rule out theoretical models or narrow them down based on whether they have a plausible explanation related to the biochemical processes in the human brain (Konova & Glimcher, 2018).

From a general view, fear can be seen as one of the primary emotions and a normal condition of human life. Thus, for this study, fear was defined as a future-directed immediate and intense reaction to threatening, uncertain, or uncontrollable events, situations, or imaginations to mobilise resources to overcome that threat (Morschitzky, 2009, p. 1). As long as the reaction is appropriate, fear is a necessary but uncomfortable part of life with evolutionary benefits. Some understand anxiety as a separate response, encompassing worry and apprehension while facing scenarios that encompass diffuse threats in the future (Stewart, 2021), and others use the terms interchangeably (Wagner & Morisi, 2019) or understand anxiety or panic as subcategories of fear (Adolphs, 2013). According to Morschitzky (2009), fear without physical symptoms is more likely to be an intellectual form of worrying. Arguably, differentiating between fear, anxiety, worry, or panic is reasonable due to the more nuanced possibilities of describing various emotional responses. However, due to their close relationship and the discussed subjectiveness of experienced emotions, the concepts related to fear were integrated into this study, albeit not included in the definition of fear.

Researchers commonly agree that it is difficult, if not impossible, to objectively measure the experience of emotion other than in terms of pleasure, arousal, and domination (Barrett, 2006; Barrett et al., 2007; Mehrabian & Russell, 1974). Thus, verbal reports might be the only means of assessing people's experience of emotion when it comes to a discrete labelling of them. An additional challenge is posed by the possibility that people with different degrees of emotional granularity experience fear, anger, etc., at varying levels of qualitatively distinct states (Barrett, 2006; Barrett et al., 2007). Furthermore, it is nearly impossible to prove causality between fear and behaviour, which makes it necessary to come to a number of assumptions (Taras, 2015). Psychological constructs can never be empirically proven with absolute certainty. Thus, empirical studies try to maximise the number of items for the construct to be observed among participants of a study (Homburg & Matthies, 1998). To this end, a variety of measurement tools has been developed for fear, such as the PANAS-X Fear, the Fear Questionnaire, the Fear Survey Schedule, the State-Trait Anxiety Inventory, and more (see Adolphs, 2013). Usually, the items are self-reported on different Likert scales and

refer to individuals' levels of stress, nervousness, worry, and personality in general (cf. Spielberger et al., 1983).

1.1.3 The German Socio-Economic Panel

The German Socio-Economic Panel (SOEP) is an annual panel survey representative for German individuals and households established by the German Institute for Economic Research (DIW) (Goebel et al., 2023). Due to its sizeable thematic range and excellent evaluation of research and data quality (Informationsdienst Wissenschaft e.V., 2008; Giesselmann et al., 2019), a secondary data analysis of its core dataset for individuals was the empirical basis of this study.

The data collection was started in 1984 and now includes around 22,000 households and 30,000 individuals that are questioned each year (DIW Berlin, 2024). As the same individuals are surveyed every year, it is possible to track long-term developments (Goebel et al., 2023). The panel covers a multidisciplinary mix of demographic items, and topics from social and behavioural sciences. Particularly relevant for this study were items from the categories of *attitudes, values, and personality; health and care; time use and environmental behaviour;* and *income, taxes, and social security*. Most of the variables are assessed by means of self-report, with few exceptions for measures of physical fitness. The most recent version of the dataset prepared by the DIW for researchers includes all waves until 2021 (ibid.).

So far, empirical research on the impact of fear and anxiety on sustainability-related behaviour is still scarce. Although recently progress has been made in this regard, the available studies mostly used cross-sectional data from convenience samples that were not representative of the general population of the respective study area. Therefore, using the SOEP data offered the advantage of being able to account for changes within individuals across time. This is particularly important for studying personality aspects that are understood to be relatively stable over time. For example, this is the reason why some specific variables, such as the Big Five personality traits (Goldberg, 1990; John & Srivastava, 1999), are only included at larger intervals of up to 5 years in the SOEP data (Goebel et al., 2023).

1.2 Present study

Currently, there is hardly any research on the relationship between general fear and sustainability-related behaviour. On that account, this study aimed to reach its contribution by addressing this research gap and investigating the impact of general fear on individual sustainability-related behaviour in a German context. Therefore, a multi-method interdisciplinary approach was chosen. First, findings of a systematic literature review are presented to summarise the research on the links between fear and related emotions, as well as sustainability-related behaviour. Second, a quantitative statistical analysis of the SOEP data was carried out to examine the association between fear and sustainability-related behaviour in individuals in Germany using the waves from 1998 to 2021. For this purpose, a latent variable for fear was constructed based on the previously discussed conceptualisation of fear using Exploratory and Confirmatory Factor Analyses, which were then used to perform Generalised Structural Equation Modelling to reveal potential associations between the latent variable and dependent variables for sustainability-related behaviour. Third, the findings were discussed and brought into the context of previous research before elaborating on the implications for the sustainability agenda in Germany and future research. Here, additional literature was used to establish a connection to the general psychology of fear.

The spatial scope of this study was set to be Germany, a country where sustainability has already been prominently discussed in policy-making and government strategy. However, if possible, parallels were drawn to other countries to account for the necessity to induce global change. Furthermore, fear and behaviour were analysed at an individual level. Nonetheless, individuals are not isolated and, on the one hand influenced by their social environment, while, on the other hand, exerting influence on their social environment and larger informal organisational structures in society (Geels, 2002). This structure is also represented by the SOEP, which captures the embeddedness of individuals in various social contexts (Giesselmann et al., 2019). Thus, implications for the agenda of a systemic sustainability transformation on a macro-level were drawn, as well.

Although links were established to existing research in the disciplines of sustainability science and psychology, this study's approach differed in that it referred to a broader concept of fear in comparison to commonly found investigations of various forms of eco-anxiety. Also, the view was shifted from pro-environmental behaviour to a more holistic definition that better reflects the notion of strong sustainability.

2 Structured literature review

First, to present an overview of the current state of research in the field of fear, anxiety, or related emotional states and its relationship with sustainability-related behaviour, a structured literature review was conducted (Luederitz et al., 2016). Therefore, the Scopus database was searched using the search string *[TITLE-ABS-KEY ((fear OR anxiety) AND (environmental PRE/0 behaviour OR environmental PRE/0 behavior) OR (sustainable PRE/0 behaviour OR sustainable PRE/0 behavior))]*, whereas the PRE/0 operator ensured that the adjacent terms were included in a coherent form.

2.1 Selection criteria and overview

The literature search produced a total of 202 publications (as of August 2024), with the first result from 1994. Most of the results were published only recently (see Fig. 1), and the most influential articles have not gathered substantial numbers of citations yet (e.g., Spence & Pidgeon, 2010, n=522 citations; Malone, 2007, n=242 citations; Stanley et al., 2021, n=225 citations), indicating that this field of research is still in its infancy. Furthermore, studies were mainly from Europe, Central Asia, and North America and published primarily by male lead authors. Nevertheless, some studies were also from Africa and Western Asia, and the numbers of female lead authors were found to be increasing. Two articles that were not available in English or German were directly excluded. To eliminate those publications from the search that were completely unrelated to the research goals of this study, the abstracts of the remaining search results were scanned. Consequently, articles that did not include findings on the relationship between any forms of fear or anxiety and human behaviour were removed from the pool. More specifically, publications were excluded that a) studied therapeutic

measures to increase general mental well-being and overcome eco-anxiety; b) revolved around specific contexts of fear, such as the fear of death, fear of missing out, fear as an instrument in social media, or fear of COVID-19; c) focussed on anxiety and fear in the context of schools and education on environmental problems, without an explicit link to behaviour; and d) only secondarily examined associations between fear and sustainability-related behaviour without a methodological contribution. Notably, a large proportion (n=53) of the excluded articles focussed on the impacts of the COVID-19 pandemic and related phenomena. Out of the remaining 70 publications, three were inaccessible, leaving a total of 67 studies for an in-depth analysis of the literature review (for the full list, see Table 4, Appendix). Although the study area of the SOEP, and thus the quantitative analysis of this study, relates to Germany, the scope of the literature review was not limited to any specific region to gather general insights on the current state of research. Finally, it was out of scope to analyse the methodological quality of the published articles, which indicates a possibility for future research. The main findings of the literature review are summarised in the subsequent sections.
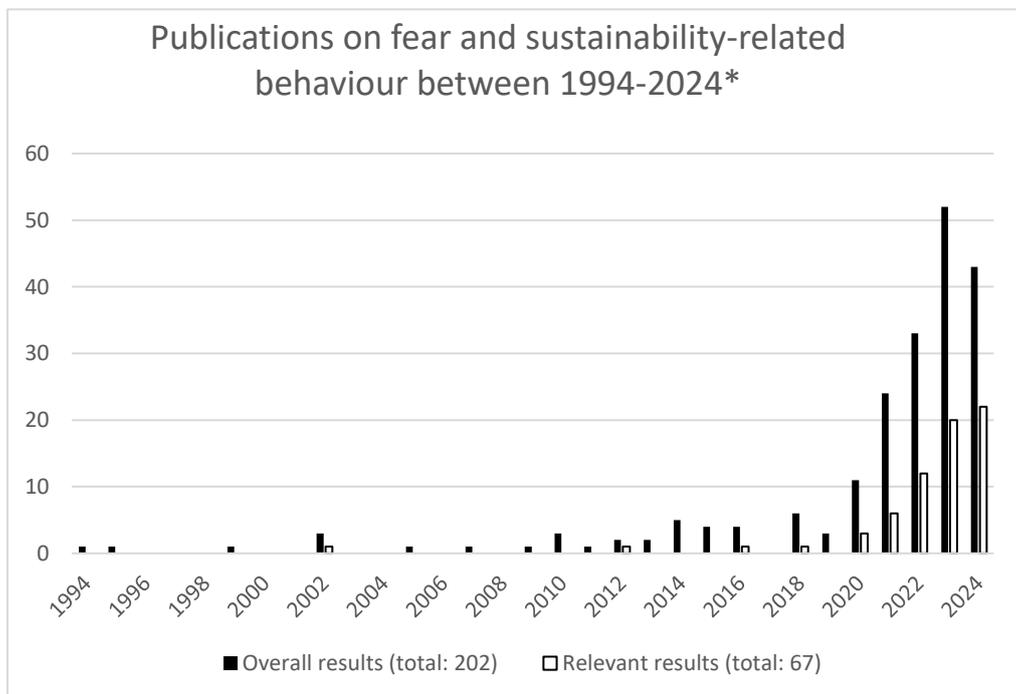

Figure 1: Numbers of publications on fear, anxiety, and related emotional states and their influence on sustainability-related behaviour (*incomplete observations for 2024, as the analysis was conducted in August 2024)

2.2   General findings

A majority of publications deployed quantitative methods, with only a small number of publications using qualitative methods (e.g., Ágoston, Csaba, et al., 2022; Ágoston, Urbán, et al., 2022; Carlson et al., 2024; Chan et al., 2024; Christodoulou et al., 2024; Corral Verdugo, 2012; Demneh & Zackery, 2023; Kapeller & Jäger, 2020; Pihkala, 2018; Voltmer & Salisch, 2024; Williamson & Thulin, 2022; Zaremba et al., 2024). Only a few studies conducted systematic reviews to evaluate the existing state of scientific knowledge regarding eco-anxiety related to climate change and accompanying effects on health (Boluda-Verdú et al., 2022), the variety of concepts used to describe eco-emotions (Cianconi et al., 2023), and empirical studies on the (in-)direct psychological consequences of climate change and environmental problems (Jarrett et al., 2024). The quantitative studies primarily relied on self-report questionnaires to assess participants' affectional states and their behaviour through various measurement tools. These were found to range between single-item measurements (e.g., Anneser et al., 2024) to more complex constructs. Here, the Hogg Eco-Anxiety Scale (HEAS) (Hogg et al., 2021), and the Climate Change Anxiety Scale (CCAS) (Clayton & Karazsia, 2020) belonged to the measures with the strongest validation support (Jarrett et al., 2024), and they were used in several different national and socio-demographic contexts (for the full list, see Table 5, Appendix). Also, most quantitative designs were cross-sectional, with only five exceptions using a longitudinal design (Becht et al., 2024; Contreras et al., 2024; Hogg et al., 2024; Lutz et al., 2023; Pavani et al., 2023). Furthermore, most samples were convenience samples and not representative of the respective populations. The heterogeneity of measures, concepts, and definitions poses serious challenges to comparability and reproducibility of results (Ágoston, Urbán, et al., 2022).

2.3   Fear, anxiety, and other emotions in the context of sustainability

In the following, findings from the literature review regarding the conceptualisation of fear and related affective states, and associated empirical findings are presented. In summary, a lack of overall literature, definitions and concepts, and empirical, especially longitudinal, research was highlighted in most publications. Generally, a large variety of terms was found in the literature, with a lack of agreed-upon definitions. Additionally,

different terms such as eco-anxiety, ecoangst, eco-fear, ecophobia, climate change anxiety, climate fear, eco-worry, solastalgia, etc., were often used interchangeably or with large conceptual overlap. However, a clear distinction is sensible in many contexts, as pointed out in this study. Cianconi et al. (2023) aimed to address this issue by providing an overview of definitions, hypotheses, and questions for many of the different emerging terms. Nonetheless, eco-anxiety or climate (change) anxiety were used most frequently, although a clearer differentiation between those is needed, as well (Jain & Jain, 2022; Ogunbode et al., 2022). Various definitions of eco-anxiety described it as being closely related to fear and worry but with additional facets of apprehension of uncertainty, unpredictability, and uncontrollability facing climate change threats and environmental degradation (Chan et al., 2024; Contreras et al., 2024; Heeren et al., 2022; Jain & Jain, 2022; Parmentier et al., 2024; Pihkala, 2020). Other approaches incorporated emotions such as fear, anxiety, or worry into their definition of eco-anxiety as different forms of reactions (Boluda-Verdú et al., 2022; Christodoulou et al., 2024; Comtesse et al., 2021; Gao et al., 2021; Leite et al., 2023; Ogunbode et al., 2022), or used the term synonymously with those emotions in relation to consequences of climate change and environmental problems (Carlson et al., 2024). Stress or distress were also mentioned as underlying mechanisms (Chung et al., 2023), whereas Hogg et al. (2024) categorised the construct using the dimensions of affective, ruminative, behavioural and social components. Christodoulou et al. (2024) pointed out the necessity to distinguish between forms of eco-anxiety that are not debilitating in daily life and that can be described as pathological forms evoking functional impairment. They further highlighted the role of the DSM-V and ICD-10, two categorisation systems to guide the identification of psychiatric disorders, which can help to develop criteria to recognise eco-anxiety. Nonetheless, both systems were criticised due to their limitation on clinical manifestations of psychological distress (ibid.). The differentiation between adaptive and maladaptive forms of eco-anxiety was also discussed while studying its associations with behavioural change. Although some measurement tools, like the CCAS (Clayton & Karazsia, 2020) and the HEAS (Hogg et al., 2021), emphasise the multi-dimensionality of eco-anxiety, this aspect was often not translated into implications by studies

administering them. Ágoston, Csaba, et al. (2022), on the other hand, provided a detailed distinction between six components of eco-anxiety: worry for the future and upcoming generations; the empathy of seeing or imagining the suffering of others; conflicts with social contacts due to diverging attitudes towards environmental problems; physical or emotional disturbance due to changes in the environment; mental health symptoms along the lines of anxiety and mood disorders according to DSM-V; and helplessness and frustration in the face of a perceived lack of control and the extend of the overall challenge of combatting environmental problems. A network analysis by Heeren et al. (2023) showed that the cognitive-emotional features of climate anxiety emerged in a separate community compared to the functional features of it. General worrying also formed its own community, while environmental behaviour and the experience of climate change were grouped. Furthermore, several potential antecedents to eco-anxiety have been analysed and partly supported by empirical evidence. These include, for example, personal experience (Chan et al., 2024; Chung et al., 2023; Heeren et al., 2022; Ogunbode et al., 2022), social interaction on norms and media exposure (Ogunbode et al., 2022), and cultural context (Chan et al., 2024; Chung et al., 2023; Cianconi et al., 2023; Leite et al., 2023). Another less frequently reoccurring theme was the role of media and their influence on fear, anxiety, and pro-environmental behaviour. Exemplary topics were fear appeals through media and their association with pro-environmental behaviour (Chen, 2016), the comparison of narrative or logical information eliciting fear and anxiety (Nakano & Hondo, 2023), the role of online social networks (Shah et al., 2021), and general media exposure (Shao & Yu, 2023; Vrselja et al., 2024). The overall dynamics of information dispersion can be illustrated by an agent-based computer modelling approach, which showed that threatening information can increase an individual's anxiety. How an individual reacts to threatening information was also shaped by their internal orientation, such as their environmental self-identity or their scepticism towards climate change. While looking at population dynamics, it was found that those populations with high environmental identity and low climate scepticism perform best regarding their motivation to increase pro-environmental intentions. However, a condition for this was a continuously high intensity of climate

messaging. This, in turn, had the side effect of an increase of climate sceptics in the population, who then reduced the environmental intentions of the pro-environmental group (Kapeller & Jäger, 2020).

Overall, the proportions of populations found to be experiencing different forms of eco-anxiety varied across studies from low to high levels. In a representative sample of the US American population, 61% of participants reported a feeling of climate stress or anxiety (Anneser et al., 2024). In a study with participants from 32 different countries, a proportion of 47% of the entire sample expressed heightened levels of negative emotions facing climate change (Ogunbode et al., 2022). However, Becht et al. (2024) only reported low-to-medium levels in their data from Columbia and the Netherlands, and Tam et al. (2023) only found low-to-medium levels in their representative samples from China, India, Japan, and the USA. In a convenience sample from several European and African countries, 11% of participants reported the frequent experience of climate anxiety (Heeren et al., 2022).

Various groups were found to be experiencing eco-anxiety in its respective definitions more frequently and more severely than others, such as younger individuals (Ágoston, Balázs, et al., 2024; Rocchi et al., 2023; Whitmarsh et al., 2022), women (Kabasakal-Cetin, 2023; Rocchi et al., 2023), politically left-oriented (Leite et al., 2023), individuals from poorer countries in the Global South (Boluda-Verdú et al., 2022), or those otherwise affected by climate change physically or psychologically (Cianconi et al., 2023). However, no significant differences in age and gender were found in some studies, as well (Chan et al., 2024; Sampaio et al., 2023). The finding that eco-anxiety was more prevalent in the younger generation can partially be explained by their increased engagement in social media and the positive relation of eco-anxiety and the "rate of exposure to information about climate change impacts, the amount of attention people pay to climate change information, and perceived descriptive norms about emotional responding to climate change" (Ogunbode et al., 2022, p. 2).

Notably, most of the publications reviewed exclusively put forward the understanding of climate change, environmental problems, and related issues as a precursor for feelings

of anxiety, fear, or other so-called eco-emotions. The association with pro-environmental behaviour was often tested under these assumptions, as discussed in the following sections. However, studies that analysed fear in this context on a more general level were rarely found, with only a few exceptions (Clayton & Ogunbode, 2023; Pickering & Dale, 2023; Pihkala, 2018; Rothermich et al., 2021; Tucholska et al., 2024; Williamson & Thulin, 2022). Although often incorporated into concepts used to define eco-anxiety, other studies specifically delineated emotions such as eco-anger, eco-grief, eco-worry, and eco-guilt, and analyse their implications separately (e.g., Ágoston, Buvár, et al., 2024; Comtesse et al., 2021; Contreras et al., 2024; Innocenti et al., 2022; Larionow et al., 2024; Stanley et al., 2021; Verplanken et al., 2020). Additionally, evidence was found that eco-emotions are distinct concepts from general forms of worry, fear, etc. (Carlson et al., 2024; Heeren et al., 2023; Parmentier et al., 2024).

2.4 Sustainability-related behaviour

The heterogeneity of operationalisations for sustainability-related behaviour was even more prevalent than for different eco-emotions. Although most publications referred to pro-environmental behaviour, the measures used were usually not comparable across different studies. Often, pro-environmental behaviour was defined as those forms of behaviour that minimise negative and even promote positive impacts on the environment. It can be seen as part of a longitudinal process, and its multidimensionality needs to be taken into account (Gao et al., 2021; Leite et al., 2023). While most analyses relied on self-report measures of actual behaviour, others also operationalised expressed intent as a form of pro-environmental behaviour (Chen, 2016; Goldwert et al., 2024; Nakano & Hondo, 2023). In general, the measurement tools ranged from one-dimensional variables (Chen, 2016; Chung et al., 2023; Sangervo et al., 2022; Shao & Yu, 2023) to scales with up to 45 items (Becht et al., 2024; Kaiser et al., 2007). Most studies included different forms of behaviour without further categorisation, while others differentiated between public-sphere, private-sphere, and sometimes also radical-sphere behaviour regarding environmental issues (Becht et al., 2024; Chan et al., 2024; Pittaway et al., 2024; Stanley et al., 2021; Vrselja et al., 2024). Other categorisations included reported behaviour in the realms of waste reduction, water and energy

conservation, product consumption, recycling, reusing, food consumption, mode of transport, environmental organisation membership, protest participation, and information seeking (Ágoston, Balázs, et al., 2024, 2024; Ágoston, Urbán, et al., 2022; Hogg et al., 2024; Innocenti et al., 2022; Kabasakal-Cetin, 2023; Leite et al., 2023; Lutz et al., 2023; Ogunbode et al., 2022). In two studies, concern was expressed about aggregating environmental behaviour into a single latent variable and the items were analysed individually (Ágoston, Balázs, et al., 2024; Ágoston, Urbán, et al., 2022).

2.5   Fear-related affect and behaviour

The findings of the association between fear-related affective states or traits and various sustainability-related behaviours mostly unanimously indicated a positive influence of eco-anxiety and related emotional concepts on engaging in sustainability-related behaviour (Becht et al., 2024; Carlson et al., 2024; Chan et al., 2024; Heeren et al., 2022; Heeren et al., 2023; Innocenti et al., 2021; Larionow et al., 2024; Mathers-Jones & Todd, 2023; Ogunbode et al., 2022; Sampaio et al., 2023; Tam et al., 2023; Whitmarsh et al., 2022). However, partly due to the different means of measurement, the discussion showed a variety of interpretations concerning the implications. The relationship was found to be influenced stronger by the cognitive-emotional aspects of climate anxiety than by the functional impairment (Tam et al., 2023). Lutz et al. (2023) found that, although low values for eco-anxiety were measured on average at the trait level, higher levels of it were associated with a negative affective state and more pro-environmental behaviour.

Another phenomenon discussed was often described as eco-paralysis, which focusses on the maladaptiveness of eco-anxiety at increased levels, leading to declining levels of sustainability-related behaviour. The resulting assumption of a curvilinear function of the influence of eco-anxiety on sustainability-related behaviour was accompanied by contradictory findings. Ágoston, Buvár, et al. (2024) concluded from their results that excessive eco-anxiety can hinder the positive influence of nature connectedness on future action. Also, the authors hypothesised that increased anxiety can lead to a decreased uptake of relevant information on environmental problems to protect mental health. A direct observation of participants with lower levels of climate anxiety engaging

in pro-environmental behaviour more often than those with high levels of climate anxiety was also reported (Christodoulou et al., 2024; Heeren et al., 2022), sometimes also in reference only to specific forms of public-sphere behaviour (Becht et al., 2024). While including the measurement of general distress in their model, Lukacs et al. (2023) emphasised that higher levels of it can weaken the correlation between pro-environmental behaviour and climate change anxiety. However, Carlson et al. (2024) presumed the adaptiveness of climate anxiety at all levels, although they stressed that no individuals with extreme levels of climate change anxiety were part of their sample. This general claim of a linear function was also put forward by Pavani et al. (2023) and Whitmarsh et al. (2022).

Regarding a more detailed deconstruction of eco-anxiety, Hogg et al. (2024) showed that while rumination and the experience of eco-anxiety were associated with pro-environmental behaviour, affective and behavioural symptoms of eco-anxiety were uniquely associated with poorer mental health (see also Ogunbode et al., 2022). An explanation attempt focussed on the extent of emotional and psychological energy spent while worrying. A longitudinal analysis by Pavani et al. (2023) showed that detected eco-anxiety during the first measurement predicted pro-environmental behaviour at the later measurement. This association also remained stable when ecological identity, the Big Five personality traits, and pro-environmental behaviour were controlled for. Notably, the authors found engaging in pro-environmental behaviour to predict increased levels of eco-anxiety at the later measurement. Thus, the idea that engaging in pro-environmental behaviour can be a beneficial coping strategy for eco-anxiety was called into question (ibid.).

Demneh and Zackery (2023) found that paralysing fear and despair, patriarchal structures, consumerism, and deeply anchored habits inhibited the pro-environmental behaviour of young people. Studies that included the analysis of various emotions as distinct concepts frequently pointed out that eco-anger was the better predictor of sustainability-related behaviour in comparison to eco-anxiety, although the latter still showed a significant association with it (Stanley et al., 2021).

Several moderating effects were identified for the positive association between eco-anxiety and related concepts and sustainability-related behaviour. For example, hope, despair, and climate change perception (Leite et al., 2023), perception of moral obligations (Chen, 2016), self-discrepancy in the sense of a perceived difference in one's current self and a desired future self (Gao et al., 2021), and low attentional bias variability (Mathers-Jones & Todd, 2023) were mentioned. Furthermore, the relationship was found to be stronger in Western countries (Ogunbode et al., 2022). Other effects on sustainability-related behaviour that have been studied in relation to eco-anxiety, but not as moderating variables, include climate change risk perception, future event cognition, belonging to the age group below 30 years (Chung et al., 2023), exposure to climate change information in combination with decision-making, self-efficacy (Shah et al., 2021), and attentional bias in general (Mathers-Jones & Todd, 2023).

The diversity of findings and methods indicates a further need to establish a transferable conceptualisation and definition of eco-anxiety and its subcomponents, including a clear distinction from concepts that have been empirically proven to differ regarding the various properties and influences on behaviour. Nonetheless, several generalised implications were drawn in the reviewed studies that are relevant to the present study.

While some argued for leveraging eco-emotions to increase levels of sustainability-related behaviour and call for steering away from a terminology of pathologisation (Becht et al., 2024), others highlighted the negative consequences on overall well-being and mental health, especially at increased levels of eco-anxiety, fear, eco-anger, etc. including the necessity to regard this state as a full psychiatric disorder (Christodoulou et al., 2024). Here, two main lines of thought were drawn from this. On the one hand, it was argued that a potential maladaptiveness of eco-anxiety, including severe implications on mental health and decreased engagement in sustainability-related behaviour, requires a careful management and detection system to keep it at appropriate levels (Chung et al., 2023). On the other hand, ethical considerations and the pursuit of human well-being require protecting people from experiencing those negative emotions. When the focus was shifted towards dealing with eco-emotions, several coping strategies were mentioned to be applied by participants, such as taking

actions and planning, confrontation, optimism, withdrawal or acceptance, problem avoidance and denial, and social support (Ágoston, Csaba, et al., 2022).

The dangers of relying on concepts that fail to incorporate the multi-dimensionality of eco-emotions and their relationship with well-being and behaviour were illustrated by several findings. For example, support was provided by climate change anxiety having multiple effects on individuals simultaneously while looking at the same dependent variables (Innocenti et al., 2023). In conclusion, the need was addressed to empower patients suffering from climate change anxiety to develop coping strategies, e.g., pro-environmental behaviour, thereby strengthening individual self-efficacy (Heeren et al., 2022; Innocenti et al., 2023). However, this particular coping strategy also comes with its downside, as pro-environmental behaviour was also found to predict eco-anger, questioning the efficacy of over-engagement (Contreras et al., 2024). This was also supported by pro-environmental behaviour being associated with functional impairment due to climate anxiety (Heeren et al., 2023). One possible explanation was that engaging in individual pro-environmental behaviour often has little or no directly perceptible effect, given the complexity and scale of the problems to be tackled (Boluda-Verdú et al., 2022). Although emotional-cognitive aspects were interpreted as a pivotal tipping point between adaptive and maladaptive forms of climate anxiety, specifications are needed, as cognitive-emotional aspects span a variety of processes that occur at different stages of climate anxiety (Heeren et al., 2023). Additionally, the assumption was brought forward that various eco-emotions are part of a multi-stage coping process (Ágoston, Buvár, et al., 2024). To promote a better understanding in academia, they suggested moving from a primarily knowledge-based educational approach in environmental science to an approach that transmits emotional aspects, as well. Also, the findings have implications for both the design of communication on climate change issues and the awareness of mental health practitioners to recognise and deal with anxiety related to climate change (Heeren et al., 2022).

Although much attention has been paid to eco-anxiety in recent literature, the close connection to fear was apparent, as the inclusion of it in several conceptualisations of eco-anxiety and many parallels between the underlying dynamics showed. However, as

previously discussed, it is reasonable to extend the analysis to a broader understanding of fear to fully account for the various impacts on sustainability-related behaviour and holistic implications for the sustainability agenda.

3   Methods of secondary data analysis

The literature review revealed several insights on the current state of research, including open questions that need to be answered to extend the understanding of how individual's emotional characteristics interact with their behaviours. Therefore, empirical support is required in order to back the theoretical construct of fear influencing sustainability-related behaviour. Consequently, a secondary data analysis of the longitudinal SOEP-Core v38.1 study (Goebel et al., 2023) was conducted. More specifically, selected variables from the *pl dataset*, by default including all variables from all waves of the individual questionnaire until 2021, were included in this study. Since not all items are collected on an annual basis, the years before 1998 were excluded from this analysis, as it is the earliest year in which the items for sustainability-related behaviour were included. In the following section, the basic characteristics of the SOEP data used are summarised before elaborating on the development of measures and statistical analysis.

3.1   SOEP procedure and participants

The individual questionnaire of the SOEP-Core survey, with all years aggregated in the *pl dataset*, is administered to all individuals above the age of 18 in households participating in the SOEP. The original sample started in 1984, with German households (n=4528) and migrant worker households (n=1393) representative of the population. To account for changes in the population and people leaving the survey due to moving abroad, declining to reply, passing away, etc., refresher samples were regularly added to the original sample pool. Examples of this include an addition after the German reunification in 1990, several samples to include people with a migration background, and various samples to represent marginalised groups that are too small to be represented through proportional sampling, such as certain family types or high-income groups (Goebel et al., 2023). To

track individuals during their lives as long as possible, households to which individuals from an original SOEP household move become SOEP households, as well, also including those individuals that have previously not been part of the survey. Also, children coming of age and people moving into a SOEP household become part of the active panel. All SOEP samples are regionally clustered multi-stage random samples, with the respondents selected by random-walk (ibid.). While the household questionnaire is completed by the person who feels most qualified as the head of the household, the individual questionnaire is filled out by each individual. Questionnaires were traditionally filled out on paper and in the presence of an interviewer, but other, e.g., digital, means have been developed since then, as well.

3.2 Measures and data preparation

A two-step approach was followed to identify the relevant variables for measuring fear and sustainability-related behaviour in the SOEP dataset. First, a list of the different topics, including a variety of subcategories of the SOEP-Core, representing all waves until 2021 (v.38), was searched to identify potentially relevant variables (for the full list, see paneldata.org/soep-core/topics). Consequently, the list of all variables (n=5,157) included in the *pl dataset* was manually scanned, as the search function was unreliable due to some items not being translated coherently from German into English (for the full list, see paneldata.org/soep-core/datasets/pl/). The data preparation and analysis were conducted using the software R (v. 4.4.1, "Race for Your Life") and RStudio (v. 2024.9.0.375). Data from the customised *pl dataset* was prepared by recoding all missing values as *NA*.

3.2.1 Fear

According to the initial understanding of fear as a future-directed emotional state as a reaction to threatening, uncertain, or uncontrollable situations, a list of potential items for the latent variable of fear was crafted. According to Conceptual Act Theory, items were chosen that acknowledge the perceptive and experience-based diversity of self-reports on emotions. This approach was in line with other fear questionnaires that were not directly applicable to the variables of the SOEP (Adolphs, 2013). Thus, variables for general worry, nervousness, and specific worries were added to the list. To account for
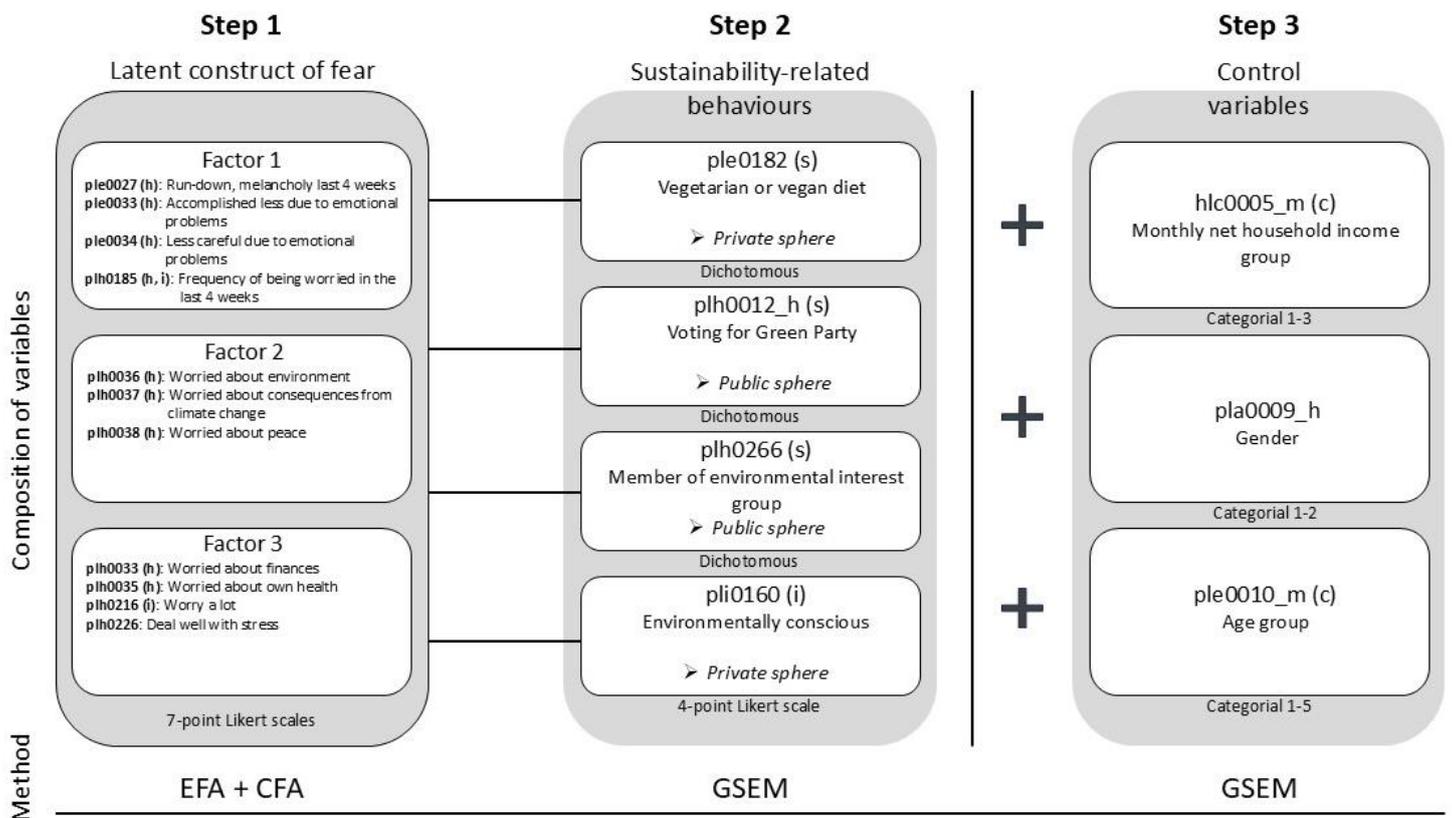
trait characteristics of fear and coping with stress and to enable the connection to psychopathology, items assessing personality traits were included, as well (e.g., "Worry a lot", "Deal well with stress"). Furthermore, items measuring subsequent indications of functional impairment due to fear or anxiety were drawn from the list of variables (e.g., "Accomplished less due to emotional problems", "Run-down, melancholy last 4 weeks"). The full list consisted of 15 items (see Table 2, Appendix).

To prepare the variables for analysis, first, the variables *plh0185*, *plh0216*, *plh0221*, and *plh0188* were reversed to match the logical direction of the other variables for the latent construct of fear, i.e. with lower values for a higher level of, e.g., fear. Then, the variables selected for constructing the latent variable for fear were harmonised to all cover the range of a 7-point Likert scale to facilitate further modelling. In addition, a multiple imputation was used to replace the missing values. Therefore, five iterations were performed using Predictive Mean Matching (PMM) with a randomiser (seed=123). In this approach, a regression for each missing value is executed, which estimates the relationship between the variable with a missing value and the other variables in the dataset. Subsequently, the actual value for the missing data point is selected by randomly choosing an observed value that is close to the value predicted by the regression (Baur & Blasius, 2014, p. 346; Giesselmann & Windzio, 2012, p. 203). As most of these variables are understood to be relatively stable over time and therefore not measured every single year (Entringer et al., 2022), this method can be justified well.

In the next step, an Explorative Factor Analysis (EFA) was conducted to test how well the selected variables load on the latent construct. This approach was chosen since the selection of variables was based on several theoretical assumptions, as no validated model for the measurement of fear was applicable to the variables available in the SOEP (Backhaus et al., 2018, p. 366). To choose the appropriate method for the EFA, the variables were individually tested for normal distribution using the Anderson-Darling-Test (Anderson & Darling, 1954) due to the large sample size and by inspecting the histograms. The test statistics ranged between A=11,514 (for *ple0034*) and A=67,962 (for *plh0216*) with p<2.2e-16, indicating that the data was not normally distributed (Backhaus et al., 2018, p. 373). Also, a Pearson correlation matrix was developed for the

EFA for all 15 variables, using pairwise complete observations (Backhaus et al., 2018, p. 372). Consequently, the EFA was conducted using the minimum residuals method, which does not require normal distribution and is robust against outliers. The results revealed a robust three-factorial structure (**F1**: *ple0027*, *ple0033*, *ple0034*, *plh0185*; **F2**: *plh0036*, *plh0037*, *plh0038*; **F3**: *plh0033*, *plh0035*, *plh0216*, *plh0226*). The variables *plh0032*, *plh0188*, *plh0191*, and *plh0221* did not load well on any factor and were removed from the model. Furthermore, as *ple0033* loaded stronger on the first factor, it was excluded from the third. The three-factorial structure of the latent construct indicated that reported feelings related to fear could be summarised along certain dimensions. Hence, Factor 1 described general worries and functional impairments, Factor 2 included worries about specific societal or global situations (e.g., the environment; peace), and Factor 3 combined aspects of coping ability and personal worries.

Based on this model structure (see Fig. 2), a Confirmatory Factor Analysis (CFA) was performed to validate the latent variable (Backhaus et al., 2018, p. 566). Since the data was ordinally scaled and not normally distributed, the Weighted Least Squares Mean and Variance adjusted (WLSMV) method was used (Muthén, L. K., & Muthén, B. O., 2017, p. 668). The CFA model included the weighting factors, but unfortunately a clustering method accounting for the panel structure was not supported by the software. However, recognising the assignment of data points to specific survey years and individuals was possible later in the analysis. The CFA showed a good fit of the model to the data and provided support for the construct of the latent variable. To further validate the model, bootstrapping with 500 repetitions (seed=123) (Backhaus et al., 2018, p. 357) and a sensitivity analysis (Wooldridge, 2013, p. 685) were carried out. Testing for discriminant validity was not feasible due to the lack of comparable latent constructs. Detailed results of the EFA, the CFA, and additional validity tests are provided in section 4.2.

Step 1
Latent construct of fear

Factor 1
ple0027 (h): Run-down, melancholy last 4 weeks
ple0033 (h): Accomplished less due to emotional problems
ple0034 (h): Less careful due to emotional problems
plh0185 (h, i): Frequency of being worried in the last 4 weeks

Factor 2
plh0036 (h): Worried about environment
plh0037 (h): Worried about consequences from climate change
plh0038 (h): Worried about peace

Factor 3
plh0033 (h): Worried about finances
plh0035 (h): Worried about own health
plh0216 (i): Worry a lot
plh0226: Deal well with stress

7-point Likert scales

Step 2
Sustainability-related behaviours

ple0182 (s)
Vegetarian or vegan diet
➢ *Private sphere*
Dichotomous

plh0012_h (s)
Voting for Green Party
➢ *Public sphere*
Dichotomous

plh0266 (s)
Member of environmental interest group
➢ *Public sphere*
Dichotomous

pli0160 (i)
Environmentally conscious
➢ *Private sphere*
4-point Likert scale

Step 3
Control variables

hlc0005_m (c)
Monthly net household income group
Categorial 1-3

pla0009_h
Gender
Categorial 1-2

ple0010_m (c)
Age group
Categorial 1-5

Composition of variables

Method

EFA + CFA   GSEM   GSEM

h=harmonised; i=inverted; s=simplified; c=constructed

Figure 2: Visualisation of the statistical model of testing the association between the latent variable of fear with different sustainability-related behaviours using Exploratory and Confirmatory Factor Analyses and Generalised Structural Equation Modelling

3.2.2   Sustainability-related behaviour

The items for sustainability-related behaviour were selected, conforming to the initial definition of such behaviour that relates to ecological, social, and economic sustainability in the dimensions of public sphere, private sphere, and radical sphere behaviour. No items for radical sphere behaviour were found in the SOEP *pl dataset*. Also, potential items were excluded when the sample sizes of participants engaging in a specific behaviour were exceedingly small. For example, heating with solar energy was only reported by less than 100 households in the respective years of data collection for that item. Due to a lack of contextual information or a context unrelated to a sustainable background, variables on modes of transportation were excluded.

Thus, the remaining variables used to analyse sustainability-related behaviour were *ple0182* ("Vegetarian or vegan diet"), *plh0012_h* ("Voting for Green Party"), *plh0266* ("Member of environmental interest group"), and *pli0160* ("Environmentally conscious"). Although the latter does not directly include exercised behaviour, it was assumed that individuals perceiving themselves as environmentally conscious engage in sustainability-related behaviour, at least to a certain degree. Although other German parties, such as the left-wing, democratic-socialist "Die Linke", include strong support for environmental protection and sustainability in their manifestos, "Voting for the Green Party" was included as they publicly position themselves as the strongest supporters in this regard (Manifesto Project, 2024; Villalba, 2016).

To prepare the data, *pli0160* was reversed to match the logical direction of the other variables for sustainability-related behaviours, i.e. with high values for a higher level of environmental consciousness. Furthermore, three variables were recoded into a dichotomous format to better represent sustainability-related behaviour. These variables now represented: a) voting for Buendnis 90/the Green Party (*plh0012_h*); b) following a vegetarian or vegan diet (*ple0182*); and c) being a member of an environmental group (*plh0266*) in this study, with a value of 0 representing not fulfilling the criteria and 1 fulfilling them. As the dataset only includes individuals above the age of 18, all participants were eligible to vote at the time of filling out the questionnaire.

Based on the variables for sustainability-related behaviour and the findings from the literature review showing an effect of specific forms of fear on it, the following hypotheses were formulated:

H1: A higher fear among individuals is associated with a higher likelihood of choosing a vegetarian or vegan diet.

H2: A higher fear among individuals is associated with a higher likelihood of being a member of an environmental interest group.

H3: A higher fear among individuals is associated with a higher likelihood of voting for the Green Party.

H4: A higher fear among individuals is associated with a higher likelihood of being environmentally conscious.

3.2.3 Demographic and weighting variables

Furthermore, several demographic and identifier variables were selected (for a complete list of variables used in this study, see Table 2, Appendix). Monthly net household income was included from the *hl dataset* on the household level. In addition, as all individuals over the age of 18 per household are usually also surveyed in the *pl dataset*, the per capita net household income was calculated by dividing the total household income by the number of participating individuals per household. This was the most suitable method available, as neither the number of members nor the number of children was collected at the household level continuously over the years. Although a harmonisation accounted for the conversion from DM to EUR, the variable does not reflect inflationary changes. Therefore, three income groups were constructed from the per capita net household income, whereas income group 1 represented those individuals whose per capita net household income was below 70% of the median for the respective year, income group 2 for those between 70-149%, and income group 3 for those with 150% or more (after Bundeszentrale für politische Bildung, 2022).

An additional variable for age was calculated using the birth year and the respective survey year for each participant. Subsequently, five different groups were formulated for the ages of 18-25, 26-40, 41-55, 56-69, and 70+. Hence, individuals had the potential to be assigned to different age groups in different survey years.

The weights from the *phrf dataset* were added to the primary dataset, recoded to match its structure, and rescaled to a range between 0 and 1 so as not to interfere with the statistical tests. Missing values across all variables were recoded as *NA*. The weights were designed by the DIW to enable the representativeness of the SOEP data to the German population (Kroh, 2018).

3.3 Data analysis

Four individual analyses were carried out using the same methodology to test each hypothesis. Generalised Structural Equation Modelling (GSEM) was performed due to

the use of dichotomous and ordinal dependent variables (Rabe-Hesketh et al., 2004). For the dichotomous dependent variables, logistic regression was part of the GSEM, and for the ordinal variables, an ordinal logistic regression was used. Furthermore, Fixed Effects modelling was included to incorporate the panel structure of the data by accounting for changes within an individual over time (ibid.). As the estimation method, a Maximum Likelihood Estimation with Robust Standard Errors (MLR) was selected because of its robustness against heteroscedasticity and not normally distributed data (ibid.). For missing data in the dependent variables, the Full Information Maximum Likelihood (FIML) method was used. GSEM was performed for each combination of dependent variables for sustainability-related behaviour and the validated latent variable for fear. For that, the respective years in which the variables for sustainability-related behaviour were collected were analysed, resulting in the following combinations: for H1, fear $\rightarrow$ *ple0182* "Vegetarian or vegan diet" (years 2016, 2018, 2020); for H2, fear $\rightarrow$ *plh0266* "Member of environmental interest group" (years 1998, 2001, 2003, 2007, 2011, 2015, 2019); for H3, fear $\rightarrow$ *plh0009_h* "Voting for Green Party" (years 1998-2021); for H4, fear $\rightarrow$ *pli0160* "Environmentally conscious" (years 1998, 2003). Each GSE model was then tested for heteroscedasticity using the Breusch-Pagan-Test (Breusch & Pagan, 1979; Wooldridge, 2013, p. 435) and for autocorrelation, using the Durbin-Watson-Test (Durbin & Watson, 1951; Wooldridge, 2013, p. 418). Furthermore, Robust Standard Errors (SE) were calculated and employed in the regression results (Wooldridge, 2013, p. 432). Lastly, each model was extended to control for the effects of age group, gender, and income group and compared to the original model using the Satorra-Bentler scaled chi-square test (Satorra & Bentler, 2011).

4 Results

4.1 Descriptive statistics

On average, n=24,614 participants took part in the individual questionnaire each year between 1998 and 2021, with the maximum number of participants in 2017 (n=32,485) and the minimum number in 1999 (n=14,085). The mean number of waves each

participant answered to the survey was 6.3. Across all analysed years, the weighted age structure was dominated by individuals between the ages of 26 and 69, while the trend showed growing proportions of participants in the age groups of 56-69 and 70+ (see Fig. 3). In a rough comparison with data from 2023, this closely resembled the general age structure of the German population in 2021, although it should be noted that the age groups were defined slightly differently (Destatis, 2024). Regarding the weighted distribution of male and female participants, the data showed an even distribution, with a slightly higher proportion of females (see Fig. 4). Here, it shall be noted that the available data only included those two categories for gender, which falls short of including people who assign themselves to other categories. However, in some years, it was possible to answer *NA*. The weighted proportion of income groups fluctuated over the years, with the medium income group (70% to <150% of the median) being represented most strongly (cf. Bundeszentrale für politische Bildung, 2022). However, the trend showed a rising proportion of the low, as well as high-income group (see Fig. 5). The variable indicating participant's school leaving degree was dropped from this study due to the large number of invalid answers across all years, leading to a proportion of less than 1.5% of participants providing that information. The descriptive statistics for the variables included for sustainability-related behaviour and in the latent variable of fear are provided in Table 3, Appendix. The results indicated the following trends: a) across the entire analysed survey period, only a low percentage of participants followed a vegetarian or vegan diet (6.8%) or was a member of an environmental interest group (4.2%), with a slight increase of the former in the reference year 2020; b) on average, 13.1% of participants voted for the Green Party or coalitions with it, with a substantial increase in the reference year 2021 (25.4%); c) people perceived themselves as quite environmentally conscious in 1998 and 2003; d) on average, participants expressed moderate levels of melancholy during the four weeks prior to the questionnaire, they did not feel like they accomplished less and were less careful due to emotional problems, and showed moderate levels of worry about finances and their own health, with falling trends in 2021; e) on average, participants showed moderate levels of worry about the environment, consequences from climate change, and peace, with slightly rising trends

in 2021; f) across the entire period, participants showed lower levels of being worried four weeks prior to the questionnaire, moderate levels of worrying a lot, and dealing well with stress, all with slight decreases in 2021.
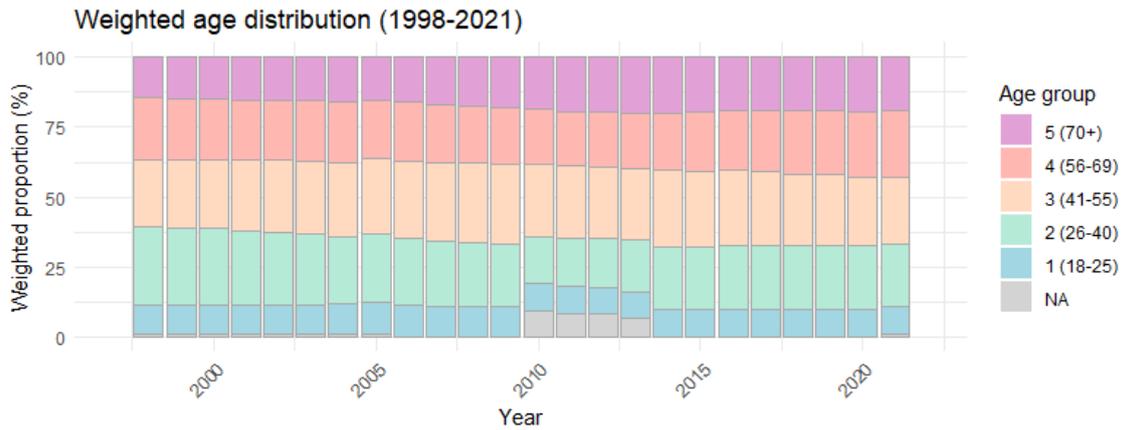

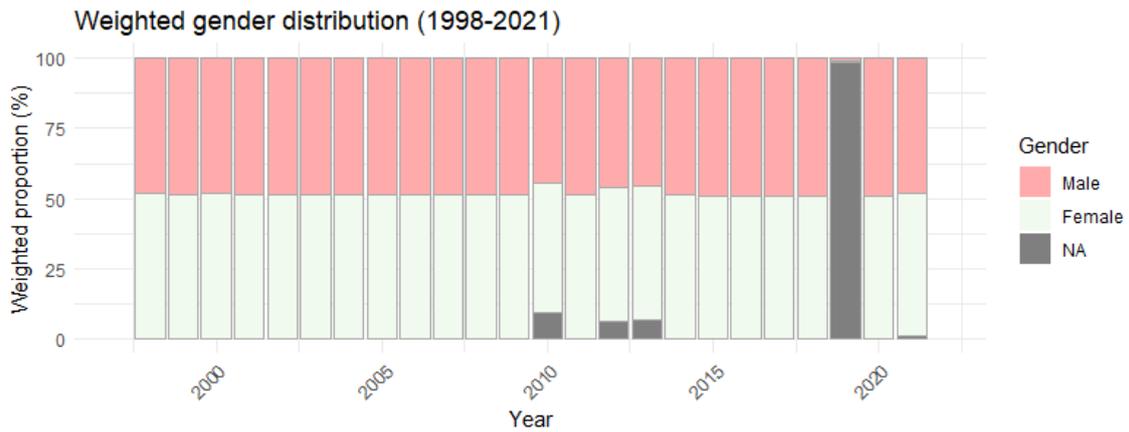*Figure 3: Weighted age group distribution of participants in the individual SOEP questionnaire*

Figure 4: Weighted gender distribution of participants in the individual SOEP questionnaire
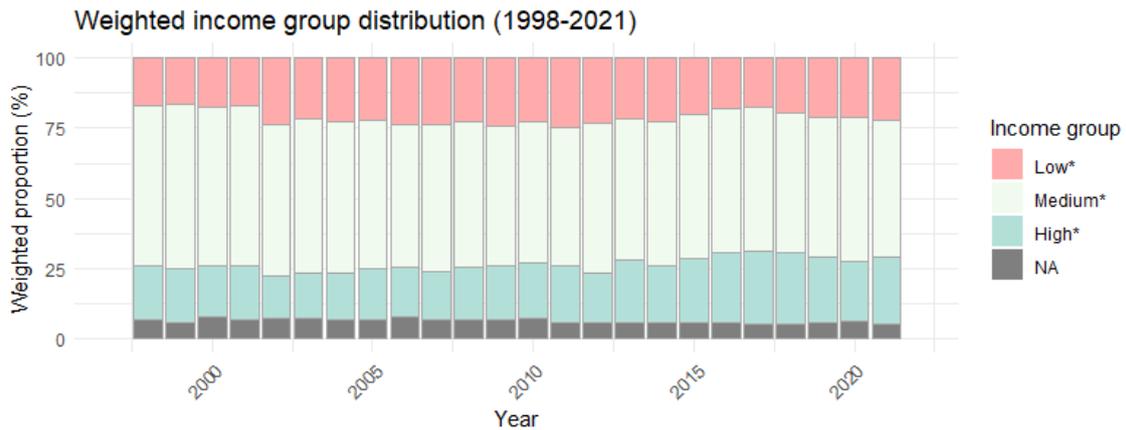
Figure 5: Weighted income group distribution of participants in the individual SOEP questionnaire (*Low=below 70% of median; Medium=between 70-149% of median; High=150% and more of median; the median refers to the respective survey year)

4.2 Properties of the statistic models

The results of the EFA showed that of the 15 variables for the latent construct of fear, 11 loaded on three factors (**F1**: *ple0033, ple0034, ple0027, plh0185*; **F2**: *plh0036, plh0037, plh0038*; **F3**: *plh0033, plh0035, plh0216, plh0226*) with standardised loadings between 0.36-0.92, while values larger than 0.3 are considered significant. High values of communalities ($0.25 \leq h^2 \leq 0.86$) indicated that a lot of variance for those variables could be explained by the factorial structure. The average complexity (com=1.4) showed that most items only loaded on one or two factors. In total, 41% of the variance was explained by the three factors (**F1**=15%; **F2**=13%; **F3**=13%), with high values for Factor Score Adequacy (0.84-0.95). A good model quality was shown by the small Root Mean Square of Residuals (RMRS=0.04). Finally, the fit based upon off-diagonal values (=0.97) indicated that the model explained the correlations well. The CFA further validated this construct, showing a good fit of the model to the data (CFI=0.993; TLI=0.990; RMSEA=0.057; SRMR=0.066; Chi^2=61056.591, df=32, p<0.001). Although the Chi^2 test was significant, this can be caused by large sample sizes (Giesselmann & Windzio, 2012, p. 188; Muthén, L. K., & Muthén, B. O., 2017, p. 795). The reference loadings were held by *ple0033* for **F1**, *plh0036* for **F2**, and *plh0035* for **F3**, respectively. All variables significantly loaded on the factors with low Standard Errors (SE<0.008). The factors were moderately correlated with each other (Cov(**F1**, **F2**)=0.114; Cov(**F1**, **F3**)=0.424; Cov(**F2**,

F3)=0.204). Furthermore, all variables showed significant within-variances, which supports their usefulness in capturing differences in the sample. The bootstrapping showed bias values close to 0 with low Standard Errors (SE<0.0052), indicating that the bootstrapping estimates were very close to the original estimates. Some parameters showed potential for covariances, which had also been established by the CFA. Thus, the robustness of the model was further strengthened. The sensitivity analysis was performed by comparing the results with a 10% increase in one variable with the original results. The comparison revealed nearly identical loadings on the factors, including very similar Standard Errors. The covariance between the factors, the within-variance of the individual variables, and the Chi^2 test statistics were also almost identical. Hence, the model estimates were reliable and robust.

4.3 Hypothesis 1: A higher fear among individuals is associated with a higher likelihood of choosing a vegetarian or vegan diet.

The GSEM of the main model with variable *ple0182* revealed a significant positive but very small association of the latent construct of fear with the dependent variable. The model fit indices (CFI=0.914; TLI=0.884; RMSEA=0.090; SRMR=0.062) indicated a moderate to good fit of the model. The Breusch-Pagan-Test showed a heteroscedasticity of the model residuals (BP=2005.7, df=10, p<2.2e-16). Additionally, the model residuals were positively tested for autocorrelation using the Durbin-Watson-Test (DW=1.396, p<2.2e-16). Therefore, Robust Standard Errors were calculated and compared to the regression results. Consequently, a significant, very small positive association between the latent variable for fear and the dependent variable was detected (see Table 1). The full GSEM with control variables differed significantly from the base model (Standard Chi^2=32502.05, df=51, p<0.001) with moderate to good model fit indices (CFI=0.906; TLI=0.878; RMSEA=0.084; SRMR=0.065). The results showed a significant, weak positive association between the income group and *ple0182*. The model comparison with the base model using the Satorra-Bentler method indicated a significantly better fit of the model with the control variable (ΔChi^2=561.47, Δdf=10, p<2.2e-16). Similar results regarding regression coefficients, model fit indices, and comparison to the base model were found for the GSEM extended by the control variables of gender and age group The

regression coefficients showed a significant small positive association between *ple0182* and gender, and a significant small negative association with the age group (see Table 1).

4.4 Hypothesis 2: A higher fear among individuals is associated with a higher likelihood of being a member of an environmental interest group.

The GSEM of the main model with variable *plh0266* revealed a significant positive but very small association of the latent construct of fear with the dependent variable. The model fit indices (CFI=0.914; TLI=0.885; RMSEA=0.085; SRMR=0.060) indicated a moderate to good fit of the model. The Breusch-Pagan-Test showed a heteroscedasticity of the model residuals (BP=1099.5, df=10, p<2.2e-16). Additionally, the model residuals were positively tested for autocorrelation using the Durbin-Watson-Test (DW=1.3335, p<2.2e-16). Therefore, Robust Standard Errors were calculated and compared to the regression results. Consequently, a significant, very small positive association between the latent variable for fear and the dependent variable was detected (see Table 1). The full GSEM with control variables differed significantly from the base model (Standard Chi^2=52532.21, df=51, p<0.001) with moderate to good model fit indices (CFI=0.909; TLI=0.883; RMSEA=0.079; SRMR=0.059). The results showed a significant, weak positive association between the income group and *plh0266*. The model comparison with the base model using the Satorra-Bentler method indicated a significantly better fit of the model with the control variable (ΔChi^2=801.19, Δdf=10, p<2.2e-16). Similar results regarding model fit indices and comparison to the base model were found for the GSEM extended by the additional control variables. However, the regression coefficients showed no significant association between the age group and *plh0266*, and a significant, weak negative association with gender (see Table 1).

Table 1: Generalised Structural Equation Model coefficients for fear and sustainability-related behaviour and control variables in additional models

Variables	Scale	Base GSEM with fear b (SE)	p	GSEM with control variables b (SE)	p
H1: Diet					
ple0182	0-1	0.019 (0.003)	<0.001***		
Income group	1-3			0.007 (0.003)	<0.013*
Gender	1-2			0.053 (0.004)	<0.001***
Age group	1-5			-0.017 (0.002)	<0.001***
H2: Env. group					
plh0266	0-1	0.011 (0.002)	<0.001***		
Income group	1-3			0.027 (0.002)	<0.001***
Gender	1-2			-0.013 (0.002)	<0.001***
Age group	1-5			0.000 (0.001)	0.809
H3: Voting					
plh0012_h	0-1	0.072 (0.003)	<0.001***		
Income group	1-3			0.042 (0.004)	<0.001***
Gender	1-2			0.053 (0.005)	<0.001***
Age group	1-5			-0.047 (0.002)	<0.001***
H4: Env. conscious					
pli0160	1-4	-0.108 (0.003)	<0.001***		
Income group	1-3			-0.041 (0.008)	<0.001***
Gender	1-2			0.096 (0.010)	<0.001***
Age group	1-5			0.150 (0.004)	<0.001***

* corresponds to p≤0,05; ** corresponds to p≤0,01; *** corresponds to p≤0,001

4.5 Hypothesis 3: A higher fear among individuals is associated with a higher likelihood of voting for the Green Party.

The GSEM of the main model with variable *plh0012_h* revealed a significant positive but very small association of the latent construct of fear with the dependent variable. The model fit indices (CFI=0.905; TLI=0.872; RMSEA=0.090; SRMR=0.067) indicated a moderate to good fit of the model. The Breusch-Pagan-Test showed a heteroscedasticity of the model residuals (BP=14932, df=10, p<2.2e-16). Additionally, the model residuals were positively tested for autocorrelation using the Durbin-Watson-Test (DW=0.727, p<2.2e-16). Therefore, Robust Standard Errors were calculated and compared to the regression results. Consequently, a significant, very small positive association between the latent variable for fear and the dependent variable was detected (see Table 1). The full GSEM with control variables differed significantly from the base model (Standard

Chi^2=214982.70, df=51, p<0.001) with moderate to good model fit indices (CFI=0.897; TLI=0.867; RMSEA=0.084; SRMR=0.068). The results showed a significant, weak positive association between the income group and *plh0012_h*. The model comparison with the base model using the Satorra-Bentler method indicated a significantly better fit of the model with the control variable (ΔChi^2=1458.1, Δdf=10, p<2.2e-16). Similar results regarding regression coefficients, model fit indices, and comparison to the base model were found for the GSEM extended by the control variables of gender The regression results showed a significant small positive association between gender and *plh0012_h*, and a significant small negative association with the age group (see Table 1).

4.6 Hypothesis 4: A higher fear among individuals is associated with a higher likelihood of being environmentally conscious.

The GSEM of the main model with variable *pli0160* revealed a significant negative but small association of the latent construct of fear with the dependent variable. The model fit indices (CFI=0.902; TLI=0.868; RMSEA=0.090; SRMR=0.066) indicated a moderate to good fit of the model. The Breusch-Pagan-Test showed a heteroscedasticity of the model residuals (BP=143.71, df=10, p<2.2e-16). Additionally, the model residuals were positively tested for autocorrelation using the Durbin-Watson-Test (DW=1.577, p<2.2e-16). Therefore, Robust Standard Errors were calculated and compared to the regression results. Consequently, a significant, small negative association between the latent variable for fear and the dependent variable was detected (see Table 1). The full GSEM with control variables differed significantly from the base model (Standard Chi^2=13420.83, df=51, p<0.001) with moderate model fit indices (CFI=0.895; TLI=0.864; RMSEA=0.084; SRMR=0.064). The results showed a significant, weak negative association between the income group and *pli0160*. The model comparison with the base model using the Satorra-Bentler method indicated a significantly better fit of the model with the control variable (ΔChi^2=387.94, Δdf=10, p<2.2e-16). Similar results regarding model fit indices and comparison to the base model were found for the GSEM extended by the control variables of gender, and age group. The regression coefficients showed a significant, but small positive association between the age group and *pli0160* and a significant, weak positive association with gender (see Table 1).

5 Discussion

First, the findings of the quantitative statistical analysis of the SOEP data are discussed and brought into the context of the literature review. However, as contemporary research on fear and sustainability-related behaviour was found to be predominantly influenced by specific instances of fear and eco-anxiety, the discussion was extended by findings from the general psychology of fear. Therefore, this study also fulfilled an explorative function. As the study of fear in relation to sustainability problems and behaviour is still in its beginnings, the theoretical foundation of the research subject is weak. Thus, explorative research is useful to create a deeper understanding and to test the feasibility of conducting further research, including the use of its methods (Amedeo et al., 2009).

5.1 Summary of findings

Overall, the analysis of the SOEP data revealed that the levels of some of the selected proxies for sustainability-related behaviour were rather low, with only 6.8% of participants following a vegetarian or vegan diet across the entire time and even lower rates of people being a member of an environmental interest group. Only voting for the Green Party and coalitions with it showed higher rates with, on average, 13.1% of participants, as well as higher rates of people describing themselves as environmentally conscious. Nonetheless, an increasing trend was observed, which aligns well with contemporary indications that the topic of sustainability has received increased attention in recent years (Flynn et al., 2024). The results could partly indicate an attitude-behaviour gap of people claiming to be environmentally conscious but not acting upon it regarding active public engagement or dietary changes. The trends of the individual variables for the latent construct of fear showed ambiguous results, with moderate to low levels on average and some slightly increasing and some decreasing. This is at least in part at odds with some of the trends of increasing fear (Albert et al., 2024; Hickman et al., 2021). A potential explanation is that some of the items for the latent construct of fear (e.g., "Worry a lot"; "Deal well with stress") are unspecific in comparison to the concrete fear of, e.g., war. Here, the three-factorial structure along the dimensions of general worries and functional impairments, worries about specific societal or global

situations, and aspects of coping ability and personal worries found in this study illustrated this multidimensionality.

All models for the hypotheses produced significant results, also when models employed Robust Standard Errors (SE). As lower values for the variables resembled higher levels of fear and lower sustainability-related behaviour, the following implications can be drawn. The effect sizes of the associations, including SE, were rather low, with values between b=0.011 (H2) and b=-0.108 (H4). It is quite usual that a weak correspondence between statistical inference modelling and survey data collection is apparent in social and human sciences, especially with large longitudinal datasets. The effects can yet be interpreted as meaningful due to a variety of reasons. The main reason longitudinal Fixed Effects regressions find small effect sizes, and less often statistically significant coefficients is the low statistical power, as only the within variance is analysed (Stoetzer, 2020, p. 237). This can also be caused by complexities, such as previously unstructured knowledge and inconsistent theory, or difficulties in finding accurate measures for constructs (Amedeo et al., 2009). Also, as all dependent variables except for being environmentally conscious were in a dichotomous format, the effect size represents a higher impact on the sustainability-related behaviour than if they were represented by a larger scale, as was the case for the latent construct of fear on a 7-point Likert scale. For example, a decrease of fear by one unit was associated with an increase of 0.072 units for voting for the Green Party, indicating an increase of 7.2% of its entire range, which in turn is more significant. This relative difference was also given between the measurement of fear and being environmentally conscious (4-point Likert scale).

In summary, an increase in fear was associated with not following a vegetarian or vegan diet, not being a member of an environmental interest group, and not voting for the Green Party. Only the counter-directional association between increased fear and more environmental consciousness was stronger, although still weak overall (b=-0.108). Thus, hypotheses H1-H3 were rejected, referring to higher fear being associated with a higher likelihood of choosing a vegetarian or vegan diet (H1), being a member of an environmental interest group (H2), and voting for the Green Party (H3). Only hypothesis

H4 was confirmed, as higher fear was associated with a higher likelihood of being environmentally conscious (H4).

Generally, the models in this study gained explanatory power when the control variables of income group, age group, and gender were introduced, underscoring their relevance for the prediction of sustainability-related behaviour. Higher income, being female, and lower age were associated with a vegetarian or vegan diet. Higher income and being male were associated with being a member of an environmental interest group. Higher income, being female, and lower age were associated with voting for the Green Party. Lower income, being female, and higher age were associated with increased environmental consciousness. The significance of the results gives reason to examine the relationship between fear and sustainability-related behaviour more closely. This is also illustrated by the fact that the results partly contradicted many studies from the literature review that have shown a positive influence of constructs like eco-anxiety on pro-environmental behaviour and moderating effects of gender, age, and income (e.g., Becht et al., 2024; Heeren et al., 2023; Ogunbode et al., 2022; Tam et al., 2023). In this study, higher levels of fear were only found to be associated with being environmentally conscious, but not the other more concrete forms of behaviour. Also, the findings differed from those studies in that they referred to a general form of fear through the latent construct. Furthermore, previous studies using SOEP data to analyse the effects of personality traits on green household installations only showed a weak indirect association through environmental concern (Busic-Sontic & Brick, 2018). Regarding other studies using the SOEP data, this study's approach is also a novelty. Related studies focussed on general trends of environmental concern (Hartmann & Preisendörfer, 2021), or the impact of fear on life satisfaction, whereas fear was operationalised through being optimistic or pessimistic about the future (Piper, 2014). Generally, few studies tried to analyse the relationship between the Big Five personality traits (see Goldberg, 1990; John & Srivastava, 1999) and sustainable behaviour (Akbar et al., 2020; Milfont & Sibley, 2012), or general behaviours, such as decision-making (Chanel & Chichilnisky, 2009; Kligyte et al., 2013). Due to the discrepancies found in the present study compared to the previous state of research, the following subsection is devoted

to the contextualisation and interpretation of the results regarding general findings on the impact of fear on human behaviour.

5.2 Implications

The discrepancy between findings in this study and research on the impacts of, e.g., eco-anxiety on sustainability-related behaviour showed that there is a difference between general concepts of fear and those that are already closely connected to sustainability problems. To interpret the findings, a closer look at the potential underlying mechanisms of the association is necessary. While increased levels of eco-anxiety can be observed in various contexts, the concept is not sufficient to accurately identify the different fears of the general population influencing sustainability-related behaviours. Especially those who experience fear that cannot be described by eco-anxiety are thereby left out. Focussing on general fear, also in differentiation from personality traits, has the advantage of examining some universal characteristics, as it is at least in its core affective state part of every human being. Also, the concept helps capture individual stimulus-directed experience according to Conceptual Act Theory, enabling a closer examination of potential leverage points. Of course, it is important to acknowledge that sustainability-related behaviour has many different antecedents, such as the attribution of responsibility, perceived control, assumed consequences, knowledge and capabilities, behavioural options, or social norms and values (Homburg & Matthies, 1998; Kals et al., 2006). Still, emotions are strong predictors of environmentally related behaviour (Hellbrück & Kals, 2012). Thus, fear must be viewed as part of a multidirectional system of conscious and sub-conscious cognitive-emotional processes (Miller, 1998). This is further illustrated by the possibility that engaging in sustainability-related behaviour influences the intensity of eco-emotions, indicating the existence of feedback loops (Contreras et al., 2024; Heeren et al., 2023).

5.2.1 General impact of fear on sustainability-related behaviour

Although a link was shown between more or less specific forms of fear and sustainability-related behaviours, the literature review was not able to reveal conclusive insights on the underlying mechanisms. These were partly provided by the quantitative analysis of

this study, but a further interpretation of the general mechanisms behind fear is necessary.

For this study, fear was defined as a future-directed immediate and intense reaction to threatening, uncertain, or uncontrollable events, situations, or imaginations to mobilise resources to overcome that threat. Preceding conditions such as situational variables and individual dispositional variables shape how through primary appraisal a situation is evaluated as threatening. If that is the case, a second appraisal asks whether the situation is manageable or whether it is possible to flee from that situation. Depending on the outcome of the second appraisal, different coping strategies are deployed (Homburg & Matthies, 1998). Fear usually fulfils the function of preparing the body for a quick reaction of fight, flight, or freeze. Fight or flight reactions follow a subconscious, automatic, and quick pattern (Morschitzky, 2009). In the context of environmental fear, fight can be interpreted as a motivational function to mobilise resources to act upon problem-solving behaviour; flight can be seen as a mechanism that leads to a cognitive dissolution of fear through denial and other strategies; freeze is often expressed through pathological or maladaptive forms of fear (Gardner & Stern, 1996; Peter et al., 2021; Rees & Lamberty, 2022). Arguably, interpretations for all these components can be found in the quantitative results of this study. Fear motivated a stronger environmental consciousness, representing a fight function. However, this variable did not specify actual engagement, so it remained unclear whether environmentally conscious participants followed actual behaviour. The characteristics of the flight mechanism were apparent in the associations between fear and voting behaviour, dietary behaviour, and engagement in environmental interest groups. Also, some links to maladaptive forms of fear were established as items representing functional impairment through emotional problems formed one of the three factors for the latent construct for fear validated here.

Nowadays, the main functions of behaviour resulting from fear have changed from a direct protection and defence mechanism to a communicative role in social contexts (Adolphs, 2013). Several aspects are important to consider here. First, the genetic makeup of modern humans has not substantially changed from when the species *Homo sapiens sapiens* first appeared about 30,000 – 90,000 years ago. Thus, the way how the

human brain is hardwired still corresponds to the environmental situations of primeval times. On the one hand, contemporary social, political, and technological systems created by cultural evolution are too complex for the human mind to comprehend by itself. On the other hand, reactions to fear-inducing stimuli that were once adaptive, now have the potential to negatively impact those systems (Gardner & Stern, 1996; Homburg & Matthies, 1998). Also, the lack of care about specific threats in modern times can be attributed to a lack of genetic predispositions, which evolved slower than the cultural evolution of our societies (Morschitzky, 2009).

Without the physical reduction of tension through classical fight or flight behaviour, fear can lead to chronic stress and overstimulation in modern societies (Morschitzky, 2009). According to environmental-stress theory, physiology, emotion, and cognition are interacting with behaviour due to stress that is induced as a consequence of environmental stimuli that exceed an optimal level. The response is partly automatic. Once the coping mechanisms are depraved, an exhaustion sets in that can have pathological consequences (Bilotta & Evans, 2013; Veitch & Arkkelin, 1995). In addition, a discrepancy between attitudes and behaviour, which often occurs in the area of sustainability, can also lead to cognitive discomfort (Diekmann & Preisendörfer, 1992; Veitch & Arkkelin, 1995). The connection between environmental stress and individual health and well-being is made by including the notion of costs in terms of physical and mental energy that needs to be invested to cope with the stressors (Bonnes & Secchiaroli, 1995). Biological, psychological, and social predisposition factors explain why a person reacts with certain pathological symptoms to stress factors or not (Krimmer, 2022). Therefore, a consideration of fear, worry, etc. from a psychopathological perspective is appropriate given the context of severe sustainability problems referred to in this study. The DSM-V (American Psychiatric Association, 2000), and the ICD-11 (World Health Organization, 2022) are international classification systems that list criteria that need to be met for a mental discomfort to count as a psychological disorder. The DSM is used for psychiatric diagnoses based on statistical and reproducible findings, while the ICD-11 offers more accurate diagnostic criteria (Morschitzky, 2009). Anxiety disorders are categorised into panic disorders, generalised anxiety disorder, PTSD, acute

stress disorder, and more (American Psychiatric Association, 2000; World Health Organization, 2022). Thus, emotional-oriented coping as a result of the experience of unpleasant emotions needs to be integrated into the discussion on the implications of fear and sustainability-related behaviour (van Bronswijk, 2022). As psychological, emotional, and social functioning are seen as prerequisites for general well-being, negative emotional reactions to environmental problems, including anxiety, are seen as potentially harmful to the quality of life (Hogg et al., 2024).

Arguably, fear can take many forms (Taras, 2015) which makes it particularly challenging to study its general effects on sustainability-related behaviour, as the information accessible through self-report usually refers to specific instances. Still, some forms of fear can be categorised to draw conclusions. One example, which is closely related to the issue of sustainability problems, is the notion of existential fears (Heinzel, 2022), some-times also called death anxiety (Pihkala, 2018). Ultimately, fear of death is seen as a universal feature of humankind. Several means to give meaning to one's life even after death have been described, such as producing offspring (biological), reaching legacy through work and arts (creative), or symbolic immortality through religion or the persistence of nature itself (theological). The climate crisis and other sustainability problems put all these possibilities under threat. Just as becoming aware of oneself leads to the experience of death anxiety, recognising the link and dependence on the natural environment can lead to existential anxiety. Thus, eco-anxiety and all other related concepts can be understood as being part of a larger existential anxiety, which is part of our very nature. The awareness of environmental problems, however, has brought a new dimension to this existential anxiety (Pihkala, 2018). For some who are not directly affected yet, this may feel like a looming shadow, while the threat is tangible for others. This relationship inevitably leads to a change in behaviour, often leading to unsustainable actions, as also shown by the decreasing levels of being a member of an environmental interest group or following a vegetarian or vegan diet while experiencing fear in this study. Also, in times of commonly found anxiety, Pihkala argues, people tend to follow authoritarian leadership to escape their fears and engage in collective movements, providing at least some idea of immortality. Regarding climate change, problematic

behaviours can take forms such as consciously blaming others, subconsciously distancing from outsiders, following denialistic leaders (Stollberg & Jonas, 2021), and others.

Influenced not least by fear, the ways people think of the future impact human behaviour (Gilead et al., 2018; Hershfield & Bartels, 2018). People have highly subjective representations of the future. Rather than intentional ignorance of some pieces of information, the missing pieces are caused by semi-conscious processes in future-oriented thinking. Also, the closer the imagined events, objects, or people are to an individual, the more realistic or even pessimistic these evaluations become. This is the case for temporal distance, as well as spatial distance and social distance, but also hypotheticality (Gilead et al., 2018; Hershfield & Bartels, 2018). Therefore, self-efficacy, environmental awareness, an orientation towards ethical principles and knowledge of options for action can be enhancing factors to promote sustainability-related behaviour (Peter et al., 2021). Still, acceptance of measures to protect the environment seems to dwindle the higher the costs for individuals are (Homburg & Matthies, 1998). Other antecedents to inaction include ideologies and worldviews, social influences, sunk costs, and perceived risks (Gifford, 2014), which are all significantly influenced by fear. The role of age groups, gender, and income group commonly reported in contexts of measuring sustainability-related behaviour was mostly supported by this study. In most cases, being male, older, and belonging to lower income groups was associated with less sustainability-related behaviours.

In summary, fear can have multiple impacts on individual sustainability-related behaviours. Some can be seen as adaptive, both in terms of sustainability impact and personal mental health, such as an increased information-seeking behaviour (Hogg et al., 2024), increased risk-perception (Böhm & Tanner, 2013), or engaging in private sphere, public sphere, or radical sphere sustainability-related behaviour. However, as shown in this study, fear can also lead to disengagement in those behaviours. On the one hand, this can be explained by flight reactions of fear but also by a lack of physical, emotional, and cognitive resources to engage in productive coping behaviour. Also, not all those behaviours are necessarily beneficial for mental well-being. Some are short-term adaptive on a personal level but are linked to adverse outcomes for sustainable

development, such as denial, blaming others, repression of the issue, and more (Habibi-Kohlen, 2021). There are those forms of fear that are maladaptive and are usually the result of non-sufficient or lacking coping abilities, leading to lower well-being and potentially clinically relevant forms of fear and anxiety.

5.2.2 Collective aspects of fear

Fear that exists because of the need to face existential questions and the complexity of sustainability problems can lead to the approach of ideological groups. Those can induce a feeling of belonging alongside offering supposedly simple solutions to complex problems. Thus, this can be seen as a form of escapism (Miller, 1998). Ideological groups characterised by denialism create the illusion of simple solutions through several strategies, such as thrilling storylines, powerful villains, referring to their own sources and research, and the tendency to believe in conspiracy theories (Rees & Lamberty, 2022). Denial is one of those traits that may have developed to enhance survivability. Moderate levels of denial led to early humans taking some risks, but not too many, consequently strengthening their chances of survival. In modern society, due to the complexity of systems and the increased human influence on them, even moderate denial can have critical consequences that destabilise any of the systems that we live in. This can go as far as to cause catastrophic and irreversible events, also regarding underestimations of risk. However, denial is also a mechanism that can help to reduce levels of stress in the face of threats that are perceived as uncontrollable (Gardner & Stern, 1996).

In Germany, about one in ten people are, in principle, receptive to claims that question climate change, its anthropogenic causes, or the necessity to act in different ways (Goebel et al., 2023; Rees & Lamberty, 2022). Denial of climate change correlates with misanthropic attitudes, such as antisemitism, sexism, devaluation of people seeking asylum, and the approval of violence as a last resort to regain political control. The assumption is that personal events that result in a loss of control over one's life situation make people more receptive to such theories, which bring back a certain predictability (Rees & Lamberty, 2022). Also, the fear of being left behind or losing identity is emphasised as a driving force behind right-wing extremism. According to Neumann

(2023), right-wing reactions in Germany can be divided into flight, moving to ethno-nationalist settlement projects in the countryside or taking refuge in conspiracy theories, or fight, choosing a way of violence.

Those and similar dynamics have important implications for moving towards a sustainable future. Spaiser et al. (2023) describe several mechanisms of social tipping points following the destabilisation of natural systems, which could lead to a new social system state of increased poverty, hostility, alienation, and violence. Those tipping points are outlined as the breakdown of norms and social order, radicalisation and polarisation, population displacement, conflict and financial destabilisation (Spaiser et al., 2023).

Meanwhile, fear is being instrumentalised by appealing to people's existential fears as an anchor to evoke new fears. Thus, the abuse of fear has become a significant force to be reckoned with in contemporary politics. As Taras (2015, p. 20) suggested:

"In Europe today the entrepreneurs of fear are most frequently the leaders of right-wing, populist, nationalist, and sometimes single-issue anti-immigrant political parties. These entrepreneurs are often the products of xenophobic grassroots political organizations. Some are opportunistic and see advantage in employing xenophobic discourse to expand and diffuse their organizational base."

Put more drastically, anyone who is able to pick up on the fears that are most prominent among members of a society and direct them towards a certain target will be able to mobilise the entire society (Bude, 2018). Wessinger (2021) argues, albeit in the context of eco-anxiety, that denial is just the first stage of a process further, including semi-consciousness, awakening, shock, despair, and encouragement. Still, individuals need to be supported in their coping with fear by other means than having to fall back to denialism. There is no single resilience measure that contributes to solving this problem by itself (Peter & Niessen, 2022). It is necessary to look at different systemic levels of climate emotions, i.e., the individual and the collective level and their interlinkages. Especially in the context of systems with multiple interactions, the identification of deep leverage points (Abson et al., 2017; Meadows, 1999) can be useful (Georgi et al., 2022). Resilience cannot be exclusively thought of on an individual level but needs to be

extended to communities and societies. Relying solely on individual resilience potentially even amplifies the trend towards more individualisation, which can be seen as a cause for many of the problems that society faces today. Also, an increased fear due to a stronger feeling of responsibility and the necessity to tackle one's fears alone can be the result. Social isolation is part of the reason why an emotional connection to one's surroundings and society is lost. This can lead to de-solidarisation and apathy, contributing to a reinforcing feedback loop of individualisation, performance pressure, and isolation of the individual (Habibi-Kohlen, 2021). Consequently, social networks need to be strengthened to function as a space where fears can be addressed, bonds to our natural environment can be strengthened, and prerequisites for societal change can be established (Weihgold, 2021). This need is further illustrated by the findings in this study that only a low proportion of participants engaged in sustainability behaviours related to diet and membership in environmental interest groups. It is often not the objective situation people find themselves in that gives rise to anxiety or fear, but rather the feeling of losing in comparison to significant people around them. Nowadays, society has provoked other-directedness as a measurement of one's success or happiness rather than relying on one's capabilities, skills, and ability to invest in oneself to produce a feeling of security. This other-directedness can also be problematic, as it might explain why many people do not engage in sustainability-related behaviours, being under the impression that others acting upon those is enough. Therefore, a social welfare state is combatting many fears of being thrown under the wheel due to the disadvantages of situational factors (Bude, 2018). Nevertheless, fear can also be empowering when it comes from the bottom up. However, the danger of xenophobes becoming entrepreneurs of fear also needs to be taken into account (Taras, 2015).

5.2.3 Implications for addressing fears

There is a need for constructive engagement with ecological, social, and environmental sustainability problems. Although fear has been a powerful tool to gather people's attention, it has also been regarded as ineffective in promoting genuine individual engagement (O'Neill & Nicholson-Cole, 2009). As the findings in this study also showed that fear and related emotions can lead to less sustainability-related behaviours, the

question is strengthened whether fear should be a constitutional part of a sustainable society. Overall, increasing levels of fear and mental discomfort indicate that it is reasonable to shift away from a dooming narrative and disregard of a culture of fear and anxiety in favour of a sense of hope that inspires agency (Llena et al., 2023). Notably, this does not imply that fears will not persist and that they should be dismissed, as it is not a realistic goal to live without fear. Rather, the attempt should be to learn to distinguish between justified and irrational fears; to overcome fears of non-existing threats; to better be able to tolerate fear of highly unlikely events, without obsessing about a need for security for a residual risk; to accept fear of uncontrollable events, without those fears spilling over into other areas of life; and to operationalise the fear of real threats into motivation for action and solutions without being overwhelmed (Morschitzky, 2009).

Emotions, including fear, fulfil a communicative role, sharing experience, and enabling coping mechanisms to become part of social discourse. Societal norms about the expression of emotions are also key in how a collective management of mental and sustainability crises can be achieved. Communication is supported by extending the knowledge about the different emotional states that can influence sustainability-related behaviour and that can be shaped by the environmental problems themselves (Clayton & Ogunbode, 2023). As various cultures display different approaches to understanding and handling fear, the role of communities and collective empowerment needs to be highlighted (Morschitzky, 2009). For example, Western societies express forms of cultural de-emotionalisation as a suppression of emotions due to a common view that talking about them is a sign of weakness (Dohm, 2021). Here, among others, the public discourse and media play an influential role in shaping the communication about fears. Thus, a cultural change towards societies and communities to accept fear and foster public discussion about it would be helpful in dealing with increasing negative emotions among the general public (Pihkala, 2022). There are two well-known recommendations for dealing with fear publicly. One key aspect is to understand the reasons behind the emergence of fear. Also, Parliamentarianism is identified as a form of organisation that is not put under the direct pressure of fear (Bude, 2018).

A crucial concept in overall communication on sustainability is the notion of positive psychology (Corral Verdugo, 2012; van Bronswijk et al., 2022; Voltmer & Salisch, 2024). The discrepancy between having understood the issue of sustainability problems intellectually and recognising the problem on an emotional level needs to be overcome (Habibi-Kohlen, 2021). While understanding the negative impacts of human behaviour is equally important, a vision of a better future cannot exist without trying to integrate ways of a bi-directional beneficial perspective of human-environment relationships into the academic agenda and public discourse. This might ultimately strongly resonate with the affectional aspects of human behaviour (Steg et al., 2013a). This view of balancing out hope and fear can be especially helpful in countering the negative image that sustainability-related behaviour is often associated with, e.g., through necessary measures being perceived as annoying, inconvenient, or connected to sacrifice (Corral Verdugo, 2012). A sustainable lifestyle can thus only be achieved by following a holistic definition of human well-being that, on the one hand, includes aspects of positive psychology and, on the other hand, acknowledges the dependence on the well-being of other systems like the natural environment. Furthermore, the role of hedonism, goal regulation, and meaning in life are emphasised in the context of achieving happiness, three aspects that are closely connected to a lifestyle in harmony with nature (Voltmer & Salisch, 2024). Yet, positive psychology is not exclusively concerned with the positive aspects of our mind, as understanding negative affect and cognition is equally important to make sense of the positive ones. The positive psychological consequences of sustainability-related behaviour can be a key strength in establishing a deep-rooted societal change fuelled by happiness shared among individuals as a critical driver of human well-being (Corral Verdugo, 2012). Additionally, strengthening the positive aspects of sustainability-related behaviour and related psychological constructs has the power to propel reinforcing feedback loops. Spill-over effects are also possible, e.g., by potentially moving away from an educational system that is tailored towards eliminating student's weaknesses without sufficiently fostering individual creativity, optimism, or self-efficacy. Also, a connection can be drawn to the general reward-punishment structure of societal institutions. Often, the focus lies on punishing unwanted behaviour

instead of promoting positive behaviour. However, this field of study is still in its infancy and still largely theoretical, without sufficient empirical evidence to back its concepts (Corral Verdugo, 2012). For the future, a narrative is needed that balances hope and fear (Heinzel, 2022). Also, the culture of laughter is seen to play an important role in overcoming fear (Bude, 2018). Finally, it can be assumed that a sustainability-related behavioural change is more likely to persist long-term when it originates from meaningful experience rather than solely from incentives, regulations, or anxiety (Maiteny, 2002).

Strengthening those psychological resources is, in part, the responsibility of education but also of those responsible for providing access to natural experiences, multiplying public information, gatekeeping ways of taking responsibility, etc. (Voltmer & Salisch, 2024). This also brings up new challenges for researchers and professionals such as psychists and psychologists on how to deal with those issues in the future (van Bronswijk & Hausmann, 2022). Affect-isolation regarding scientific publications that address various issues of sustainability problems can be problematic for the aforementioned reasons. While it is equally vital to uphold scientific standards of writing, thought is appropriate for the question of how also emotionally to convey messages to a broader public (Habibi-Kohlen, 2021). Also, professionalising in the sense of creating a financial incentive for working in sustainable psychology and setting up criteria that define those services is important. This includes criteria for public institutions, as well as the academic community (Hellbrück & Kals, 2012; Pihkala, 2022).

5.3   Limitations and future research

This study is not without limitations. First, the SOEP data was not designed for the purpose of this study. Consequently, the items from the SOEP were used as proxies for fear and sustainability-related behaviour, which resulted in an imperfect coverage of the definitions of fear and sustainability-related behaviour that were established here. Generally, voting behaviour, dietary behaviour, and membership of an environmental interest group are valid measures of sustainability-related behaviours. However, they only cover a small proportion of the relevant behaviours. Furthermore, not all items in this category were assessed on an annual basis. While this approach is reasonable for

more stable variables, such as personality traits, sustainability-related behaviour is influenced by many antecedents, making it more volatile. This is especially problematic in the case of environmental consciousness, which was only assessed in 1998 and 2003. Also, while environmental consciousness is correlated with sustainability-related behaviour, it is only an indirect proxy for it. Further, caution must be advised, as the subjective perception of an understanding of sustainability changes over time. This must be considered, especially when interpreting long-term studies. For future research to represent a more complete picture, surveys, including the SOEP, could integrate more holistic measures for sustainability-related behaviour in the dimension of ecological, social, and economic strong sustainability. For example, this could be achieved by including a more extensive variety of items and assessing them more regularly. As it is nearly impossible to capture all relevant behaviours for a sustainable society fully, a certain categorisation can be helpful. Therefore, an approach could be to measure sustainability-related behaviours along the dimensions of public sphere, private sphere, and radical sphere behaviour.

The same applies to the measures for fear. Here, the limitation was that no suitable validated construct was identified to be applicable to the SOEP data. As current research on emotions and fear showed, there is still a lack of consensus in terms of the process how emotions develop and how it is experienced by individuals. Thus, although the robust latent construct of fear used in this study includes several items that describe aspects of fear mentioned in the literature, the use of validated constructs is necessary for future data collection and studies. While those exist for the notions of eco-anxiety (Hogg et al., 2021) or climate anxiety (Clayton & Karazsia, 2020), it can be argued that they are not fit to fully capture all aspects of fear that are relevant to sustainability-related behaviour. A further issue lies in the discrepancy between the necessity to measure general levels of fear and the specificity of experiencing and communicating fear via self-report. One potential solution could be to establish a measurement tool that assesses the general susceptibility of individuals to fear and study its interactions with sustainability. Furthermore, the relationship between fear and sustainability-related behaviour is likely influenced by additional confounding factors, such as income,

educational degree, or political attitude, which could only partially be included in this study. One critical aspect that should be explored in future research is the role of individuals below the age of 18, which could not be included here because the SOEP questionnaire used in this study was only administered to participants above that age. As the younger generation is already heavily affected by fear and since they will shape how society develops in the future, extending research in this regard is essential.

A further downside of relying on self-reports, next to the different forms of response biases (van de Mortel, 2008) potentially distorting the reality of actual behaviours and levels of fear, lies in the difficulty of capturing the impact of sustainability-related behaviours. Nonetheless, the sustainability-related behaviours chosen here were considered relatively stable over a social desirability bias, except for reports on environmental consciousness. Sustainable impact has the benefit of being more tangible for stakeholders outside academia, e.g., for policy-makers. This would allow researchers to identify the more relevant behaviours among different forms of it. Furthermore, this enables discrimination between people engaging in multiple but low-impact behaviours and people with few but very impactful behaviours (Gatersleben, 2013). However, the weighting of those variables comes with its challenges of determining how environmental impact is quantified. Partly due to the aforementioned reasons, Gatersleben (2013) claims that psychology can only aim to understand behaviour by itself and not its impact. Also, due to the lack of detail in physical measurability, the method of self-report is commonly applied and justified in psychological research (Wagner & Morisi, 2019).

Additionally, the research design does not allow for the identification of a causal relationship (Amedeo et al., 2009; Taras, 2015). Instead, the correlation between fear and sustainability-related behaviour was tested. Future research could extend the method by trying to establish causal inference. Here, it is necessary to show that two variables change in a particular sequence. Inferring a causal connection between two or more factors allows for a story to be told, no matter if it proves the causal connection. This has the benefit of being able to engage in theory-building while being reflective

about the assumptions (Taras, 2015). Due to this study's limited capacity, it was not possible to investigate additional interaction effects, but these could certainly contribute to a more differentiated explanation of the dependent variables and should be addressed in future research.

Finally, as also shown by the literature review, challenges for future research of environmental psychology include the need for further integration into the broader context of research across the disciplines of sustainability science and psychology, further development of theories and methods, and engagement in inter- and transdisciplinary research designs (Steg et al., 2013b).

5.4 Ethical-normative aspects

Sustainability is a normative concept aimed at shaping the future following specific design criteria. Those criteria originate from diverse backgrounds and are not always without controversy. Most importantly, these criteria do not follow a universally given logic but are the product of our culture, as well. However, in this study, strong sustainability is considered mandatory for the survivability of humankind and for the assumed role that humans play in the course of life on Earth. Additionally, the notion of sustainability is built on underlying theoretical ethical paradigms that change depending on the perspective of the author (Bourban, 2021). Not only does that lead to incompatible sustainability paradigms, but it also allows for an abuse of what Zaccai (2012) calls the game of interpretation by powerful institutions. Strong sustainability does not fall short of different interpretations, either (see Bourban, 2021; Holland, 2008; Norton, 2005; Nussbaum, 2006; Ott, 2014; Sen, 1980). The discussion around sustainability is still dominated by Western world views and therefore represents narratives for a sustainability transformation that is led by stakeholders from those countries. This requires an ethical foundation of sustainability that represents all humans equally, also respecting path-dependent inequalities and injustices that need to be addressed (Becker, 2012; Hausmann et al., 2022).

Usually, the objectivity of the researcher is desired in science. However, in sustainability science, the researcher is part of the problem and is directly involved in relevant aspects. This makes a clear reflection of this relationship necessary (Homburg & Matthies, 1998).

Regarding the experience of fear, it needs to be pointed out that fear is manifested differently depending on the individual circumstances. While in Germany, fears regarding sustainability might centre around individual needs such as personal economic factors, in other regions of the world, this can also occur at other levels of Maslow's hierarchy of needs (Maslow, 1943), e.g., through basic physical needs being threatened. Germany, as part of Western society, can be held responsible for many of the sustainability problems that we face today. While it is a privileged position to analyse fear as a manageable leverage point, it can help to create an understanding of why Western societies struggle to fulfil their sustainability goals.

In summary, a holistic understanding needs to acknowledge the role of the present as a carrier of misperceptions, which will only be recognised later in retrospect. For example, etymological studies reveal the influence that earlier cultures had on our understanding of human psychology. Although technology has rapidly advanced since the times of the ancient philosophers, we cannot expect to have freed ourselves from all of our inherited misperceptions (Marcus et al., 2000). Thus, actions for a sustainable future need to uphold the ability of future generations to free themselves from such misperceptions and disregard of chronocentric solutions (Uhlig, 2021).

6   Conclusions

This study aimed to reveal the impact that fear can have on sustainability-related behaviours, using a structured literature review and data from the longitudinal SOEP of individuals in Germany. Until now, related fields of science such as eco-anxiety research are still in their infancy, although environmental psychology and the psychology of fear have already set a theoretical foundation.

While it was found that specific forms of fear-related affectional states, such as eco-anxiety, can have a positive impact on sustainability-related behaviour, this study showed that general fears were weakly associated with disengagement in different sustainability-related behaviours. Only self-reported environmental consciousness was found to be positively associated with the latent construct of fear used here. Thus, the multidimensionality of fear and its relationship with the sustainability agenda needs to be highlighted. Even though attention to sustainability problems and affectional involvedness, as well as some forms of coping, such as information seeking or engaging in sustainability-related behaviours, can be caused by fear, they should not be the constituent factors of sustainability-related behaviour. On the one hand, this can have negative consequences for individual mental well-being, for example, when the forms of behaviour are perceived as ineffective in countering the uncertain, complex, and extensive nature of sustainability problems. Thus, fear has side effects that are contrary to the notion of strong sustainability. On the other hand, fear can be abused by agents of populist, right-wing, and anti-democratic institutions that often follow goals that harm the much-needed progress towards a sustainable society.

Fears know no limits of demographics, cultural differences, or temporal focus. It is a central part of human nature and evolved with many adaptive characteristics. However, regarding its negative impacts on the sustainability agenda, fears can only be contained and dealt with through discussion, which requires accepting one's own fears. If the connection between fear and individual sustainability-related behaviour can be holistically analysed, the contribution to research, policy-making and the public has the potential to induce change at a very deep leverage point for sustainability. The importance becomes clear when looking at the ongoing societal developments of increasing fear, stagnation of progress towards sustainability goals, and increased mental discomfort of individuals across the world.

The challenge lies in the combination and integration of knowledge from the different disciplines, including sustainability science. This explorative study cannot accomplish this on its own, but the aim was to point out ways of delving deeper into the issue and moving forward in research. Ultimately, to constructively deal with individuals' fears, the

notion of positive psychology needs to be integrated into the concept of strong sustainability.

7 Final words

This thesis shall be finally concluded with some personal words to shed some light on the motivation behind the research objective. Although somewhat unconventional, I think it is fruitful to elaborate on my thoughts, and although this research was conducted with the goal of being objective to the best of my capabilities, it is still influenced by my normativity and understanding. Making this transparent can help to bring the findings into their rightful context.

But let me begin by extending my gratitude towards those who helped me during the process. Thanks are due to my wonderful friends, family, and loving partner, who actively supported me while writing this thesis. I am especially grateful to both of my supervisors, Prof. Dave Abson and Prof. Roman Trötschel, for encouraging me to follow my interest in this research. Furthermore, the statistical analysis would not have been possible without the provision of additional resources by the IT service of Leuphana University Lüneburg. Lastly, I would like to thank the team of the DIW for the opportunity to work with such high-quality data.

As a strong advocate for a fundamental shift away from harmful economic and societal systems it is easy to become frustrated with the lack of decisiveness of our governments. However, governments are only as strong as the people voting for them, at least in a functional democratic system. Thus, the question must be how to get rid of those systems that humans created, that we cannot control anymore. Many of those are strong remnants of times when people were lacking knowledge of the damage they were dealing on the one hand and when perpetrators of injustice, often originating from Western culture, were in power on the other hand.

However, I strongly believe in kindness and humanity in most individuals on Earth. Nonetheless, contemporary societal developments show how significant the impact of

fear can be. Still, acknowledging this seems to be something that public discourse, research, and politics are often dismissive about. Without a public discourse about our fears, overcoming habits, behaviours, and values that led us to the path that we are on, will be impossible. Otherwise, we remain vulnerable to those greedy, power-hungry, blinded men who want to exploit our fears.

Most of all, everyone lives with fears. Fear is a normal part of our existence. But accepting that fear, living with it, and fighting is part of what makes us human. Choosing to let the greedy, power-hungry people decide for us what that fight looks like only leads us down the same old path where we came from. The result is hatred, twisted and destructive, letting us believe that others are not human and they do not understand our fears. Excessive individualism is just as unhelpful as blind fanaticism and faith that pretends to take away fears and projects them onto others. This is at least one way in which the powerful have exploited and consolidated their power, and should not correspond to the original idea of faith. Added to this is commonly found social isolation, which prevents us from communicating our own fears and understanding the fears of others.

Accepting and understanding our fears is not an easy task to do, but the reward will be a closer connection to ourselves and nature, without the need to only pretend to be happy.

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9   Appendix

Table 2: Summary of all variables used in the study

Variable*	Label	Usage**	Original data format	Survey years	Dataset	In final analysis
hlc0005_h	Monthly net household income	CV	Metric [Euro]	All	hl	No
hlc0005_m	Monthly net hh income group per person	CV	Ordinal [1-3]	All	-	Yes
pla0009_h	Gender	CV	Nominal [dichotomous]	All	pl	Yes
ple0010_h	Birth year	CV	Metric	All	pl	No
ple0010_m	Age group	CV	Ordinal [1-5]	All	-	Yes
plg0078_h	General school-leaving degree	CV	Ordinal [1-5]	All	pl	No
ple0182	Vegetarian or vegan diet	SB	Recoded: nominal [dichotomous]	2016, 2018, 2020	pl	Yes
plh0012_h	Voting for Green Party	SB	Recoded: nominal [dichotomous]	All	pl	Yes
plh0266	Member of environmental interest group	SB	Recoded: nominal [dichotomous]	1998, 2001, 2003, 2007, 2011, 2015, 2019	pl	Yes
Pli0160	Environmentally conscious	SB	Ordinal [Likert, 1-4]	1998, 2003	pl	Yes
ple0027	Run-down, melancholy last 4 weeks	F	Ordinal [Likert, 1-5]	2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016-2021	pl	Yes
ple0033	Accomplished less due to emotional problems	F	Ordinal [Likert, 1-5]	2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016-2021	pl	Yes
ple0034	Less careful due to emotional problems	F	Ordinal [Likert, 1-5]	2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016-2021	pl	Yes
plh0032	Worried about economic development	F	Ordinal [Likert, 1-3]	All	pl	No

plh0033	Worried about finances	F	Ordinal [Likert, 1-3]	All	pl	Yes
plh0035	Worried about own health	F	Ordinal [Likert, 1-3]	1999-2021	pl	Yes
plh0036	Worried about environment	F	Ordinal [Likert, 1-3]	All	pl	Yes
plh0037	Worried about consequences from climate change	F	Ordinal [Likert, 1-3]	2009-2021	pl	Yes
plh0038	Worried about peace	F	Ordinal [Likert, 1-3]	All	pl	Yes
plh0185	Frequency of being worried in the last 4 weeks	F	Ordinal [Likert, 1-5]	2007-2021	pl	Yes
plh0188	Confident about future	F	Ordinal [Likert, 1-4]	1990-1993, 1995-1997, 2008, 2013, 2018	pl	No
plh0191	Barely able to cope with things	F	Ordinal [Likert, 1-4]	1990-1993, 1995-1997, 2008, 2013, 2018	pl	No
plh0216	Worry a lot	F	Ordinal [Likert, 1-7]	2005, 2009, 2012, 2013, 2017, 2019	pl	Yes
plh0221	Somewhat nervous	F	Ordinal [Likert, 1-7]	2005, 2009, 2012, 2013, 2017, 2019	pl	No
plh0226	Deal well with stress	F	Ordinal [Likert, 1-7]	2005, 2009, 2012, 2013, 2017, 2019	pl	Yes
hid	Current wave household number	I	Nominal	All	All	Yes
pid	Never changing person ID	I	Nominal	All	All	Yes
syear	Survey year	I	Metric	All	All	Yes
weights	Weighting factors	W	Metric	All	phrf	Yes

* The suffix "h" indicates a variable harmonised by the DIW; the suffix "m" indicates a variable modified or constructed for this study

** CV=Control variable; SB=Sustainability-related behaviour; F=Latent variable of fear; I=Identifier; W=Weighting factors

Table 3: Weighted descriptive statistics for all variables used for the latent construct of fear and sustainability-related behaviour

Variable	Total period 1998-2021						Reference year*	
	Mean	SD	Median	Q1	Q3	Count	Mean	SD
ple0182	0.068	0.089	0.0	0.0	0.0	79431	0.085	0.279
plh0266	0.042	0.089	0.0	0.0	0.0	98628	0.041	0.198
plh0012_h	0.131	0.222	0.0	0.0	0.0	235141	0.254	0.435
pli0160	3.213	0.185	3.0	3.0	4.0	36011	3.268	0.662
ple0027	4.864	1.458	5.5	4.0	5.5	590752	4.972	1.469
ple0033	5.836	1.490	7.0	5.5	7.0	590752	5.915	1.430
ple0034	5.994	1.370	7.0	5.5	7.0	590752	6.074	1.313
plh0033	4.440	2.120	4.0	4.0	7.0	590752	5.097	2.042
plh0035	4.321	2.082	4.0	4.0	7.0	590752	4.370	2.017
plh0036	3.502	1.897	4.0	1.0	4.0	590752	2.981	1.900
plh0037	3.544	2.035	4.0	1.0	4.0	590752	2.925	1.991
plh0038	3.163	2.039	4.0	1.0	4.0	590752	2.972	1.947
plh0185	5.547	1.487	5.5	4.0	7.0	590752	5.601	1.454
plh0216	3.617	1.740	4.0	2.0	5.0	590752	3.756	1.764
plh0226	4.550	1.522	5.0	4.0	6.0	590752	4.596	1.525

*The reference year is the year in which the most recent data was available. For ple0182 this was 2020; for plh0266 it was 2019; for plh0012_h it was 2021; for pli0160 it was 2003; for the variables, where missing data was imputed, this was 2021 (ple0027, ple0033, ple0034, plh0033, plh0035, plh0036, plh0037, plh0038, plh0185, plh0216, plh0226). Green indicates an increase in comparison to the total period, red a decrease (note that higher values represent lower levels of fear, and higher levels of sustainability-related behaviour)

Table 4: List of publications included in the literature review

Ágoston, Balázs, et al., 2024; Ágoston, Buvár, et al., 2024; Ágoston, Csaba, et al., 2022; Ágoston, Urbán, et al., 2022; Anneser et al., 2024; Becht et al., 2024; Boluda-Verdú et al., 2022; Carlson et al., 2024; Chan et al., 2024; Chen, 2016; Christodoulou et al., 2024; Chung et al., 2023; Cianconi et al., 2023; Clayton & Ogunbode, 2023; Comtesse et al., 2021; Contreras et al., 2024; Corral Verdugo, 2012; Demneh & Zackery, 2023; Gao et al., 2021; Goldwert et al., 2024; Heeren et al., 2022; Heeren et al., 2023; Hogg et al., 2024; Innocenti et al., 2021; Innocenti et al., 2022; Innocenti et al., 2023; Jain & Jain, 2022; Jarrett et al., 2024; Joy J et al., 2021; Kabasakal-Cetin, 2023; Kapeller & Jäger, 2020; Larionow et al., 2024; Leite et al., 2023; Lukacs et al., 2023; Lutz et al., 2023; Maiteny, 2002; Mathers-Jones & Todd, 2023; Meijers et al., 2022; Nakano & Hondo, 2023; Ogunbode et al., 2022; Parmentier et al., 2024; Pavani et al., 2023; Pickering & Dale, 2023; Pihkala, 2018; Pittaway et al., 2024; Qin et al., 2024; Rocchi et al., 2023; Rothermich et al., 2021; Sampaio et al., 2023; Sangervo et

al., 2022; Shah et al., 2021; Shao & Yu, 2023; Stanley et al., 2021; Stewart et al., 2023; Stollberg & Jonas, 2021; Strömbäck et al., 2023; Tam et al., 2023; Tucholska et al., 2024; Türkarslan et al., 2023; Vecina et al., 2024; Verplanken et al., 2020; Voltmer & Salisch, 2024; Vrselja et al., 2024; Whitmarsh et al., 2022; Williamson & Thulin, 2022; Zaremba et al., 2024; Zuo et al., 2024

Table 5: List of quantitative studies using the CCAS or HEAS in literature reviewed

Climate Change Anxiety Scale (Clayton & Karazsia, 2020)		Hogg Eco-Anxiety Scale (Hogg et al., 2021)	
Publication	Study area	Publication	Study area
(Hogg et al., 2024)	Australia	(Becht et al., 2024)	Columbia, Netherlands
(Kabasakal-Cetin, 2023)	Turkey	(Carlson et al., 2024)	USA?
(Lutz et al., 2023)	Canada	(Chung et al., 2023)	South Korea
(Mathers-Jones & Todd, 2023)	Australia	(Contreras et al., 2024)	?
(Pavani et al., 2023)	French speaking	(Goldwert et al., 2024)	USA
(Pittaway et al., 2024)	Australia	(Heeren et al., 2022)	French speaking: France, Africa
(Rocchi et al., 2023)	Italy	(Heeren et al., 2023)	French speaking: France, Africa
(Sampaio et al., 2023)	Portugal	(Innocenti et al., 2021)	Italy
(Türkarslan et al., 2023)	Turkey	(Lukacs et al., 2023)	Canada
(Vecina et al., 2024)	Spain	(Parmentier et al., 2024)	French speaking
		(Qin et al., 2024)	Chinese
		(Shao & Yu, 2023)	Chinese
		(Stewart et al., 2023)	USA
		(Tam et al., 2023)	Various
		(Tucholska et al., 2024)	Poland
		(Whitmarsh et al., 2022)	UK

10 Declarations (German)

Erklärung 1

Hiermit erkläre ich, dass ich die vorliegende Arbeit - bei einer Gruppenarbeit der entsprechend gekennzeichnete Teil dieser Arbeit - selbstständig verfasst und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt wurden, und - alle Stellen der Arbeit, die wortwörtlich oder sinngemäß aus anderen Quellen übernommen wurden, als solche kenntlich gemacht wurden. Die vorliegende Arbeit hat in gleicher oder ähnlicher Form noch keiner Prüfungsbehörde vorgelegen.

Erklärung 2

Die elektronische Fassung dieser Arbeit sowie die zusätzliche elektronische Fassung in anonymisierter Form gem. §7 Abs. 10 RPO stimmen inhaltlich überein.

_____   <u>Lüneburg, 24. Oktober 2024</u>

Unterschrift   Ort und Datum