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Walk it like you talk it: An Experimental Study on Barriers to Climate-Friendly Behavior from an Interdisciplinary Perspective

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Marcel Seifert, BSc

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Abstract English

Although most people agree that climate change is among the most pressing challenges of our time, they fail to take pro-environmental actions. While this "value-action gap" is well-documented, our understanding of its underlying behavioral processes remains scarce. In keeping with the open, interdisciplinary orientation of human ecology, this work is drawing on findings from different fields of behavioral science, such as psychology and behavioral economics, complemented by an evolutionary perspective, to investigate the determinants of climate-friendly behavior. Based on this, the following three factors, that can act as internal barriers for translating climate change concerns into actions and thus counteract pro-environmental behavioral changes, were identified. It was argued that individuals struggle to translate their values and knowledge into actions if: a) pro-environmental actions do not lead to immediate outcomes (immediacy); b) the actions have an impact on the environment only with a certain probability (uncertainty); and c) the individual contributions to climate change mitigation are marginal (marginality), as these factors can make it difficult for individuals to fully grasp the implications of their own actions. This work aimed to empirically investigate their simultaneous influence on pro-environmental decision-making and their moderation through personal factors. To this end, an online experiment studying behavior in a stylized environmental collective-risk social dilemma game was developed. This allowed to empirically investigate the underlying cognitive and behavioral factors of barriers and examine actual decisions in order to explain how different factors influence pro-environmental behavior as determinants of the value-action gap. The simultaneous investigation of all barriers revealed that the immediacy of the impact was the strongest barrier for contributing and reaching the climate goal and in turn enlarged the value-action gap. Also, uncertainty of actions was found to be of slight relevance in the climate game. However, marginality did not pose a significant barrier, which might have been due to too small group sizes. Moreover, results highlighted the importance of personal factors. Environmental concern, preference for delayed rewards and distrust in others positively affected contribution behavior, while higher degrees of cognitive abilities negatively affected the outcomes. On the basis of this approach, a detailed and comprehensive picture of the determinants of climate-friendly behavior was drawn. Further, by shedding light on the individual constraints of translating knowledge and environmental consciousness into action, this could work propose recommendations to improve successful communication and environmental policy design on closing the value-action gap.

Keywords

Value-action gap, barriers, pro-environmental behavior, climate change, collective-risk social dilemma, public goods game, online experiment, human ecology, anthropology, evolutionary perspective, psychology, behavioral economics

Abstract German

Obwohl sich die meisten Menschen einig sind, dass der Klimawandel zu den drängendsten Herausforderungen unserer Zeit gehört, versäumen sie es, umweltfreundliche Maßnahmen zu ergreifen. Während dieser „value-action gap“ gut dokumentiert ist, bleibt unser Verständnis der zugrundeliegenden Verhaltensprozesse dürftig. Im Einklang mit der offenen, interdisziplinären Ausrichtung der Humanökologie greift diese Arbeit auf Erkenntnisse aus verschiedenen Bereichen der Verhaltenswissenschaften zurück, wie zum Beispiel der Psychologie und der Verhaltensökonomie, ergänzt durch eine evolutionäre Perspektive, um die Determinanten klimafreundlichen Verhaltens zu untersuchen. Darauf basierend wurden die folgenden drei Faktoren identifiziert, die als interne Barrieren für die Umsetzung von Bedenken bezüglich des Klimawandels in Handlungen wirken können und somit umweltfreundlichen Verhaltensänderungen entgegenwirken. Es wird argumentiert, dass Individuen Schwierigkeiten haben, ihre Werte und ihr Wissen in Handlungen umzusetzen, wenn: a) umweltfreundliche Handlungen nicht zu unmittelbaren Ergebnissen führen (Unmittelbarkeit); b) die Handlungen nur mit einer gewissen Wahrscheinlichkeit eine Auswirkung auf die Umwelt haben (Unsicherheit); und c) die individuellen Beiträge zur Minderung des Klimawandels marginal sind (Marginalität). Dies wird damit begründet, dass diese Faktoren es erschweren können, die Implikationen der eigenen Handlungen vollständig zu erfassen. Ziel dieser Arbeit war es, den gleichzeitigen Einfluss der Barrieren auf die umweltfreundliche Entscheidungsfindung und deren Moderation durch persönliche Faktoren empirisch zu untersuchen. Zu diesem Zweck wurde ein Online-Experiment entwickelt, das das Verhalten in einem stilisierten sozialen Dilemma-Spiel mit kollektivem Umweltrisiko untersuchte. Dies ermöglichte es, die zugrundeliegenden kognitiven und verhaltensbezogenen Faktoren der Barrieren empirisch zu erforschen und tatsächliche Entscheidungen zu untersuchen, um zu erklären, wie verschiedene Faktoren das Umweltverhalten als Determinanten des „value-action gaps“ beeinflussen. Die gleichzeitige Untersuchung aller Barrieren ergab, dass Unmittelbarkeit die stärkste Barriere für das Beitragen und das Erreichen des Klimaziels war und damit den „value-action gap“ vergrößerte. Auch die Unsicherheit über die Auswirkung der Handlungen erwies sich im Klimaspiel als nicht unbedeutend. Die Marginalität stellte jedoch keine signifikante Barriere dar, was an einer zu kleinen Gruppengröße gelegen haben könnte. Darüber hinaus unterstrichen die Ergebnisse die Bedeutung von persönlichen Faktoren. Die Sorge um die Umwelt, Präferenz für verzögerten Nutzen und das Misstrauen gegenüber anderen wirkten sich positiv auf das Beitragsverhalten aus, während ein höherer Grad an kognitiven Fähigkeiten die Beiträge verminderte. Auf Basis dieses Ansatzes konnte ein detailliertes und umfassendes Bild der Determinanten klimafreundlichen Verhaltens gezeichnet werden. Basierend auf der Untersuchung der individuellen Einschränkungen bei der Umsetzung von Wissen und Umweltbewusstsein in Handeln, präsentiert diese Arbeit darüber hinaus Empfehlungen zur Verbesserung einer erfolgreichen Kommunikation und umweltpolitischen Gestaltung zur Verminderung des „value-action gaps“.

Keywords

Value-action gap, Barrieren, umweltfreundliches Verhalten, Klimawandel, soziales Dilemma-Spiel mit kollektivem Umweltrisiko, Öffentliche-Güter-Spiel, Online-Experiment Humanökologie, Anthropologie, evolutionäre Perspektive, Psychologie, Verhaltensökonomie

Climate Change has happened because of human behavior, therefore it's only natural it should be us, human beings, to address this issue. It may not be too late if we take decisive actions today.

Ban Ki-moon, former Secretary-General of the United Nations

In the long history of humankind (and animal kind, too) those who learned to collaborate and improvise most effectively have prevailed.

Charles Darwin

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IPCC	Intergovernmental Panel on Climate Change
MPCR	Marginal Per Capita Return
PEB	Pro-Environmental Behavior
PGG	Public Goods Game
WEIRD	Western, Educated, Industrialized, Rich and Democratic

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1. Introduction

Scientists have warned of climate change for many decades, pointing out the boundaries of our planet and the dangers of a continued global warming (Ripple et al., 2019). In light of the current environmental issues, humanity faces the most pressing challenges in its history. Human lifestyles and behaviors cause anthropogenic greenhouse gas emissions, leading to global warming and environmental deterioration all over the globe. As a result of climate change, extreme weather events, droughts and floods are becoming more intense and more frequent, as reported by the Intergovernmental Panel on Climate Change (IPCC, 2013).

With this, also socio-ecological factors will be influenced in the long run: decreased food security or water scarcity are only some of the most present challenges (Incropera, 2016). Moreover, climate change can also drive environmental migration (Hoffmann et al., 2020). These facts are, however, not new. The Club of Rome (Meadows et al., 1972) as well as reports from several climate summits have predicted the limits of the planet and changes in climate for nearly 50 years. In 1987, the World Commission on Environment and Development defined sustainable development for "Our Common Future" as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (p. 16).

Current efforts towards meeting this statement were the Paris Agreement of the United Nations Climate Change Conference in Paris and in the same year the ambitious Agenda 2030 with its Sustainable Development Goals that were adopted by the United Nations General Assembly (2015). With this definition of sustainability in mind and given the time that passed since the first reports and the still predominant necessity of such action-plans, it is observable that reduction of greenhouse gas emissions is still urgent (IPCC, 2013). However, this needed cutback seems to be hindered by an incongruence between knowledge, concerns, values and actual actions.

Zooming in from this macro level to a micro level, the same gap can also be observed in the individual behavior of a majority of citizens in western countries: although most people agree that climate change is among the most pressing challenges of our time, they fail to take pro-environmental actions, and willingness to "walk the talk" seems to be lacking (Kollmuss & Agyeman, 2002). As research shows, pro-environmental values are not always translated to actual behaviors and actions. This phenomenon is commonly referred to as "*value-action gap*" (Blake, 1999; Kollmuss & Agyeman, 2002).

So far, individual decisions and behavior were less in focus than institutional actors, which however, are of high importance for societal change (Clayton et al., 2015). To reach the

climate goals, behavioral change of consumption patterns and lifestyles, especially in the global food systems is necessary (Clark et al., 2020; Holden et al., 2014). Beliefs have to be translated to climate mitigation actions (Steg, 2018) and it has become obvious that individual actions are of essence. This raises the question: why do people fail to translate their pro-environmental orientations into actions? To this end, the behavioral processes underlying the choice of (in)activity at the individual level have to be empirically explored alongside the factors that prevent individuals from achieving the above-mentioned definition of sustainability.

Gifford (2011) distinguishes between structural and psychological barriers for pro-environmental behavior (PEB). While the former are typically outside a persons' control, the latter can be overcome individually. However, people often fail to identify effective actions and to assess their impact (Nielsen et al., 2020; Wynes & Nicholas, 2017). Moreover, pro-environmental behaviors such as recycling, energy-saving and the avoidance of flights come with individual costs (Diekmann & Preisendörfer, 2003; Farjam et al., 2019).

The decision between individual benefits and pro-environmental behavior for conserving a collective good such as the earth's climate, creates a collective-risk social dilemma (Milinski et al., 2008). Thus, when people decide to translate concern into action, they face cognitive difficulties in this decision-making process. These difficulties, or in other words barriers, can hinder the translation of the values into actual action via moderating effects.

To fully shed light on these barriers for pro-environmental behavior, the necessity for a more holistic (sustainability) science arises and boundaries between scientific disciplines have to be crossed (Clayton, 2019; Giampietro, 2001; Gifford, 2011; Kastenhofer et al., 2011; Nettle, 2009; Nettle et al., 2013; Nielsen et al., 2020; Peattie, 2010; Turaga et al., 2010; Venkatachalam, 2008; Vlek & Steg, 2007).

This crossing of disciplinary boundaries is in line with the concept of human ecology, which focuses on the relationships of humans and their environment and *"…unites an array of otherwise unconnected scholarly traditions*" (Freese, 2001). While there are different sub-strands and understandings of human ecology, what brings most of them together is that human ecology is not bound to single disciplines (Dyball, 2010) and the emphasis is on interdisciplinarity (Bates, 2012). Moreover, in light of a future post-normal science of sustainability, human ecology is declared as a suitable candidate, that also narrows the gap between social and natural sciences (Giampietro, 2001).

In keeping with this open, interdisciplinary orientation (Dyball, 2010), the aim of this study is to investigate cognitive determinants of climate-friendly behavior from the perspective

of human ecology to provide a deeper insight into the interactions between humans and their environment. The human side of this dyad shall be illuminated in an attempt to bridge between disciplines, grounded in an evolutionary perspective on the roots of human behavior. From historical hunter-gatherer minds to modern humans embedded in a western lifestyle, current findings from psychology complement this perspective and more specific insights from behavioral economics finally complete the picture. Literature of the latter two fields further provides information on aspects that are characteristic of environmentally relevant actions and their consequences.

In one merged framework of these disciplines, the following three aspects, that can act as barriers for translating climate change concerns into actions and thus counteract pro-environmental behavioral changes, were identified:

1. Immediacy: Climate-friendly actions often do not lead to *immediate* outcomes since a time or spatial lag exists between an action and its effect.
2. Uncertainty: The consequences of actions for the environment are perceived to be *uncertain* since each action shows an effect only with particular probability.
3. Marginality: The individual contribution to climate change mitigation is perceived to be only *marginal*.

Pro-environmental behavior is argued to be hindered by those three barriers, as they contribute to misjudging the implications of the individuals' actions and exacerbate to align individuals' decisions with their preferences. However, so far, the literature review shows that there are still several questions unanswered. The theoretical understanding of as well as empirical research on the three proposed barriers remain scarce. Moreover, their interaction and the extent of their effect on pro-environmental decision-making and the value-action are understudied, which this research aims to change. Therefore, the following research questions (*RQ*) will be addressed by this study:

> *RQ1: To what extent do the three identified barriers influence climate-friendly decision-making and the value-action gap?*
>
> *RQ2: Which personal factors such as environmental concern, environmental knowledge, political affiliation, cognitive abilities, trust in others or risk and time preferences have an influence on pro-environmental behavior?*

So far, studies in environmental sciences on pro-environmental behavior or on the value-action gap are largely based on surveys that assess environmental behavior on the basis of hypothetical questions and the self-assessment of respondents (Osbaldiston & Schott, 2012; Peattie, 2010). These settings, however, might miss to observe actual behavior, which is

central for the investigation of the value-action gap. Moreover, the impact of psychological barriers remains understudied, since emphasis is often put more on structural barriers (Gaspar et al., 2010).

To answer the research questions and close this research gap, this work aimed to theoretically conceptualize the role of the three barriers (immediacy, uncertainty and marginality), which were identified by particularly drawing on insights from behavioral sciences. Furthermore, the study aimed to empirically investigate the impact of these barriers in an actual decision situation instead of relying on self-reported behaviors. To this end, an experimental online setting in a group of test persons was applied. By this, the design of Milinski et al. (2008), who did similar work for uncertainty, is expanded by the factors immediacy and marginality.

On the basis of this approach, a detailed and comprehensive picture of the determinants of pro-environmental behavior and the value-action gap is drawn. The integration of an online experiment allows to investigate the underlying cognitive and behavioral factors of barriers. The results of this study provide a deeper insight into the obstacles and problems with which specific groups of people are confronted when adapting pro-environmental behavior. Moreover, by integrating an experimental approach as well as previous findings of psychology and behavioral economics, numerous links to current literature on pro-environmental decision-making in these fields are offered. In response to the call for necessary research on climate action (Steg, 2018) and as an addition to previous literature, an empirical understanding of the value-action gap is added.

The present study revealed that a majority of participants reported high levels of concern about climate change, which was positively related to contributions in the climate game. Higher cognitive abilities and, interestingly, trust in others were negatively related to contributions. Of the three barriers, immediacy showed the strongest impact across all aspects of the experiment. Uncertainty was found to have only limited effects, while marginality did not yield any effects.

The remainder of this paper is organized as follows: the following Chapter 2 provides an interdisciplinary perspective on the state of the art regarding the barriers to pro-environmental decision-making and determinants of the value-action gap. Chapter 3 proposes the theoretical framework, summarizes the collective-risk dilemma and presents the central hypotheses as well as predictions. The research design and methods are described in Chapter 4. Chapter 5 and 6 present the results, discuss the findings and conclude. The main text is accompanied with the budget, the study description given on the crowdsourcing platform and a full-text version of the experiment in the Appendix.

2. State of the Art

The scientific evidence on pro-environmental behavior and its antecedents as well as its implications is rich. To shed more light on the value-action gap it is essential to delve deeper into current literature of different disciplines. Beginning with the incongruence between pro-environmental values and actual behavior, the first section gives an overview on the value-action gap. The second section will further discuss an interdisciplinary perspective on pro-environmental behavior. The third section examines the underlying process of decision-making, which represents the step between values and pro-environmental behavior. The last section will cover several perspectives on obstacles to pro-environmental behavior and finally present the three barriers in detail.

2.1. Walk It Like You Talk It? The Value-Action Gap

Pro-environmental behavior has been recognized as *"behavior that consciously seeks to minimize the negative impact of one's action on the natural and built world (e.g. minimize resource and energy consumption, use of non-toxic substances, reduce waste production)"* (Kollmuss & Agyeman, 2002, p. 240). PEB is grounded in multiple factors, which in line with Kollmuss & Agyeman (2002, p. 257) are "*...environmental knowledge, values, and attitudes, together with emotional involvement as making up a complex we call 'pro-environmental consciousness'.*" Further, these authors state that this complex is part of one's "*broader personal values*" (p. 257).

Despite pro-environmental consciousness or broader personal values concerning environmental matters, a translation into actions aligning with these values is often absent and a considerable amount of people fail to "walk their talk". Blake (1999) as well as Kollmuss & Agyeman (2002) have thoroughly discussed and documented this issue as the "*value-action gap"*.

This phenomenon of lacking action was also described as attitude-behavior gap. Values and actions, however, are not perfectly identical. Based on Rokeach's (1973) work, Anable et al. (2006, p. 85) as well as Kollmuss & Agyeman (2002, p. 251) summarized that values "*are responsible for shaping much of our intrinsic motivation*", by being "*important life goals or standards that serve as guiding principles in life*" (Anable et al., 2006, p. 85). Attitudes, however, relate to feelings regarding tangible objects, people or issues and are less stable over time (Anable et al., 2006; Kollmuss & Agyeman, 2002).

The value-action gap was observed in multiple domains such as transport behavior (Anable et al., 2006) or green consumption (Nguyen et al., 2019; Peattie, 2010). In line with the reported value-action gap in food consumption (Chekima et al., 2017; Gifford & Chen, 2017; Vermeir & Verbeke, 2006), for example Young et al. (2010) summarized, that although about one third of the costumers claimed environmental concern and half of the costumers were in favor of organic products, actual purchase behavior remained below 10%. Moreover, the value-action gap was observed as gap between intention and action in buying renewable energy sources (Momsen & Stoerk, 2014). Although positive values indisputably are existent, pro-environmental behavior often is not realized as it would be expected.

The causes of this gap still remain unclear and have been investigated by several studies, which tried to shed light on the links between values and action. Among others, Ajzen's Theory of Planned Behavior (1991) is an often applied theory to investigate the value-action gap. However, for example in terms of travel behavior, Anable et al. (2006) concluded that this theory is not sufficient to fully account for the gap as it is "*too simplistic*" (p. 61).

Gaspar et al. (2010, p. 269) and Gaspar (2013, p. 2961) summarize that this vagueness in explaining the value-action gap is also caused by a "*positive fallacy*". By this they mean a misjudgment in practice and research, in that pro-environmental behavior is mainly a consequence of attitude, intention and information and therefore barriers remain understudied. However, literature shows that knowledge, information and knowledge alone are not enough to explain pro-environmental behavior (Kollmuss & Agyeman, 2002; Weber, 2018) and designated with different terms, there is a gap between "talking" and finally "walking the talk". The question remains what makes people fail to "walk their talk"? In order to answer this question, the process of decision-making for pro-environmental behavior comes into focus.

2.2. An Interdisciplinary Perspective on Pro-Environmental Behavior

All types of behaviors can be studied from different viewpoints. Combining different fields of research provides an interdisciplinary and broader perspective. This holds also true for studying pro-environmental decision-making and behavior. Thus, under the umbrella term of human ecology and its emphasis on interdisciplinarity (Bates, 2012; Dyball, 2010; Freese, 2001; Giampietro, 2001), the evolutionary as well as the psychological literature, complemented with insights from behavioral economics will serve as the basic foundation to explore the barriers. After a short general introduction to pro-environmental decision-

making in several domains of research, each of the three identified barriers will be discussed according to this procedure.

The first step to gain a comprehensive picture, is to examine the background of PEB, rooted in the human evolutionary history starting from its early ancestors. Within the field of evolutionary analysis of human behavior, diverse and different strands of literature exist (Brown & Richerson, 2014; Sear et al., 2007; Smith, 2017). However, this work will view them as complementary and will not focus on the differences, but on the synergies and, therefore, on the common assumptions.

From the evolutionary perspective, behavior is mainly driven by the interest in replicating own genes and not by the interest in species survival (Van Vugt et al., 2014). Dawkins (1976) denominated this as the selfish gene. Notably, this does not mean that humans are overwhelmingly selfish, as it is context dependent (Van Vugt et al., 2014) and cooperation can also arise due to mechanisms such as reciprocity (Nowak, 2006). Based on the concept of inclusive-fitness or kin selection, altruism is amplified if the recipients are genetically related or, in other words, relatives (Hamilton, 1964). In line with this, having children is expected to encourage PEB (Palomo-Vélez et al., 2020).

For an evolutionary perspective on PEB, different approaches were undertaken and documented in the literature. The evolutionary view draws a more negative picture as it is hypothesized that homo sapiens is "*unsustainable by nature*" (Rees, 2010, p. 13), since biological mechanisms are now maladaptive and not in line with the current challenges of the modern world and an evolutionary mismatch between past and current environments exists (Sih, 2013). Therefore, research highlights the importance of understanding human evolutionary history to solve environmental issues (Penn, 2003) and suggestions of solutions to promote PEB should be based on research which includes evolutionary human tendencies (Van Vugt et al., 2014). The same implications hold true for marketing and policy (Griskevicius et al., 2012). In line with this, authors examined energy consumption and the role of habits from the evolutionary point of view (Maréchal, 2009).

Concerning behavioral responses to climate change, again the consideration of an evolutionary perspective and a framework for empirical work is proposed to gain a broader understanding of human responses to environmental changes (Sih, 2013; Sih et al., 2011). Similarly, the challenge of balancing pro- and contra-environmental behavior can be studied from an evolutionary viewpoint (Sörqvist & Langeborg, 2019).

Likewise, there is a broad body of psychology literature that discusses PEB and decision-making in light of environmental matters. The literature covers various determinants of pro-environmental behavior (Bamberg & Möser, 2007; Blankenberg & Alhusen, 2018;

Hines et al., 1987; Stern, 2000), the relationship between rational choice and moral motivation (Turaga et al., 2010), values and PEB (Cameron et al., 1998; de Groot & Steg, 2008, 2010), behavior and environmental sustainability (Vlek & Steg, 2007), responsibility (Wells et al., 2011), up to the link between education and PEB (Hoffmann & Muttarak, 2020), motivating PEB (Steg & Vlek, 2009) or, more specific, green consumer behavior (Peattie, 2010). Also, there is a vast body of literature on climate change, starting from its link to psychology (Clayton, 2019; Clayton et al., 2015; Clayton & Manning, 2018) or behavioral contributions to climate change (Swim et al., 2011) as well as climate change and transport behavior (Anable et al., 2006).

Finally, the specific insights from behavioral economics add further perspectives on pro-environmental behavior. With the intention to bring more psychological literature to economics, introducing fairness and norms and by challenging the concept of homo oeconomicus, behavioral economics is a promising field to contribute to the understanding of human behavior and to deliver inputs for successful environmental policy (Carlsson & Johansson-Stenman, 2012; Croson & Treich, 2014; Kesternich et al., 2017; Shogren & Taylor, 2008; Venkatachalam, 2008). In terms of adaptation to climate change, behavioral economics emphasizes the importance of risk and time preferences regarding pro-environmental behavior (Bernedo & Ferraro, 2016).

2.3. Decision-Making for Pro-Environmental Behavior

The common denominator for the three disciplines in this thesis can be found in the process of decision-making and heuristics. Firstly, the similar focus on decision heuristics connects behavioral economics to evolutionary psychology (Witt, 2011). The latter can also help economists to learn more about objectives of behavior (Friedman, 2005; Witt, 2011). Secondly, Hutchinson & Gigerenzer (2005) proposed a connection of behavioral biology and psychology, as humans as well as animals often rely on heuristics or rules of thumb, that allow fast decision-making without full information to make decision-making easier and more efficient.

In practice, such heuristics can influence pro-environmental behavior, for example in the form of unconscious habits (Maréchal, 2009). Moreover, heuristics for social exchange can complicate balancing of environmentally friendly and unfriendly behavior (Sörqvist & Langeborg, 2019). Furthermore, Witt (2011) claimed a shared interest of evolutionary psychology and behavioral economics for attitudes towards risk and time, for heuristics and rationality or for cognitive limitations. These cognitive challenges that can appear

especially in terms of risk and time are also part of climate psychology (Clayton, 2019). With this link, the common basis of these three disciplines for this thesis is found.

The process of decision-making on an individual level is coupled with uncertainty (e.g. Heal & Millner, 2014), which itself is also accompanied by lack of knowledge (Lorenzoni et al., 2007), risk perception (e.g. Bernedo & Ferraro, 2016; Carlsson & Johansson-Stenman, 2012) and perceived adaptive capacity (Grothmann & Patt, 2005). Moreover, the costs of behavior are a central decisive factor for the value-action gap. In this context, Diekmann & Preisendörfer (2003) proposed *the low-cost hypothesis of environmental behavior*, which claims behavior is only affected by concern in low-cost situations. As such, low-cost actions will be undertaken, however, high-cost situations do not evoke pro-environmental behavior. Similar results for the translation of attitudes to behavior were found in an experimental study by Farjam et al. (2019).

From an evolutionary perspective, adaptive behaviors such as the human approach to uncertainty, the preference for immediate over future benefits, and the tendency to put self-interest before group interest (Bentley & O'Brien, 2015; Griskevicius et al., 2012; Van Vugt et al., 2014) have long contributed to successful survival. In dealing with climate change, however, they can become behavioral barriers that explain why increased environmental consciousness and knowledge are not always followed by appropriate action.

In this line of thought cognitive abilities need to be considered. Cognitive abilities were found to be positively correlated with willingness to take risks and patience (Dohmen et al., 2010). In terms of tackling climate change, the German National Academy of Sciences Leopoldina, (2019) concluded that brain power is of relevance due to increased adaptive capacity. However, in experimental situations, it has been shown, that participants with lower cognitive skills are more likely to contribute, if the money is not self-earned (Hackinger, 2016).

The numerous factors that influence the decision-making process towards pro-environmental behavior might make it difficult for individuals to grasp the implications of their own actions and in consequence could undermine individual efforts and actions. In other words, in the decision-making process, some elements could act as barriers to pro-environmental decision-making and deeper understanding is necessary.

2.4. Barriers for Climate-Friendly Behavior from Different Perspectives

In the following, general implications of restrictive factors to pro-environmental behavior will be explored and the three relevant barriers of this study will be proposed and presented in detail.

In the particular case of climate change, one point that needs to be addressed is the perception of climate change itself. Panno et al. (2015) summarized that perception promotes pro-environmental behavior. Weber (2010) depicts the complex issue of this perception and highlights the limits of action initiated by perception of climate change, as the latter is difficult to be perceived in personal experience as well as from statistical data. Direct experiences with climate change were shown to more have more impact on individuals than indirect experiences (Clayton et al., 2015). Misperception is promoted by the abstract nature of climate change or ignorance (Clayton, 2019). Similarly, Slovic (1987), proclaimed a bad human ability to understand environmental risks due to their imperceptibility. This is supported by Griskevicius et al. (2012), who summarized that human perception mechanisms are not sufficient to take action towards problems that are not directly perceived, even though most people "*cognitively know*" (Griskevicius et al., 2012, p. 124) about these challenges. Moreover, the perception of responsibility, which is often considered to be shared between governments, consumers and corporations (Wells et al., 2011) might foster inaction. Another interesting facet is the (mis)perception of belief in climate change and political polarization in the United States (Van Boven et al., 2018) or the correlation between political affiliation and attitude towards the environment (Farjam et al., 2019).

Therefore, also belief in climate change, which is on the decline, has to be considered. Yet the main issue is not that people do not believe in climate change or its anthropogenic causes (Weber, 2018). It is rather the fact, that belief in climate change has only limited influence on the willingness to act climate-friendly (Hornsey et al., 2016) and that beliefs are not translated into action (Steg, 2018; Weber, 2018). Similar holds true for environmental knowledge (Kollmuss & Agyeman, 2002), which also supports the notion that information-based intervention contributes only marginally to tackling climate change (Weber, 2018).

In light of this weak influence, to increase action and to close the value-action gap, the focus should shift away from understanding the roots and causes of beliefs (Steg, 2018). In detail, Hornsey et al. (2016) pointed out, that even though belief in climate change is correlated to the intention of acting climate friendly, the relationship between belief in climate change and actual actions is even smaller. Similar difficulties hold true for

knowledge and perception. This further strengthens the notion, that the state of knowledge, attitudes, perception or belief, which corresponds to "*pro-environmental consciousness*" (Kollmuss & Agyeman, 2002, p. 256), is not the only determinant of the value-action gap.

Given the weak relationship between pro-environmental consciousness and pro-environmental behavior, other moderating barriers need further attention. Two interesting articles give an overview on barriers to responding to climate change (Norgaard, 2009) and what they mean for communication concerning this issue (Katz, 2018). In peer-reviewed literature, Takács-Sánta (2007) summarizes the barriers to environmental concern, which is one of the requirements for pro-environmental behavior. The author further defines environmental concern as "*... (1) affective attitudes referring to the seriousness and importance of environmental problems, (2) positive affective attitudes to those affected by environmental problems, and (3) negative affective attitudes referring to (a) people, groups of people and organizations causing environmental problems, (b) their actions, and (c) the situations caused by them."* (Takács-Sánta, 2007, p. 27). This relationship between concern and PEB is further examined by Stern (2000), who defines causal variables for PEB. Interestingly, evidence was also found that PEB can in turn increase concern (Carrico et al., 2018).

In terms of pro-environmental behavior or climate change discussions, a major limitation of action is posed by ignorance (Geiger & Swim, 2016; Gifford, 2011). At the point where ignorance is overcome, causes for not acting are diverse and the step from environmental knowledge to environmental attitude to pro-environmental behavior is affected by various factors or, in other words, barriers, which are defined as blocking factors occurring between concern and behavior (Tam & Chan, 2017).

There are different psychosocial or economic blocking factors, which prevent people from acting. Researchers have distinguished two types of barriers: Kollmuss & Agyeman (2002) name internal factors, which relate to aspects such as knowledge, feelings, value attitudes and their corresponding barriers. Additionally, they elaborate on external barriers such as infrastructure, political, social and cultural factors and the economic situation. Also, Gifford (2011) distinguishes between structural barriers, such as unsuitable infrastructure for acting pro-environmentally, and psychological barriers, which remain to be tackled after removing structural hindrances. Similarly, individual versus social barriers (Lorenzoni et al., 2007) or subjective factors versus objective conditions (Tanner, 1999) are named.

Gaspar (2013) published a classification of barriers to PEB, in which he distinguished non-psychological barriers, lack of positive determinants and lack of negative determinants. In this classification the external, structural and objective factors are grouped as the non-

psychological barriers. These are part of promoting pro-environmental behavior, but are not sufficient to fully overcome the value-action gap, as they are often beyond individual control, e.g. available infrastructure (Gifford, 2011).

By contrast, psychological or internal factors refer to psychological factors that prevent individuals from translating their values into actions. These internal barriers can be overcome individually. Therefore, they might be a suitable point of entry for powerful interventions supportive of climate-friendly behavior (Hornsey et al., 2016) and with this, presumably a relevant part of the value-action gap. In this psychological context, Van Lange et al. (2018) discuss borders of thought, time and space as relevant hindrances for climate-friendly action and propose solutions, such as fostering of cooperative, future-oriented and collective mind-sets.

Based on this body of literature this research identifies three such internal factors, that can act as barriers for translating climate change concerns into actions and thus counteract pro-environmental behavioral changes. These barriers to pro-environmental behavior are repeatedly encountered in the literature and are as follows: immediacy, uncertainty and marginality.

In this thesis is argued that individuals struggle to translate their values and knowledge into actions if these three barriers are present, as they can make it difficult for individuals to fully grasp the implications of their own actions. This is in line with the predictions of the Construal Level Theory on climate change, based on which it was argued that increasing psychological distance can under certain circumstances pose a hindrance for climate action (Brügger et al., 2015; McDonald et al., 2015; Schuldt et al., 2018; Spence et al., 2012). Psychological distance is hypothesized to consist of temporal, social and spatial distance (immediacy), hypothetical distance (uncertainty) and, broadly defined, low self-efficacy (marginality). The psychological distance is reduced by personal experiences of climate change, which links back to the afore-mentioned perception of climate change. This thesis therefore concludes that with the presence of these three barriers also psychological distance is increased which in turn enlarges the value-action gap.

2.4.1. Immediacy

Immediacy: Climate-friendly actions often do not lead to immediate outcomes since a time or spatial lag exists between and an action and its effect. A major issue discouraging pro-environmental behavior is that people undervalue the long-term consequences of their actions or in other words: "My actions will not help me now but maybe some other people at an uncertain point in the future."

Throughout history as hunter-gatherers, human actions were rewarded immediately without delay and thus preferences were selected to value the present over the future (Friedman, 2005; Griskevicius et al., 2012; Stoknes, 2015; Van Vugt et al., 2014). It was more important to pay attention to immediate dangers, available resources or fellow humans than to invest time in the unknown future (Gifford, 2011). This shortsightedness of preferring immediate over delayed rewards combined with the propensity to underestimate the likelihood of future events poses a risk of missing the chance for acting against environmental hazards (Penn, 2003; Van Vugt et al., 2014). As a current example, Van Vugt et al. (2014) present insights from nature conservation: In the case of uncertainty when limited resources will be exhausted, people will be shortsighted and discount future gains.

A similar conclusion could be drawn in terms of spatial discounting or social discounting, which also is a hyperbolic function of social distance (Jones & Rachlin, 2009). This means, the higher the social distance between two individuals, the lower is the willingness to forgoing financial benefits for the sake of others. Also, the above-mentioned proclivity for immediate rewards and the abstract nature of climate change do not point towards a mechanism that was concerned with far-away locations and unknown strangers living there. Similar as in an intergenerational situation (Kamijo et al., 2017), also in terms of social distance, the requirements for reciprocal altruism are missing, which, however, is considered a prerequisite for cooperation (Nowak, 2006). Moreover, in comparison to ancient times where each action had immediate consequences, in modern environments it is seldomly possible to grasp the implications of one's behavior as the consequences arise with a temporal or spatial lag (Griskevicius et al., 2012), as shown in case of pollution in the production process of goods that takes place abroad or by the delayed impact of carbon dioxide that is emitted when flying.

Psychology offers numerous papers on time-preferences and the phenomenon of hyperbolic discounting, which describes the preference for small and immediate rewards over larger but later rewards (Myerson & Green, 1995) which, although varying individually and culturally, can be found throughout modern societies (Green & Myerson, 2004). Research on engagement with climate change reported climate change perception as barrier for action as it is a distant threat in terms of time and space (Lorenzoni et al., 2007). Favoring the present over the future as well as favoring local interests over global interests was also proposed by Van Lange et al. (2018) as hindrance for action on climate change; with the necessity of negotiation between countries, the latter tackles the field of intergroup conflicts. In contrast, Busse & Menzel (2014) did not find any impact of socio-spatial distance on willingness to act pro-environmentally and add to previous research, which even found a positive relationship between distance and taking environmental

problems seriously (Gifford et al., 2009). Notably, the former research focused on intention and not actual behavior.

Likewise, in the literature of behavioral economics, time preferences and hyperbolic discounting can be repeatedly encountered, for example in behavioral environmental economics (Croson & Treich, 2014). Decisions in favor of short-term are preferred when costs and benefits are immediate, named as myopia choice behavior (Gsottbauer & van den Bergh, 2011) and in accordance with the hypothesized shortsightedness stated above.

Experimental evidence for time and other-regarding preferences of fishermen was presented by Fehr & Leibbrandt (2011), who examined the link to cooperativeness or by Rachlin et al. (2015) on hyperbolic discounting in gambling. An attempt to simulate an intergenerational common pool resources scenario by declaring other players as future generations did not paint an optimistic picture about exploitation of the future (Fischer et al., 2004). More optimistic was the work of Kamijo et al. (2017), who found a positive effect for pro-environmental behavior if (imaginary) representatives of future generations are present in negotiations. Bargaining was found to be supportive for more equality in an intergenerational resource sharing game, while not-yet identifiable future players were restrictive (Wolf & Dron, 2020).

Again building on the collective-risk social dilemma introduced by Milinski et al. (2008), a positive effect of voting and democratic decisions opposing selfish resource extraction and therefore its benefits for future generations was proposed by Hauser et al. (2014). Another work by Jacquet et al. (2013) examined intra- and intergenerational discounting by making rewards for defection immediate but delaying the rewards for cooperation, which was also discussed by Hurlstone et al. (2017).

In an attempt to introduce immediacy in its spatial and temporal dimension, the design of this study aims to simulate the dependency of later groups' outcome on the results of previous groups including the possibility of occurring difficulties in decision-making due to lacking reciprocity or intergroup interests.

Closely linked to decisions with time delay are decisions under uncertainty, which under certain conditions are perceived as equal (Weber & Chapman, 2005). Therefore, uncertainty is proposed as the second barrier to pro-environmental decision-making, as investing in a collective good comes with uncertain outcomes.

2.4.2. Uncertainty

Uncertainty: The consequences of actions for the environment are perceived to be uncertain since each action shows an effect only with particular probability. It has been shown that reducing uncertainties can help improving the quality of decisions and can prevent regret about negative consequences of own actions or in other words: "Is it really certain that my efforts will help to mitigate climate change?"

During its long history, the human cognitive apparatus has adapted to the survival of immediate and visible dangers (Gifford, 2011; Griskevicius, Cantú, et al., 2012). The brain, which has been formed over thousands of years, is only adapted to a limited extent to the perception of long-term ecological changes. Slow and gradual changes such as climate change usually do not have an immediate social component and no direct negative impact on personal well-being, particularly as in this situation dangers are not immediately apparent. Continuing with the previous argument on perception of climate change, the invisible and imperceptible nature of climate change compared to other environmental hazards makes it impossible to feel or sense and the lack of cognitive abilities to perceive climate change makes it likely to be underestimated or ignored (Gifford, 2011; Griskevicius, Cantú, et al., 2012; Penn, 2003; Van Vugt et al., 2014). From an evolutionary perspective, global, elusive and slow-moving dangers such as climate change therefore confront humankind with unforeseen challenges.

These challenges were as well identified by psychological literature on risk perception (Slovic, 1987) and recent literature on adaptation to climate (Clayton, 2019; Grothmann & Patt, 2005; Weber, 2010). It is evident, that climate change comes with numerous sources of perceived uncertainty, such as its abstract nature, complexity and immense global and temporal dimensions, misinterpretation of models or the probability to be affected oneself or ambiguous information in the media (Gifford, 2011; Grothmann & Patt, 2005; Heal & Millner, 2014; Lorenzoni et al., 2007; Van Lange et al., 2018). Moreover, there can be uncertainty about the impact of one's own individual actions. Unfortunately, for effectively combatting climate change, this uncertainty favors self-interest, inaction or delayed actions (Gifford, 2011) or a pessimistic view on the willingness of others to take climate action, also defined as the myth of self-interest (Van Lange et al., 2018).

Costs and benefits of cooperation are unevenly distributed between cooperators and those who do not cooperate. This increases uncertainty and cooperation is even harder to achieve (Raihani & Aitken, 2011). The immediate benefit for free riding versus the delayed benefit for cooperative actions is a typicality of social dilemmas and exacerbates cooperation (Van Lange et al., 2013).

Similar results have been found in the field of behavioral economics. Bernedo & Ferraro (2016) collect evidence on risk and time preferences and their influence on climate change adaptation; despite ambiguities in the literature these authors conclude that risk aversion reduces cooperation and contributions. The misperception of risk further complicates successful environmental policies (Carlsson & Johansson-Stenman, 2012).

In the last years there have been several experiments on uncertainty, for example by Fischbacher et al. (2014) who found that uncertainty reduced contributions in a public goods game (PGG). Another strand of literature examines the collective-risk social dilemma of avoiding a climate catastrophe based on a threshold public goods game by Milinski et al. (2008). In this initial game, uncertainty was simulated by varying the probability of the catastrophe when failing to reach the threshold. Based on this design, numerous other studies have followed, such as the work of Hagel et al. (2017), who showed how different risk assessments influence contributions. More of these follow-ups are excellently summarized by Hurlstone et al. (2017) and it can be observed, that uncertainty is mainly manipulated via the probability of the impact or threshold uncertainty (Barrett & Dannenberg, 2012; Barrett & Dannenberg, 2014; Dannenberg et al., 2011, 2015). In a climate scenario, if certainty is given, the success rate is high in this coordination game; introducing uncertainty of the threshold which equals the 2°C goal makes success difficult, as it can turn coordination games into a prisoner's dilemma (Barrett & Dannenberg, 2012).

As summarized, uncertainty has only been varied in terms of threshold and outcome so far. By contrast, in the threshold public goods game applied in this thesis (see Chapter 4: Research Design and Experiment), uncertainty will be simulated via the probability to which a contribution will help to reach the threshold. Admittedly, this uncertainty of action doesn't exist objectively, as every climate action will help to avoid climate change. However, the focus of this study is the subjective perception of laypeople, which differs from the perception of experts (Truelove & Gillis, 2018). Thus, it is concluded that the above-mentioned implications of uncertainty can be well operationalized as uncertainty of action.

2.4.3. Marginality

Marginality: The individual contribution to climate change mitigation is perceived to be only marginal. In extant studies on decision-making, the relative importance of the own action proves to be a decisive factor in predicting personal efforts to a common good or in other words: "I am only one of many. My contribution is only a drop in the ocean."

In the course of development, human cognitive abilities have adapted to life in smaller social groups (Dunbar, 1993, 1998). The hypothesized social brain, however, does not necessarily mean pro-social, but developed in, or more specifically, for a social environment and its challenges. People seem to have propensity for self-interest, meaning a tendency to put self-interest before group-interest in social dilemmas (Griskevicius et al., 2012). Mechanisms such as indirect reciprocity, reputation or kin selection as the concern for own relatives can oppose this tendency. However, in groups where these do not occur, the selfish choice might be encouraged (Griskevicius et al., 2012; Milinski et al., 2006; Nowak, 2006).

Importantly, the size of a group is of relevance as cooperation seems to be more difficult for bigger groups than for smaller groups (Boyd & Richerson, 1988). Also, in bigger groups the relative importance of the individual action seems lower and a perceived diffusion of responsibility can occur (Saha, 2018; Wells et al., 2011). Another situation, where this becomes relevant is the bystander-effect, which suggests that the willingness to act and help decreases in larger anonymous groups, especially in situations that are perceived as less dangerous (Fischer et al., 2011). Although the increasing group size is discussed as ambiguous depending on the context and interaction mechanisms (Barcelo & Capraro, 2015; Powers et al., 2019), other authors suggest that small and medium sized groups are beneficial for global coordination efforts (Pacheco et al., 2014). Similarly, Santos et al. (2012) showed in an evolutionary game theoretical model, that small groups facing high risk were most successfully coordinated to prevent climate change.

Recently, Nosenzo et al. (2015) found negative group size effects in conditions with high marginal per capita return (MPCR). However, these results and the dependency on the MPCR are not directly applicable to the design of the work at hand, as in the threshold public goods game applied in this study (see Chapter 4: Research Design and Experiment), the individual returns do not increase with group size. The participants will not profit from an increasing return with bigger group size but only from reaching the threshold. This threshold will be adapted to the group size which simulates a constant MPCR for both group sizes and all participants need to invest half of their endowment to reach the threshold. By this, it is intended to examine the sole effect of group size.

Another point that can be linked to the effect of group size and that reduces cooperative actions is perceived inefficacy, defined as the believe that one's own actions do not matter (Van Lange et al., 2018). Likewise, Gifford (2011) and Hoffmann & Muttarak (2020) discuss Ajzen's (2002) perceived behavioral control and highlight the importance of the belief that individual actions can contribute to reaching a goal (perceived self-efficacy) for individuals to take action. Mock et al. (2019, p. 1) emphasize the feeling of "*capacity to*

cope with global environmental problems beyond individual control" as a crucial point for pro-environmental engagement. These references could also be discussed in light of a threshold public goods game, where increased group size reduces the relative value of each participant's contribution in relation to the threshold, and with this, has influence on reaching this threshold.

3. Theoretical Framework and Hypotheses

In summary, it is argued that pro-environmental behavior is hindered by those three barriers. The question is how their influence can be empirically investigated? Before further describing the detailed research design in Chapter 4, the current chapter will discuss the theoretical framework by first, introducing public good games and social dilemmas, and, second, presenting the derived hypotheses and testable predictions.

3.1. The Collective-Risk Social Dilemma and Experimental Approaches

The climate is a public good, accessible for any of the 7 billion people on earth and prone to be overused by individuals for their own gain (Pfeiffer & Nowak, 2006). This exploitation of a public good for the maximization of gain while simultaneously minimizing the costs is well known as the tragedy of the commons (Hardin, 1968).

One common way of behavioral economics to simulate and examine such social dilemmas are public good games (e.g. Barcelo & Capraro, 2015). In general, the structure of a public good game (Chaudhuri, 2011) is as follows: each player in a group is endowed with a certain amount of money, which the players can invest simultaneously in a group project. The amount invested in the group project is multiplied by the experimenter, depicting a growth factor, and then divided equally among the players in the group. This means, that if one does not contribute anything but the other players do contribute, the so-called free riders will still profit from their investment, although they did not contribute. The conditions in this setting can vary, for example by the introduction of punishment of such free riders (Boyd et al., 2010; Egas & Riedl, 2008; Fehr & Gächter, 2002), the possibility to build up a reputation (Milinski et al., 2002, 2006) or the possibility to communicate with other players (Tavoni et al., 2011). Also, trust was found to be important for contributing in public goods games (Hasson et al., 2010; Lo Iacono & Sonmez, 2020).

While the above-mentioned tragedy of the commons is often accompanied with a negative notion, there is also literature on how it can be avoided or handled, often in smaller, local communities (Ostrom, 1990). In line with this and as described above, most of the human skills and adaptations have evolved in such communities. Humanity is considered to be adapted to these conditions. In order to draw conclusions on how to avoid a global tragedy of the commons, it is therefore necessary to understand the adaptations and their consequences in smaller groups.

From an evolutionary perspective, situations where global cooperation is necessary are new and due to increasing population size and global challenges, the number of people involved in collective-risk social dilemmas such as climate change have elevated to unknown extent. Of course, a small group of participants will not be able to be representative for 7 billion players of a global public goods game. Yet, if small groups fail, a bigger group is also likely to fail (Milinski et al., 2008), as small- and large-scale groups are confronted with the same problems and solutions, which are not differing qualitatively but merely quantitatively (Powers et al., 2019). Thus, it seems feasible to examine the underlying barriers of contributing to climate change with an experimentally manageable number of players (Pfeiffer & Nowak, 2006).

Assuming the conception of homo oeconomicus, as economic theory at times did, humans would be rational profit maximizers, caring only for themselves, and not willing to contribute anything to a public good. Contrary to this assumption, there is a variety of literature that supports human cooperativeness (Axelrod, 2006; West et al., 2011), altruism (Becker, 1976; Fehr et al., 2002; Fehr & Fischbacher, 2003) and fairness (Carlsson & Johansson-Stenman, 2012). Here again, these results are in line with the broader conception of a cooperative and sustainable homo sustinens (Siebenhüner, 2000b, 2000a) and not with the non-cooperative behavior predicted by game theory (Hoffman et al., 1998).

What basically all public good games have in common, is the opposition of personal interests and group interest, which creates a social dilemma. Such social dilemmas pose a collective subjective barrier to pro-environmental behavior change (Anable et al., 2006). The importance of social dilemmas on an individual level for successful sustainable societies was highlighted by Osbaldiston & Sheldon (2002), who in line with Van Lange et al. (2013) claimed that most environmental problems are a result of social dilemmas which in general are about the short-term self-interest vs. long-term collective-interest (Van Lange et al., 2013).

In the specific case of climate change, the dilemma occurs as the conflict between short-term investments to prevent or at least mitigate climate change and the risk of long-term

damages when failing to do so. Milinski et al. (2008) called this a collective-risk social dilemma, which differs from other social dilemmas:

> *"(i) People have to make decisions repeatedly before the outcome is evident, (ii) investments are lost (i.e., no refunds), (iii) the effective value of the public good (in this case, the prevention of dangerous climate change) is unknown, and (iv) the remaining private good is at stake with a certain probability if the target sum is not collected."* (Milinski et al., 2008, p. 2291).

Thus, the collective-risk social dilemma creates a tradeoff between the consequences of investing or not investing. Milinski et al. (2008) link this to the ability of building common goods, such as food reserves and also collective defense systems, which probably were important in human history. Failing to achieve this common effort, meant that private goods were in danger. Investing more, reduced the risk of loss. Translated to climate change this means, there is a dilemma between personal interests and collectively investing to prevent climate change. Thus, with regard to climate change, the collective-risk social dilemma creates a tradeoff between the consequences of investing or not investing and confronts people with the decision whether they want to take climate-friendly action to avoid risks.

To empirically investigate this decision-making process, Milinski et al. (2008) developed a laboratory experiment studying behavior in such a dilemma. To this end, a threshold public goods game, which is an extended version of the public goods game, was applied. The difference to experimental public goods games, is in this version, that within the game, the participant's investments are not aimed to support a common good in order to gain, but in order to avoid losing by reaching a certain threshold (Milinski et al., 2008). The threshold in the game stands for the earth's climate tipping points. The short-term vs. long-term dilemma is reflected in the circumstance that money invested to the collective will be lost immediately but it contributes to the aversion of climate change and its impact (Barrett, 2016).

Based on the collective-risk dilemma (Milinski et al., 2008) a series of experiments followed. Several scholars examined the effect of uncertainty concerning the impact or the threshold (Barrett & Dannenberg, 2012; Barrett, 2016; Dannenberg et al., 2011, 2015), imposed vs. voted thresholds (Rauchdobler et al., 2010), passing problems to others (Ponte et al., 2017), heterogenous endowment (Burton-Chellew & West, 2013; Freytag et al., 2014; Tavoni et al., 2010, 2011; Waichman et al., 2018), and some of them introduced intermediate targets, milestones or temporal dimensions. Social distance and delay were investigated by Jones & Rachlin (2009) and temporal discounting and generations by Jacquet et al. (2013) or in combination with heterogenous wealth by Milinski et al. (2011).

Based on this series of studies, it becomes obvious, that the three barriers, marginality, uncertainty and immediacy, can be observed at different stages (Fig. 1). Uncertainty can occur about whether an action adds to reaching the goal, about the value of the threshold and about the probability (risk of loss) and severity of consequences. Similarly, immediacy can be the delayed impact of one's action as well as the timely- or spatially displaced impact of failure. Marginality can be observed at the action level as the size of the group, which is involved in the game.

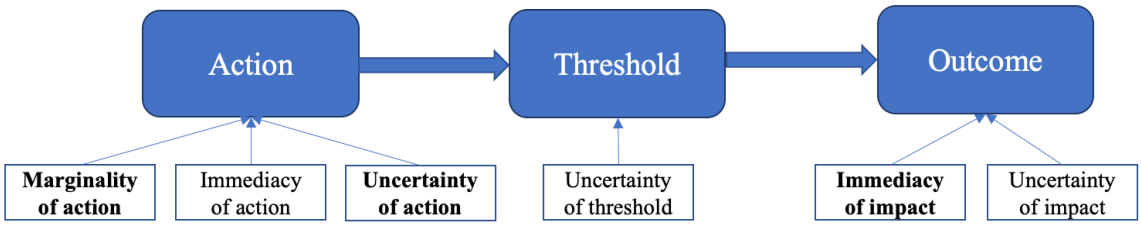

Fig. 1. Conceptual figure of barriers to pro-environmental decision-making.

For this study, marginality of action, uncertainty of action and immediacy of impact were identified as the most promising combination. Closely related to individual reality, concerns such as *I am only one of many* or *How sure is it that my contribution helps* or *Will climate change tackle me or my descendants* were suspected as driving forces for not acting although having pro-environmental values. So far, research on the value-action gap is largely based on surveys that assess environmental behavior on the basis of hypothetical questions, behavior intentions and the self-assessment of respondents (Peattie, 2010). In the experiment, actual decisions can be examined in order to explain how different factors influence the value-action gap. In a similar attempt, Farjam et al. (2019), who did a study based on Milinski et al. (2008), found that the attitude-behavior gap is especially of relevance in high-cost situations.

3.2. Hypotheses and Predictions

Assuming the concept of homo oeconomicus, it might be expected, that nobody contributes anything to the public good and the main goal is to maximize individual profit. Yet, this concept has been frequently challenged and alternatives, such as the more sustainable homo sustinens were proposed (Siebenhüner, 2000b, 2000a).

In line with this, numerous of the studies provide evidence that contradicts this statement, showing that contributions are higher than expected. Also, in the present study, there are repeated interactions, though anonymous. Moreover, due to the consequences imposed by

failing the threshold of the group project, in some conditions, the individual earnings are at stake, which creates the dilemma between personal and group interests.

In the baseline treatment without uncertainty of action, the expected account values vary in different strategies. For a group of free riders, who will never contribute, the climate goal will not be achieved and the points they saved are lost with a probability. Given the endowment of 40 points and the loss in 9 out of 10 cases, the expected account value is 4 points. Fair sharers, who always contribute the necessary amount of 2 points per round, will reach the climate goal and therefore end up with 20 points. Altruists, who invest everything will reach the climate goal, however they keep 0 points in their private account. Milinski et al. (2008) further discuss the implications of different probabilities of loss and individual strategies.

Given the human tendency to cooperate and the individual interest to reach the threshold in order to keep the points saved in the private account, initial contributions are expected to be higher than zero. In the further course of the game, the contributions might depend on the dynamics of the groups of players and the treatments. It was shown that contributions decline from the first round to the last round of the game, which in previous studies mostly consisted of 10 rounds (Zelmer, 2003). A particularly interesting part will be the last stage, as seen by Neuhofer (2015): if threshold is reached no one will contribute, if it is not reached do the people invest a lot to try to save it? And what happens if it is clear that the group will fail to surpass the target amount?

Additionally, the three cognitive barriers presented before, can make the decision-process more difficult as they contribute to misjudging of the implications of the individuals' actions. By this, investments to the climate account might be negatively affected, which, however, is counteracted by pro-environmental concern. Derived from theory and based previous experimental results, five hypotheses (H_X) with three sub hypotheses each are proposed.

H1: First, the perceived immediacy of individual actions will
- *H1a*) decrease the probability of reaching the threshold,
- *H1b*) decrease individual contributions to the climate account, and
- *H1c*) increase the value-action gap (*RQ1*).

H2: Second, the perceived uncertainty of individual actions will
- *H2a*) decrease the probability of reaching the threshold,
- *H2b*) decrease individual contributions to the climate account, and
- *H2c*) increase the value-action gap (*RQ1*).

H3: Second, the perceived marginality of individual actions will
H3a) decrease the probability of reaching the threshold,
H3b) decrease individual contributions to the climate account, and
H3c) increase the value-action gap (*RQ1*).

H4: Fourth, personal factors affect individual decisions and contributions will
H4a) increase with environmental concern and preference for delayed rewards,
H4b) neither increase nor decrease with environmental knowledge and
H4c) decrease with cognitive abilities, willingness to take risks, distrust and conservative political affiliation (*RQ2*).

H5: Fifth, personal factors affect individual decisions, and the value-action gap will
H4a) decrease with environmental concern and preference for delayed rewards,
H4b) neither increase nor decrease with environmental knowledge and
H4c) increase with cognitive abilities, willingness to take risks, distrust and conservative political affiliation (*RQ2*).

The hypotheses imply the following predictions, which can be tested based on the data of the experiment. In the results chapter, predictions will be tested, first, based on whether the threshold was surpassed, second, for the contributions and, third, for the value-action gap and, finally, for the personal factors. The findings will be brought together discussed and put into context with corresponding literature in the discussion chapter.

P1a) In immediacy condition, influencer groups will surpass the threshold with a lower probability than groups that depend on their own contributions (baseline).
P1b) In immediacy condition, contributions to the climate account will be lower in influencer groups compared to groups that depend on their own contributions (baseline).
P1c) In the immediacy condition, the value-action gap will be higher in influencer groups compared to groups that depend on their own contributions (baseline).
P2a) In uncertainty condition, groups facing uncertainty will surpass the threshold with a lower probability than without uncertainty.
P2b) In uncertainty condition, contributions to the climate account will be lower in groups with uncertainty than in without uncertainty.
P2c) In the uncertainty condition, the value-action gap will be higher in groups facing uncertainty than in groups without uncertainty.

P3a) In marginality condition, large groups will surpass the threshold with a lower probability than small groups.

P3b) In marginality condition, contributions to the climate account will be lower in large groups than in small groups.

P3c) In the marginality condition, the value-action gap will be higher in large groups than in small groups.

P4a) Contributions to the climate account are positively correlated to measures of environmental concern and preference for delayed rewards.

P4b) Contributions are not significantly correlated to environmental knowledge.

P4c) Contributions to the climate account are negatively correlated with cognitive reflection, risk-taking, distrust and conservative political affiliation.

P5a) The value-action gap is positively correlated to measures of environmental concern and preference for delayed rewards.

P5b) The value-action gap not significantly correlated to environmental knowledge.

P5c) The value-action gap is negatively correlated with cognitive reflection, risk-taking, distrust and conservative political affiliation.

4. Research Design and Experiment

This section will present the experimental design and its implementation step by step, discuss external validity and criticism of experiments and their link to an interdisciplinary perspective on behavior. Further, it is argued why online experiments are a considerable alternative to laboratory settings. Finally, possible limitations of the experiment in this thesis will be outlined.

4.1. Experimental Design

Empirical quantification on the role of barriers to pro-environmental decision-making is scarce, especially in terms of simultaneous influence of the three identified barriers. Moreover, the role of personal factors in the value-action gap in light of these barriers needs further investigation. To answer the research questions and to test the hypotheses and predictions, an online experiment was designed and implemented.

Climate-friendly actions were conceptualized as behavior that minimizes negative externalities on others in a climate change game. In this threshold public goods game, the participants could make investments to a common pool resource, called the climate

account, which reflected the earth's climate. If the participants did not reach the target sum it was interpreted as failing to prevent climate change, which had consequences for the player's earnings (see treatment description below). The game created a collective-risk social dilemma, as each player's investment was ecologically beneficial, however, individually costly.

In the experimentally simulated collective-risk social dilemma with its conflicting personal interests and collective investments to prevent climate change, a gap between values and actions was predicted to occur. In such dilemmas, people are confronted with the decision whether they want to take action to avoid the risk of climate change. The three above-mentioned barriers could make this decision-process more difficult as they contribute to misjudging of the implications of the individuals' actions and by this widen the value-action gap.

As described in the literature review, research on the value-action gap was largely based on surveys that assess environmental behavior on the basis of hypothetical questions, behavior intentions and the self-assessment of respondents. In the experiment, actual decisions could be examined in order to explain how the proposed barriers influenced the value-action gap in such a dilemma. In the experiment, the value-action gap occurred between the normative preferences queried in the hypothetical decisions at the beginning of the experiment and the observed decisions in the threshold public goods game. By this, the predictions could be tested in a controlled environment, which allowed to gain primary data and empirically investigate the underlying mechanisms of the internal barriers without the influence of contextual factors such as habits or available infrastructure.

4.1.1. General Design of the Experiment

The experiment was interactive, and participants played together in groups of real people in real-time with real money being at stake. An overview on the design is provided in Fig. *2*. Each participant was in a group and received an initial endowment of 40 points. In each of the 10 rounds of the game, they could decide to contribute 0, 1, 2, 3 or 4 Points to the group project, named as climate account. The rest would stay in their private account. The barriers the participants faced during these decisions were varied groupwise.

In the climate account each group had to reach a certain threshold of 120 or less, depending on the treatment, as shown in Tab. 1. For every treatment, each player would need to invest an average of 2 points per round, which equals half of the endowment, to surpass this threshold. In case the threshold is not reached, the outcome is that climate change will occur

and with a probability of 90%, determined by a random draw, participants lose all points kept in their private account.

For each decision participants had 60 seconds. In case the player made no decision within this time, the contribution for the respective round was automatically set to zero. Groups which lost players due to drop out of participants continued with reduced group size. In a real-life situation this would be equivalent to stop acting pro-environmentally and deliberately forgoing further action in a group. After each round they were shown the sum of contributions in their group of the current round, the cumulative sum of all rounds and how many points were missing to reach the threshold. By this, an overview on the contributions of others was provided, estimations of the likelihood of reaching the threshold made possible, and trust or distrust could be built. Communication between players was not allowed. The possibility to punish others or to communicate was omitted in order to keep the experiment straightforward for the participants.

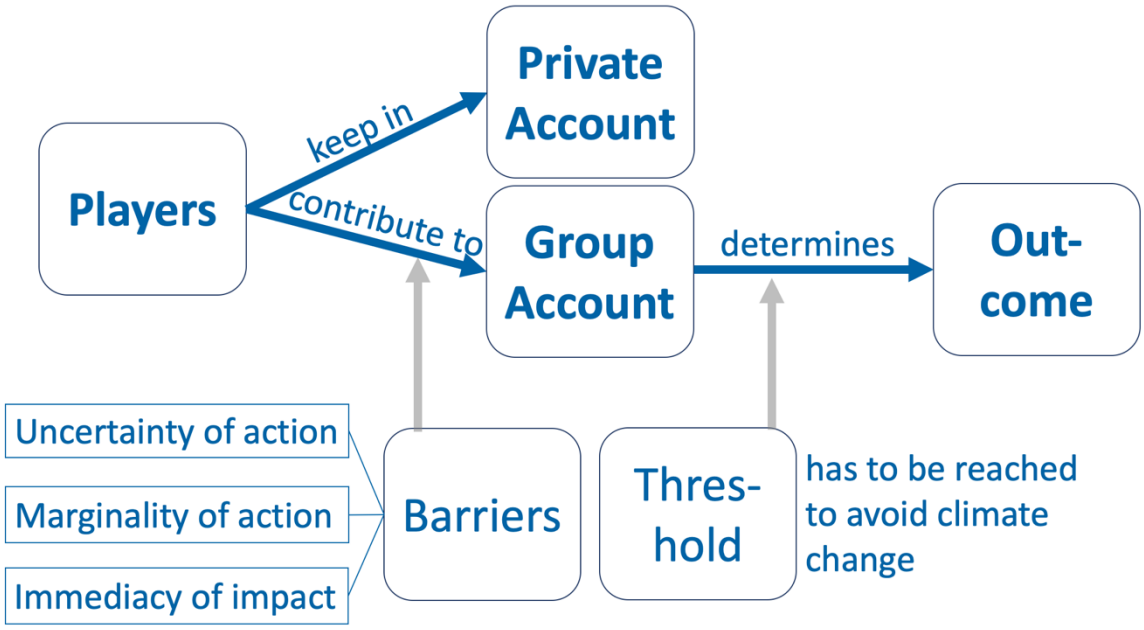

Fig. 2. Schematic depiction of the experimental design.

And now the question is, where the value-action gap lies in all this? Before starting the game, the participants were given the instructions of the game without introducing the barriers. After this they had to make hypothetical decision where they had to state how much they would contribute and what they think others will and should contribute. By this their normative preference or values were observed. Then they were forwarded to the actual experiment, where the barriers were simulated. Here their actions were observed. Based on what the participants would contribute in the hypothetical decision and their actual contributions in the experiment with the introduced barriers, the difference between their

intended contribution and their actual contributions could be observed (Fig. 3). By this, the value-action gap could be empirically investigated and the influence of the three barriers determined.

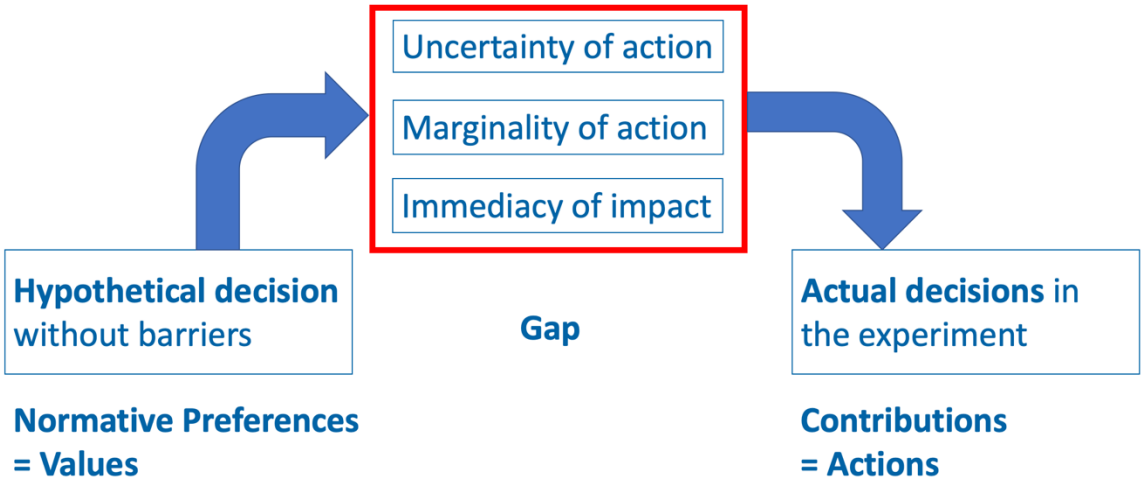

Fig. 3. The value-action gap between intended and actual contributions in the lab.

4.1.2. Treatments

The three barriers that are considered to make contributions to a public good less likely, are not mutually exclusive but interconnected. Therefore, the barriers, which the participants faced while deciding on their contributions to the climate account, were varied in a 3 x 2 x 2 design, which resulted in 12 different experimental treatments, simultaneously varying in

(1) the degree to which a distant group of players was affected by missing the threshold (immediacy),
(2) the probability with which the individual investment of each round was added to the climate account (uncertainty),
(3) and the potential marginal impact of each individual to reaching the threshold by changing the group size (marginality).

In the experiment these three barriers and the consequences for failing to reach the target sum were operationalized as follows:

(1) Immediacy of impact: To introduce immediacy in its spatial and temporal dimension, the design of this study aimed to simulate the dependency of later groups' outcome on the results of previous groups. There were three different possibilities: Firstly, groups who lost the points in their own private account when failing to reach the threshold. Secondly, groups who did not lose their own points

but triggered the loss of points for another group that depended on them. And thirdly, there were groups, who lost depending on the success of their reference group as well as their own success.

(2) Uncertainty of action: To simulate uncertainty of one's actions, contributions to the climate account were added with a probability of (i) 70% or (ii) 100% throughout the game.

(3) Marginality of action: To simulate the relative value of each participant's contribution to reaching this threshold, group size was varied. Therefore, groups consisted of (i) three or (ii) six players.

In total, the variation of the three barriers resulted in twelve different combinations of treatments. For each combination the threshold amount in the climate account was adapted in a way, that every player of a group had to contribute 2 points each round in order to reach it (Tab. 1). The treatment with role 9 (small group without uncertainty and dependent on climate game results) was considered as the baseline treatment.

Tab. 1. Treatments applied in the experiment and threshold values of the climate account.

Role	Treatment	Threshold in Points
1	Small, Certainty, Influencer	60
2	Large, Certainty, Influencer	120
3	Small, Uncertainty, Influencer	42
4	Large, Uncertainty, Influencer	84
5	Small, Certainty, Influenced	60
6	Large, Certainty, Influenced	120
7	Small, Uncertainty, Influenced	42
8	Large, Uncertainty, Influenced	84
9	Small, Certainty, Baseline	60
10	Large, Certainty, Baseline	120
11	Small, Uncertainty, Baseline	42
12	Large, Uncertainty, Baseline	84

4.1.3. Questionnaire and Cognitive Abilities

After playing the public goods game, the participants were asked to complete a detailed questionnaire to collect additional information about participant's profiles, environmental attitudes and behavior as well as social preferences. One main focus was on environmental concern for which the items were chosen based on already established and well-discussed questionnaires (Cruz & Manata, 2020) such as the New Environmental Paradigm (Dunlap & Van Liere, 2008) or measurements of environmental concern for oneself, others, and the

environment (Schultz, 2001). All questions can be found as part of the full experiment in the Appendix and consisted of questions on:

- Sociodemographic variables (age, gender, education, income, current main occupation, household structure, children, political affiliation, grew up in city or rural area)
- Risk and time preferences, trust in society
- Environmental attitudes, concern and knowledge
- Environmental behavior (reported private and public domain)
- Social surroundings during participation and previous experience (Bader et al., 2019).

Furthermore, as part of the questionnaire the participant's cognitive abilities and information processing speed were measured by using a short test named the Symbol-Digit-Test (Dohmen et al., 2010; Lang et al., 2007; Silva et al., 2018), which has been applied in several previous studies. These measurements were first used to link between cognitive preconditions for pro-environmental behavior and, second, to risk aversion and patience, as cognitive abilities were found to be positively correlated with willingness to take risks and patience (Dohmen et al., 2010).

4.2. Implementation of the Experiment

The implementation of the experiment contained different steps, beginning with the recruitment of the participants, the start-up, the experimental platform and the participant's interaction with the platform during the experiment and, finally, the payment as well as the costs of the study.

4.2.1. Qualification Criteria, Recruitment and Session Start-up

The recruitment of the participants was administered via the crowdsourcing platform Prolific.co, which was described more in detail by Palan & Schitter (2018) or Peer et al. (2017). The latter concluded a similar data quality on Prolific than on other crowdsourcing platforms such as Amazon MTurk, which is commonly used (Chandler et al., 2019; Mason & Suri, 2012; Paolacci et al., 2010; Paolacci & Chandler, 2014) and for which the demographics of the participants are known (Ross et al., 2010). Prolific provides information on demographics of participants on their homepage[1]. About 60% percent stated

[1] https://www.prolific.co/demographics/

UK or US as their current country of residence and about 40% were working full-time. There is a slight surplus of female workers and about 40% stated being students. The pool of workers is relatively young, half are between 20 and 30 years, and around one quarter between 30 and 40 years. Overall, the participants are well educated with nearly half of them having an (under-)graduate degree.

Challenges, such as the administration of payments, anonymity, or prevention of repeated participation were resolved by using this crowdsourcing platform. By this, the correct indication of demographic data was also made more reliable. Dropouts were reduced by keeping the instructions as simple as possible and approving the payment of participants only after full completion of the experiment. In case participants dropped out during the game or failed to make a decision in time, their group continued with the remaining players and contributions were automatically set to zero.

Preventing repeated participation was guaranteed by several mechanisms. First by excluding participants from joining another session by excluding a second participation via their Participant-ID on Prolific (Palan & Schitter, 2018) and second by the experimental platform (Lioness), which itself checked IP addresses and cookies in the browser to lock double participation with the same IP address. For further information on deception and fraudsters see for example Teitcher et al. (2015). Moreover, participants who had already participated in previous sessions were not shown the invitation for the following sessions, based on their Prolific-ID.

The data collection was conducted in 18 sessions between December 4, 2020 and January 20, 2021. To eliminate potential issues, pilot sessions were launched at the end of November 2020, after which minor changes were included. The sessions were published on Prolific between 12:00 and 19:00 (GMT) as these are the most frequented hours on Prolific. The treatments were played alternating in order to avoid any bias due to daytime.

The participants who were able to see the study were pre-screened by the following qualification criteria: United Kingdom or United States of America as current country of residence; being 18 years or older; PC or tablet as used device; to exclude excessive or less reliable players only players with an approval rate higher than 90% on Prolific were invited. To avoid recruiting players who are naïve towards experimental approaches, not biased by previous participation in similar experiments, only those with less than 100 participations were invited. In total, this screening resulted in about 40.000 eligible participants.

The participants were shown a short introduction text to the study on Prolific (see Appendix) where they were informed about the interactive nature, duration and payment

of the study. For those who agreed to participate, a link to the website for experimental interaction (Lioness) was then provided and the places in a session reserved on a first-come first-serve basis.

4.2.2. Experimental Platform and Interaction

Lioness is a free web-based platform for interactive online experiments, which does not need any installation and allows participants to play simultaneously in groups. Lioness is based on the programming language JavaScript (Giamattei et al., 2020). Another commonly used and comparable tool would be the oTree platform (Chen et al., 2016), which is based on Python and similar to the laboratory software z-Tree (Fischbacher, 2007). The study description for participants on Prolific as well as the full experiment can be found in the Appendix. After being redirected from Prolific to Lioness the procedure of the online experiment was as follows.

1. Starting page and entering of the Prolific-ID
2. Welcome and introduction
3. Game instructions
4. Seven test questions
5. Hypothetical contributions
6. Waiting room (lobby) and group forming depending on treatment.
7. Decision-making to contribute to game account repeated over 10 periods
8. Feedback on income and climate account repeated over 10 periods
9. Questionnaire including a short cognitive abilities test
10. Feedback on results of the game, hypothetical contributions and cognitive abilities
11. Information on earnings and link back to Prolific to receive the payment

In each session, 6 of the 12 different treatments were played. Therefore, 48 players were invited, consisting of 6 players per treatment and 2 additional backup players each. This aimed to reduce waiting times until enough players are online at the start of the experiment and to compensate attrition. As soon as the participants entered the experiment, they were randomly assigned to one of the treatments by drawing a so-called role. By this, differences in the time needed for instructions, control questions and hypothetical decisions did not lead to a selective treatment allocation. The first six players who completed the instructions, control questions and hypothetical decisions were sent to a waiting room (lobby). Admission to this lobby was only granted after reading the instructions and answering the control questions to ensure, that the participants have carefully read the instructions and understood the decision situation.

In this lobby, groups of six players in the same treatment were formed and the interactive game started. In case, one or two of the backup players of a treatment were also on course to reach the lobby, the program automatically assigned them to another treatment, where players were needed. If no group could be formed within 13 minutes, the participants in the waiting room were sent back to the stage before the lobby, where they were assigned to another treatment in an iterative process and then again sent to the lobby for 2 minutes to be matched. If again, they could not be assigned to a group, the participants were redirected to the end of the survey and paid a fixed participation fee. Participants were informed about their role after forming the groups in the lobby by showing them the specific treatment instructions.

Unlike previous studies (e.g. Milinski et al., 2008) no information sheet on climate change was provided in the instructions to avoid biasing the participants before the hypothetical decisions, the game as well as the questionnaire, where several questions on knowledge and values concerning climate change were included.

4.2.3. Payment of Participants and Costs of Experiments

One of the major challenges for conducting online experiments is the administration of payments. To facilitate this process while avoiding requiring personal data of participants to cash out their earnings, again the crowdsourcing platform Prolific was used. By matching the participant's Prolific-ID with their final earnings, the money could be transferred anonymously. In return, Prolific charged a service fee of 33% + 7% VAT of the participant's earnings. The full project budget (Tab. A1) and the financing plan (Tab. A2) can be found in the Appendix.

The participants received a show up fee for absolving the instructions, test questions, hypothetical scenario and reaching the lobby. If they could not be assigned to a group within 15 minutes, they were redirected to collecting a fee of £2.00. For those players, who were successfully matched, the guaranteed participation fee was raised to £2.50 to reward the completion of the final survey. In addition to this fixed payment, participants had the chance to earn points during the experiment. The conversion rate between Points and Pounds was 8:1. A maximum of 40 points (£5.00) could be earned in the climate game, 2 points (£0.25) for two correct estimations in the hypothetical scenario, and 10 points (£1.25) in the cognitive abilities test. For successful completion the expected payment therefore was between £2.50 and £9.00.

A draft of calculation for the payment is suggested based on an experiment duration of 30 minutes and an average payment of £5.40 for successful participants. This equals £10.80 per hour, which is above minimum wage and the common participation fee for paid studies.

The average payment (Tab. 2) amounted to £5.21 (*SD* = 1.44) with a maximum of £13.00, including the fixed payment of £2.50 and bonus payments for the cognitive abilities test (on average about £1.00) and hypothetical decisions (on average £0.16). On average, participants took about 33 minutes and 38 seconds to complete the full study.

Tab. 2. Summary of number of groups, payment and number of players by treatment.

Role	Treatment	*N* (groups)	%	Payment (£)	*SD*	*N*
1	Small, Certainty, Influencer	16	9.94	5.60	0.85	43
2	Large, Certainty, Influencer	10	6.21	5.75	1.37	57
3	Small, Uncertainty, Influencer	16	9.94	5.84	1.14	42
4	Large, Uncertainty, Influencer	10	6.21	6.04	1.80	55
5	Small, Certainty, Influenced	16	9.94	4.63	1.14	42
6	Large, Certainty, Influenced	9	5.59	4.85	1.46	50
7	Small, Uncertainty, Influenced	16	9.94	4.01	1.12	42
8	Large, Uncertainty, Influenced	13	8.07	5.07	1.30	66
9	Small, Certainty, Baseline	20	12.42	5.17	1.69	49
10	Large, Certainty, Baseline	10	6.21	5.24	1.16	53
11	Small, Uncertainty, Baseline	14	8.70	5.27	1.31	39
12	Large, Uncertainty, Baseline	11	6.83	4.86	1.41	53
	Total	161	100.00	-	-	591
	Mean	-	-	5.21	1.44	-

4.3. Advantages and Limitations

This section will first discuss the advantages of experiments and the transportability of results outside the lab, followed by a summary of literature on online experiments. Finally, the limitations of the study will be discussed.

4.3.1. External Validity and Advantages of Experiments

Given the rich tradition of lab experiments especially in economics and psychology, experimental approaches supposedly bring new insights into behaviors. Under the right circumstances, they seem to be a good choice to study the implications of cooperative behavior (Reindl et al., 2019) or voluntary climate action (Goeschl et al., 2020) for real-world situations.

While internal validity is not the main concern of experiments (Zelditch, 2014), external validity and generalizability were the subject of several papers published in the last years. Behavior in lab and field is compared and while some scholars claim that comparability is rather low, correlations were found in certain conditions and the results seem to be pointing towards the right direction, although the quantity of effects differ (Benz & Meier, 2008; Galizzi & Navarro-Martinez, 2019; Hergueux & Jacquemet, 2015; Kessler & Vesterlund, 2015; Laury & Taylor, 2008; Levitt & List, 2007a, 2007b; Sturm & Weimann, 2006).

The advantages of experiments are that they allow to create an artificial situation and vary the factors that are the focus of the research (Neuhofer, 2015; Zelditch, 2014), which could not be realized in a natural setting. Thus, the sole influence of the factors can be isolated and compared. By translating the interconnected barriers into a testable operationalization, the predictions can be investigated in a controlled environment and the ability of experiments to isolate causal effects of the treatments on behavior (Goeschl et al., 2020) is employed. This approach allows to filter out the external or structural barriers in this context-free environment and to focus on the internal or psychological barriers. Therefore, it is possible to empirically investigate the underlying mechanisms of the internal barriers while minimizing influence of contextual factors such as habits or available infrastructure. For example, in contrast to commonly used models of pro-environmental behavior, the mediating role of old behavior patterns between internal factors and PEB (Kollmuss & Agyeman, 2002) or habits (Gaspar, 2013; Gaspar et al., 2010) can be systematically excluded.

By this, the present study defuses one main criticism of experiments, which claims that the settings are artificial and do not reflect the complexity of a real-world setting, and, thus, results cannot be translated to the real world. However, as Neuhofer (2015) summarizes in her thesis, the aim is not to reproduce a real world setting, but to create insights on mechanisms that drive behavior and decisions; it is not intended to reproduce real-world settings but to test out a theory (Zelditch, 2014) and predictions in a controlled environment. Experiments can help to discover causal mechanisms and improve knowledge on behavior (Brent et al., 2017). With this, the examination of internal psychological barriers can be undertaken free from external structural barriers that were discussed in the context of the value-action gap (Gifford, 2011; Kollmuss & Agyeman, 2002) and in light of the personal factors collected in the questionnaire.

4.3.2. Online Experiments

Originally, this thesis intended to conduct the experiments in a laboratory with physically present participants. However, plans do not always work out. In my case, a temporary

closing of the universities including the labs due to COVID-19, demanded a change of methods. To be able to still conduct the experiment but without physical attendance of participants, an online version was applied. Lab experiments, also when conducted online, are found as a valid method to identify causal effects (Bader et al., 2019). The possibility of online experiments brings up an emerging strand of literature which discusses methodological drawbacks and advantages of interactive online platforms (Arechar et al., 2018; Chen et al., 2016; Giamattei et al., 2020) as well as crowdsourcing platforms such as Amazon mTurk (Mason & Suri, 2012; Paolacci et al., 2010; Paolacci & Chandler, 2014; Ross et al., 2010), Prolific (Palan & Schitter, 2018) or direct comparisons of several platforms (Chandler et al., 2019; Peer et al., 2017).

One main challenge of conducting experiments online is attrition (the dropout of participants), which can be suitably addressed and reduced by using the right measures (Arechar et al., 2018). Nonetheless, conducting experiments online also brings advantages such as lower costs per data point and reliable data quality (Arechar et al., 2018). Another point to address is the avoidance of fraudsters, for which Teitcher et al. (2015) discuss several interventions. A comprehensive overview on the conduction of experiments online was given by Bader & Keuschnigg (2018).
In general, lower costs per data point are expected in the online experiment compared to a laboratory experiment, however, they might also be varying more, due to dropouts and other unforeseen events. In the literature, the average costs seem to be about one third lower than in laboratory experiments (i.e. Arechar et al., 2018: $80 vs. $47 per data point), and about 5-7€ total earnings per participant. Bader & Keuschnigg (2018) reported earnings of $2.34 for 14 minutes. Show-up fees can be held lower than in a laboratory experiment (e.g. £2 instead of £10). Moreover, no laboratory staff has to be paid, however, most crowdsourcing platforms such as Prolific or MTurk charge fees for administering the recruitment and payment of participants.

4.3.3. Limitations

The challenges of this research concern both, the experiments as well as the participants. The sample of this study is restricted to western countries, namely United Kingdom and United States of America. To make universal claims on behavior, insight should be drawn from different populations, apart from WEIRD (western, educated, industrialized, rich and democratic) student samples (Henrich et al., 2010). Belief in climate change, social preferences and norms, perception of barriers as well as environmental concern and its link to actual behavior might vary with cultural background (Franzen & Vogl, 2013; Gifford, 2011; Tam & Chan, 2017). Although data collection beyond UK and US is far beyond the

means of this thesis, the online availability of the experiment would allow to replicate the study in other countries to fetch the effect of cultural differences.

Another challenge to address is the external validity, as discussed in the literature review. Despite the fact that external validity cannot be taken for granted, and generalizability is limited, lab results can give first insights (Goeschl et al., 2020). To strengthen the correlation between real-life and laboratory, the instructions and the game were presented with a climate change framing. In that regard, belief in climate change was considered to endanger the setting of the experiment. However, as seen in the results, participants predominantly believed that climate change is happening and recognized its effects on themselves and their environment.

The conduction of an interactive experiment online comes with the challenge of higher attrition (dropout rates) or less possibilities to verify the participant's integrity. These issues, however, were tackled by using a crowdsourcing Platform where participants had to provide information on several domains of their life in their profile. This also allowed to prescreen via qualification criteria for participants with high rate of successful completion in previous studies. Moreover, repeated participation could be excluded. For the experiment, it was aimed to reduce dropout by the use of simple instructions, fast group assignment, appropriate group sizes to reduce waiting times and adequate payment. In addition to lower costs per data point and the relatively simple replication of the experiment worldwide, the benefits of conducting the experiment online outweigh the drawbacks.

To keep the experiment in an acceptable time frame and to avoid boredom of participants, the available time on the decision-making and the result screen in each round was limited. Moreover, the waiting time for group assignment was kept as short as possible by a randomized role assignment with additional backup players. However, waiting times also have a positive effect, as they make it more plausible to the participants, that they are interacting with other real people, with whom their payments are interrelated.

The conclusions on psychological barriers drawn from the experiment would need to be complemented by the structural barriers in a field study in order to be applicable outside the context of this particular experiment. The combination of lab and field experiments helps to increase external validity (Sturm & Weimann, 2006). In this context as Levitt & List (2007a) pointed out, lab and field data both have strengths and weaknesses, which, in combination, can improve each other in favor of a comprehensive insight. This will be realized in an upcoming field experiment, as further described at the end of the paper.

5. Data Analysis und Sample Characteristics

Firstly, an overview on data management and analysis is given. This includes a brief overview on regression analysis, which was employed in this study. Secondly, a summary of descriptive statistics of sociodemographic variables is presented.

5.1. Data Analysis

The management and analysis were conducted with *Stata 16 SE* for Mac. Data of all sessions was downloaded from the Lioness platform and combined to one single data file. For the final dataset, all players who finished the interactive part of the study were included.

Data analysis was conducted on an individual level. However, for a follow up study based on this data, which will also include analysis on a group level, it was important to have a comparable number of observations on both levels. Since there were always two groups of three for one group of six, this was not directly possible and solved by increasing the number of groups with six players. Thus for 14 groups of three players, would be seven groups with six players, which was, however, increased to ten groups.

For the study, in total 672 participants were recruited, of which 592 in 161 groups (98 groups of three and 63 groups of six players) finished all 10 periods of the game. The dropout rate therefore was 11.90%. As announced in the participant's instructions, the contributions to the climate account of players who dropped out were automatically set to zero. Dropping out was therefore seen as the participant's decision not to contribute any more. Following this argumentation, all groups were analyzed despite dropout.

When generating indices for several variables, Cronbach's Alpha (α) as measure for internal consistency was calculated, which was acceptable if $\alpha > 0.70$. For all statistical analyses the commonly used 5% significance level of ($p < 0.05$) was assumed. The null hypothesis was that there are no differences between the compared groups.

Combining multiple variables ("Climate change affects me personally nowadays", "Climate change will affect me personally in the future", "We worry too much about the future of the environment and not enough about prices and jobs today", "People worry too much about human progress harming the environment") to a summarized index for environmental concern was administered by applying a Principal Component Analysis (PCA). Scores ranged from -6.57 to 2.23 with a mean of 1.97*e-9 ($SD = 1.48$, $N = 591$). Cronbach's Alpha showed acceptable results ($\alpha = 0.71$).

Ratings on concern for 12 domains ($\alpha = 0.87$) from 1, not important, to 10, supreme importance were collected. Highest importance was given to animals and marine life, followed children & my children. Own lifestyle and concern for oneself were rated the lowest. When calculation the summarized concern for each of the three domains it was found that biospheric concern was highest ($M = 8.52$, $SD = 1.49$) and slightly higher than altruistic concern ($M = 8.30$, $SD = 1.68$), while egoistic ($M = 7.57$, $SD = 1.84$) was the lowest.

In the same manner as for the index for concern, three indicators on behavior ($\alpha = 0.84$; willingness to pay higher taxes or prices and acceptance of cuts in standard of living) were combined to an index for stated behavior by employing a PCA. Scores ranged from -4.18 to 2.50 with a mean of $1.01*e^{-10}$ ($SD = 1.48$, $N = 591$). For the actual behavior, 12 questions ($\alpha = 0.77$) on reported behavior in the private and public domain (see Questionnaire F2 & F3) were used. After recoding the 5-Point Likert-scales (never, rarely and sometimes to 0, often and always to 1), a PCA was applied. Scores ranged from -3.13 to 4.18 with a mean of $1.13*e^{-9}$ ($SD = 1.72$, $N = 591$). The operationalized concern scores from the PCA on concern strongly correlated with the single-indicator value for concern ($r = 0.61$, $p < 0.001$).

To introduce a measure for actual knowledge, four questions on causes and consequences with a 4-Point-Likert scale from "definitively not true" to "definitively true" were included. After recoding, true answers counted 4 points, and the points were summed up for all questions and divided by 16 to generate a score for knowledge on climate change.

In terms of inferential statistics, different tests of comparison were applied (Cameron & Trivedi, 2010; Kohler & Kreuter, 2016). As the non-parametric alternative for the *t*-test to compare group means, the Mann-Whitney-*U*-test (or Wilcoxon-Ranksum-test) was used. The proportions test was applied to analyze the equality of proportions between two groups. Correlations were determined using Pearson's correlation analysis with pairwise deletion.

For the more advanced analysis of the data and testing of the hypotheses, regression analysis was conducted, and models calculated. In the following, a short introduction to this method is given based on literature on data analysis using Stata (Cameron & Trivedi, 2010; Kohler & Kreuter, 2016).

Regression analysis is a frequently used method of linear models to examine the influence of specific independent variables (regressors) on a dependent variable, which is often metric. The aim of regression analyses is to identify relationships between variables and to

measure the strength as well as the direction of this relationship. Moreover, predictions and controlling for the influence of several variables are possible.

Linear regression models assume linear relationship between two or more independent variables and depict this in a model that allows to predict the dependent variable. In the present thesis, this would be for example the regression of the independent barriers on the dependent contributions. This model allows to estimate the linear association of two or more variables as well as the simultaneous influence of the independent variables on the dependent variable.

Yet, this does not imply causality, which could only be concluded on the base of theoretical justification. Moreover, identified relationships between variables can also be a spurious correlation or, in other cases, existing correlations may not be found (suppression), for example due to correlation of the independent variable with other, unobserved variables. To counteract these effects, multivariate analysis (simultaneous analysis of several variables) can be applied which allows to control for effect of third variables, given they were collected in the data.

Multivariate regression analysis, as conducted in this thesis, is the extension of normal regression analysis by more independent variables. The advantage is, that it can be controlled for the effect of additional variables (control variables). Control in this context means, that influence of independent variables on the dependent variable is measured without the distorting effect of other variables. In other words, the impact of one predictor on the independent variable is measured, while keeping other variables constant.

For multivariate regressions, this model (Fig. 4) includes Y as the dependent variable and X_i as the independent variables ($i = 1, \ldots n$). Further, b_i is an estimator for the slope parameter of the particular X_i variable, which resembles the strength of the influence on the dependent variable and is the central test statistic, allowing to calculate a p-Value. B_0 is a constant to adjust the regression line. Finally, u_i is introduced as error term (residuals of the estimation), showing the influence of unobserved variables, which are not explained by the model. The estimation of the b_i parameters is done by minimizing the sum of squared deviations from the regression line, which is called the Ordinary Least Squares Regression (OLS).

$$Y_i = \hat{b}_0 + \hat{b}_1 X_1 + \hat{b}_2 X_2 + \ldots + \hat{b}_k X_k + u_i$$

Fig. 4. Mathematical representation of a multivariate linear regression model.

The characteristics of the estimators are i) unbiasedness (reflect real values in examined population) and ii) consistency (with increasing number of observations, the estimated values converge with the real value) and iii) efficiency (the smaller the variance of an estimator around the real value, the more efficient is the estimator).

Central assumptions of the regression analysis are among others that the sample is random, there are no outliers, there is no perfect multicollinearity between independent variables, the variance of errors is homoscedastic, and errors are normally distributed.

As a measure for the quality of the fit of the model, the coefficient of determination (R^2) is calculated by the division of explained sum of squares (ESS) by the total sum of squares (TSS), as depicted in Fig. 5. This coefficient stands for the proportion of variance in the dependent variable that is explained by the regressors. The adjusted coefficient of determination additionally controls for the number of independent variables.

$$R^2 = \frac{\sum_{i=1}^{n} (\hat{Y}_i - \overline{Y})^2}{\sum_{i=1}^{n} (Y_i - \overline{Y})^2} = \frac{ESS}{TSS}$$

Fig. 5. Calculation of the coefficient of determination (R^2)

Some of the included control variables such as gender (coded 0 – 1) were dichotomous variables and therefore dummy variables. In the analysis the differences in the depending variable between two groups, in this case males and females, was of interest. By introducing the dummy variable, the effect of the dichotomous independent variable in the regression analysis could be interpreted as the main difference in the dependent variable between the two manifestations of the independent variable. For the interpretation this means that B_0 is the mean of the dependent variable of the reference group. B_1 is the slope of the regression line when going from one to the other group, which equals the difference between the groups. The mean of the second group would therefore be the addition of B_0 and B_1, based on which significance tests are possible.

Moreover, also nominal or ordinal variables can be independent variables, for example education in this study. However, in this case it is not possible to calculate regression analyses since the B_1 parameter measures how the dependent variable changes by one unit, which cannot be done for nominal or ordinal variables. Therefore, for each category of education, a dummy variable was created. It is however not unusual to treat certain ordinal variables as continuous in the analysis since there is a reasonable ascending order. Therefore, for example distrust (1 = trust everyone, 10 = careful) was treated as continuous.

As stated above, the dependent variable is often continuous. However, for the regression analysis whether groups passed the threshold or not, the outcome was dichotomous and again a dummy variable. This is called a probability model, since B_1 in this case gives the gives the change of probability, that a certain condition occurs, e.g. that a group passes the threshold. If both, the dependent as well as the independent variable are dichotomous, B_1 is the difference in the probability that the dependent variable equals to 1.

Regression models were employed to estimate the effect of the barriers – immediacy, uncertainty and marginality – on whether groups passed the threshold, on contributions in the climate game, and on the extent of the value-action gap. For the latter two of these three regression analyses, three models were calculated. The first model only examined the effect of the barriers, the second model included additional control variables such as gender, socioeconomic status and education. For the third model, additional personal factors were added. This allowed to infer information about the strength and changes of the barriers' effects under consideration of different control variables. If the effect of the barriers remained significant under the introduction of control variables, this strengthens the conclusion that the barriers affect the dependent variables.

5.2. Sample Characteristics

The sample of participants consisted of 342 females (57.97%) and 248 males (42.03%). The average age of the participants was 29.92 years (SD = 10.45). The minimum age was 18 years and the maximum was 65 years. 470 participants (85.77%) indicated the United Kingdom as their current country of residence and 78 participants the United States of America (14.23%). More than half of the participants (54.15%) were working full-time or part-time, 29.78% were students (with and without working) and 8.97% were unemployed or looking for work. For more details on the descriptive statistics of the control variables see Tab. 3.

A majority reported to be at home (96.62%) with no other person observing their decisions when participating in the study (98.65%) using their PC or notebook (92.05%). Just under half (49.07%) had never participated in similar interactive games online or in the laboratory, about one quarter (26.90%) once, 13.87% twice and 10.15% three times or more.

6. Results

The following chapter will present the results of the study in light of the hypotheses and predictions. The hypotheses were tested based on results of regression analyses. In addition, bivariate tests were also calculated to further illuminate the results. The chapter is further organized as follows: firstly, an overview on descriptive statistics is given. Secondly, the outcomes on surpassing the threshold will be explored. Thirdly, results for contributions in the climate game and, fourthly, the value-action gap are described. Finally, the effect of personal factors will be examined.

6.1. Descriptive Statistics

The political view was in general more liberal: 29.95% indicated to be very liberal, (39.76%) liberal, while only 19.12% indicated being (very) conservative. A majority of the participants stated to be concerned about climate change ($M = 8.08$, $SD = 1.66$). However, participants believed that climate change will personally affect them more ($X^2(16, N = 591) = 380.95$, $p < 0.001$) in the future ($M = 4.44$, $SD = 0.72$) than at present ($M = 3.48$, $SD = 0.91$).

Self-reported knowledge on climate change showed that a majority of the participants believed to be informed about climate change to a certain degree. While 13.37% ($N = 79$) stated to know nothing or little, more than half of the respondents claimed to know something about this topic (53.81%, N = 318). About one third (32.82%, $N = 194$) chose knowing “a lot” or “a great deal”. The mean knowledge score of 0.79 ($SD = 0.12$) indicated that most participants were informed about climate change. This score and the self-reported knowledge were significantly correlated ($r = 0.17$, $p < 0.001$).

In the cognitive abilities task, the average number of correct assignments (Tab. 3) was slightly lower yet comparable to the results of Dohmen et al. (2010). However, in contrast

to the results of Dohmen et al. (2010), the cognitive reflection score showed a weak negative correlation to the willingness to take risks (r = -0.09, p = 0.025).

Tab. 3. Descriptive statistics of the main variables.

Variable's Description	M	SD	Range	N
Children				
1 = yes; 0 = no	28.43	-	0 – 1	168
Income				
1 = Less than 1000 £; 0 = Other	54.99	-	0 – 1	325
1 = 1000 - 2000 £; 0 = Other	25.55	-	0 – 1	151
1 = 2000 - 3000 £; 0 = Other	8.97	-	0 – 1	53
1 = More than 3000 £; 0 = Other	5.25	-	0 – 1	31
1 = Prefer not to answer; 0 = Other	5.25	-	0 – 1	31
Education				
1 = Less than a high school diploma; 0 = Other	1.35	-	0 – 1	8
1 = High school degree or equivalent; 0 = Other	22.67	-	0 – 1	134
1 = College degree or equivalent; 0 = Other	29.10	-	0 – 1	172
1 = Vocational or commercial school; 0 = Other	3.21	-	0 – 1	19
1 = Graduate degree; 0 = Other	41.12	-	0 – 1	243
1 = Other degree; 0 = Other	1.86	-	0 – 1	11
1 = Prefer not to answer; 0 = Other	0.68	-	0 – 1	4
Cognitive reflection	25.54	9.73	0 – 61	591
Time-preference				
1 = very unwilling; 5 = very willing	4.00	0.71	1 – 5	592
Risk-preference				
1 = very unwilling; 5 = very willing	3.33	0.94	1 – 5	592
Trust in others				
1 = trusting; 10 = distrusting	6.00	2.19	1 – 10	592

As Fig. 6 shows, the average contribution per round was 2.12 points (SD = 0.75). An overview of average contributions by treatment is given in Tab. 4. To reach the threshold, each participant had to contribute 2 points each round. Of all 5920 choices, 1605 (27.11%) decisions were 0 or 1 points, while 4315 (72.89%) decisions amounted to the necessary 2 points or higher (Fig. 7). The average is therefore higher than it would be required per person, which is partly due to groups that surpassed the threshold by some points. In line with the literature, these results could be interpreted as evidence for human cooperativeness (Axelrod, 2006; Becker, 1976; Carlsson & Johansson-Stenman, 2012; Fehr et al., 2002; Fehr & Fischbacher, 2002; West et al., 2011), opposing the non-cooperative behavior by game theory (Hoffman et al., 1998).

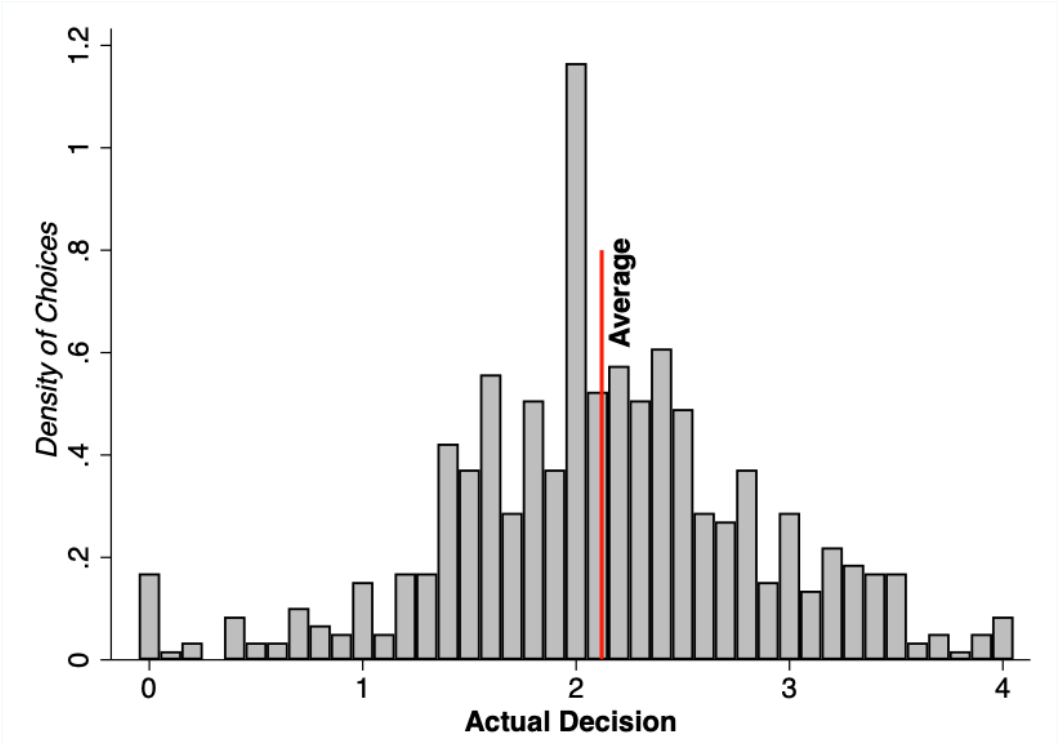

Fig. 6. Distribution of average decisions over 10 periods in the climate game.

Of the summarized individual contributions, 216 participants (36.49%) contributed less than a sum of 20 points. In total, 10 participants never contributed to the climate account. Except one, these were all in large groups and six were in the influencer condition. 35 participants, of which 23 were in the influencer condition, contributed in sum less than 10 points. Free riding (Cosmides & Tooby, 2013; Fehr & Gächter, 2000; Raihani & Aitken, 2011) thus seems to be at least to some extent an issue, especially for the influencer groups, which were able to avoid accepting responsibility without personal costs or being punished (Boyd et al., 2010; Fehr & Gächter, 2000, 2002).

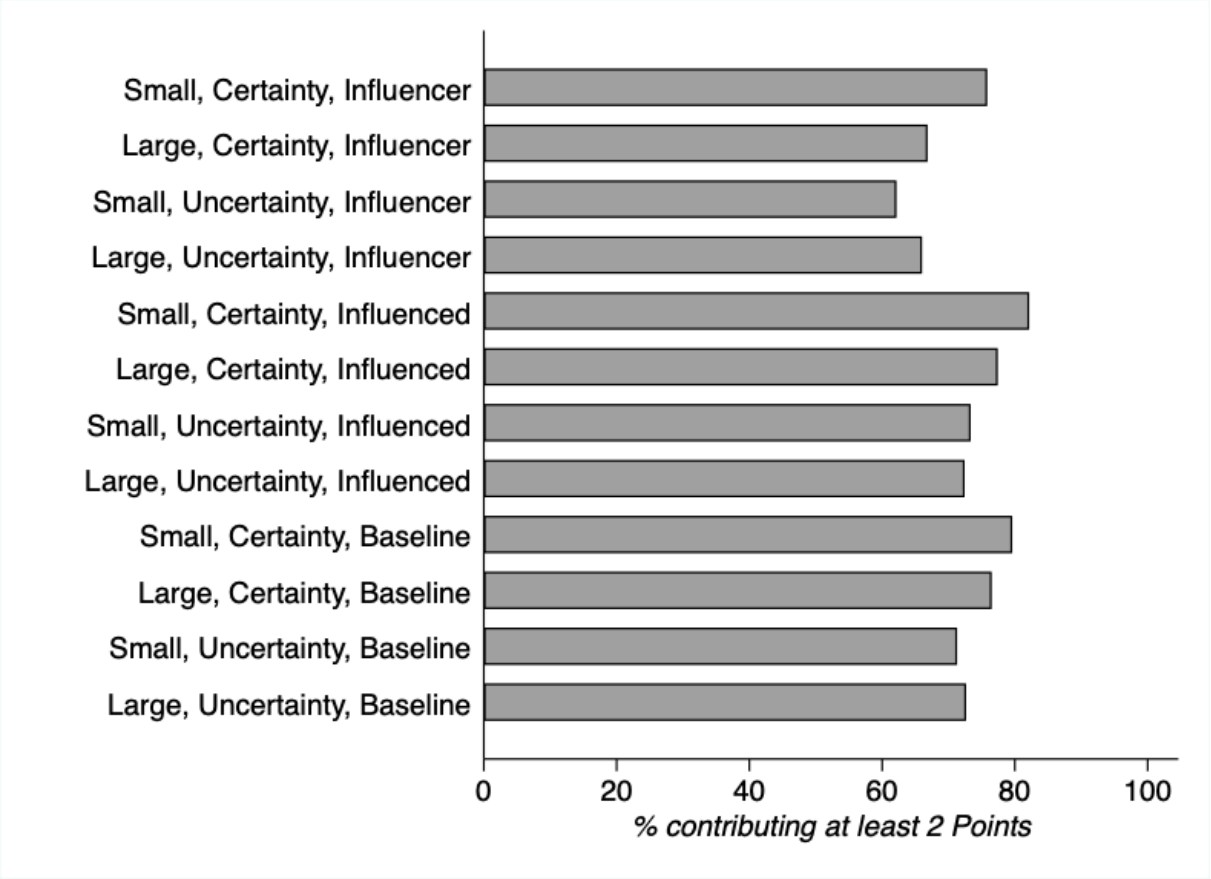

Fig. 7. Proportion of contributions that equal 2 or more points.

Nonetheless, the chosen contributions were relatively high in the first round, also in the influencer condition. Contributions decreased over the periods over all treatments (Fig. 8). After period 6 there was a sharp decline in contributions, which was especially observable for conditions where barriers were present (uncertainty, large groups and influencers), with contributions dropping to zero in period 10. This decline resembles the results of Milinski et al. (2008), who reported a similar curve. An endgame effect could be observed after period 8, when contributions in most cases decreased to about 1.4 points on average.

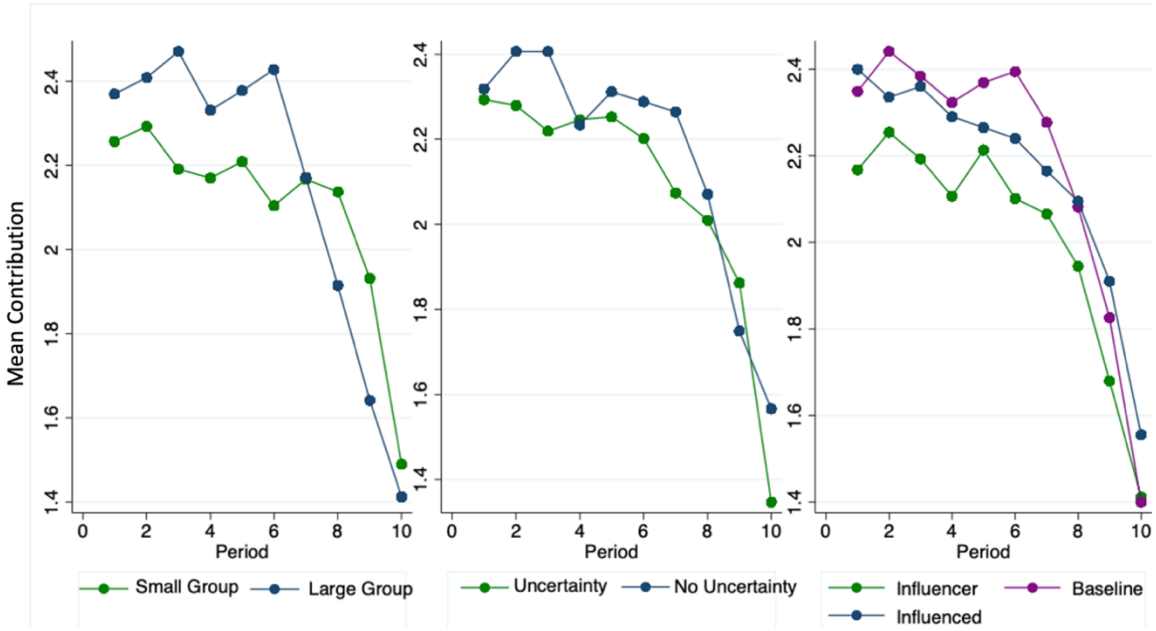

Fig. 8. Mean contributions per period by treatment.

Before drawing conclusions on the value-action gap, the results of the hypothetical decisions have to be examined. The average hypothetical investment (Fig. 9 and divided by treatment in Tab. 4) was 2.27 ($SD = 0.73$) and moderately correlated to the sum of invested points in the game ($r = 0.41$, $p < 0.001$). It could be observed that the hypothetical decisions were well above 2 points per round, which would be necessary to reach the climate goal in the game. Interestingly, within the treatments a slight variation in the hypothetical investment was found. However, as the barriers had not been introduced at the time of the hypothetical decision, this variation might be harmonized with increased sample size.

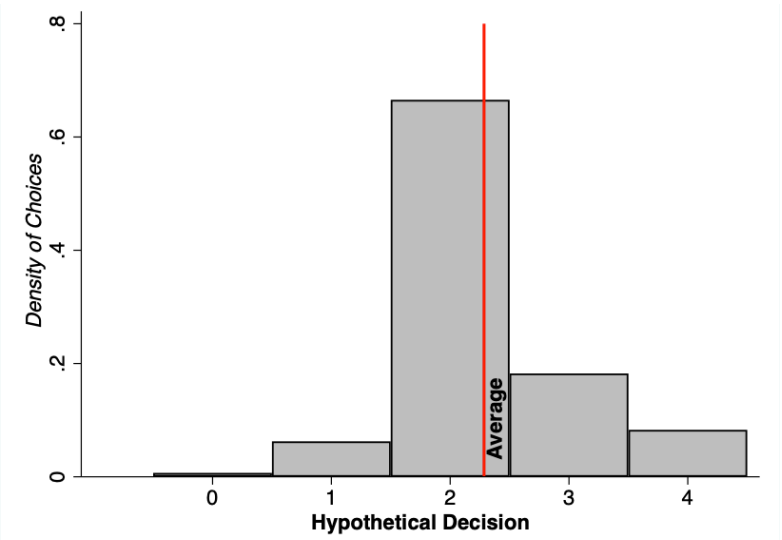

Fig. 9. Distribution of hypothetical decisions in the climate game.

The value-action gap was quantified by calculating the actual investments minus the hypothetical investment. If the hypothetical decision was higher than the actual decision, the value-action gap therefore was a negative number. The mean gap across all groups was -0.15 points (*SD* = 0.80), with a range from -3.3 to 3.0. It has to be considered that the gap in this study is not an absolute measure a measure of the relative position of a participant within the distribution of all participants' value-action gaps

Tab. 4. Means of contributions, hypothetical decisions and value-action gap by treatment.

Treatment	Contribution		Hyp. Inv.		VAG		
	M	SD	M	SD	M	SD	N
Small, Certainty, Influencer	2.10	1.16	2.19	0.63	-0.08	0.81	43
Large, Certainty, Influencer	1.95	1.37	2.33	0.74	-0.38	1.00	57
Small, Uncertainty, Influencer	1.95	1.34	2.36	0.76	-0.41	0.86	42
Large, Uncertainty, Influencer	2.06	1.34	2.35	0.70	-0.29	0.79	55
Small, Certainty, Influenced	2.25	1.45	2.40	0.73	-0.15	0.82	42
Large, Certainty, Influenced	2.20	1.95	2.38	0.83	-0.18	0.66	50
Small, Uncertainty, Influenced	2.22	1.23	2.17	0.62	0.06	0.75	42
Large, Uncertainty, Influenced	2.04	1.46	2.18	0.70	-0.14	0.70	66
Small, Certainty, Baseline	2.29	1.83	2.22	0.77	0.07	0.81	49
Large, Certainty, Baseline	2.21	1.22	2.26	0.87	-0.05	0.85	54
Small, Uncertainty, Baseline	2.07	1.26	2.15	0.59	-0.08	0.59	39
Large, Uncertainty, Baseline	2.15	1.29	2.26	0.71	-0.12	0.86	53
Mean	2.12	1.25	2.27	0.73	-0.15	0.80	-
Total	-	-	-	-	-	-	592

The graphic depiction of the previous table in Fig. 10, clearly shows that the value-action gap is more pronounced in the influencer treatments, which supports the predictions of a higher discrepancy between values and actions with lower immediacy of impact.

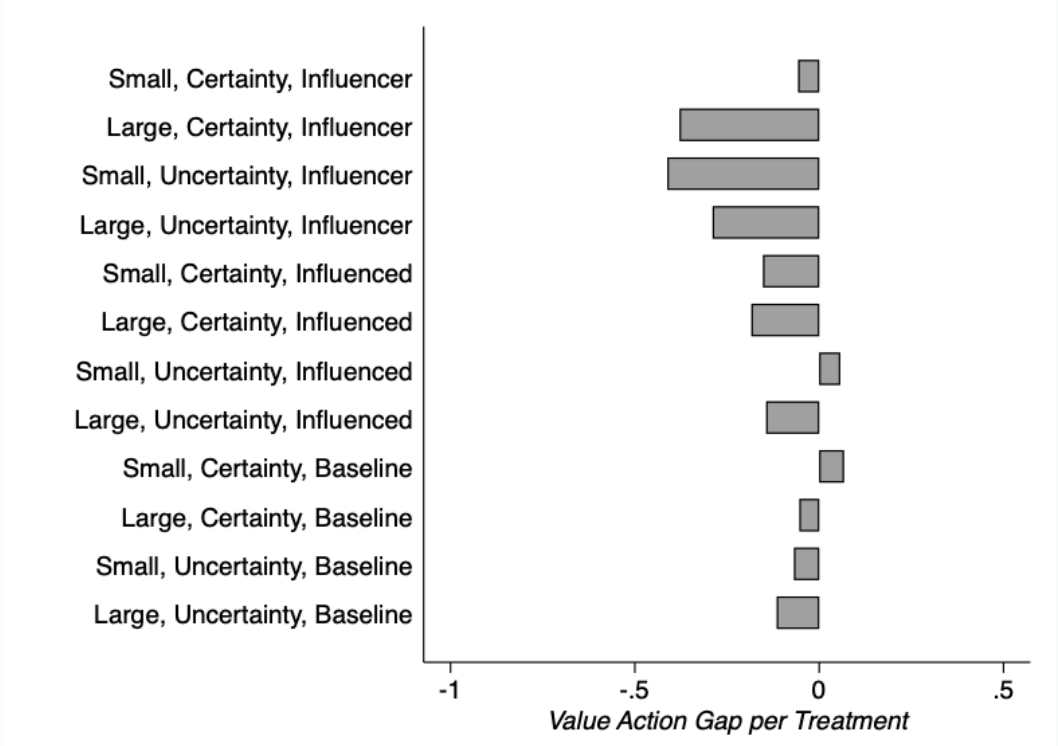

Fig. 10. Average value-action gap by treatment.

6.2. Group Outcomes

Of all players, 75.84% passed the threshold (*SD* = 0.43, *N* = 592), which was surprisingly high in light of the three simultaneous barriers which were considered to lower this percentage. Yet, also Milinski et al. (2008) found more than 80% of the groups surpassing the threshold if probability of loss was 10% or 50%. Nonetheless, this thesis' results revealed that in certain treatments this probability significantly decreased. Applying a proportions test, differences in passing the threshold (Fig. 11) were found in the immediacy and the uncertainty, however for uncertainty no effect was found in the regression analysis. In groups that did not reach the threshold on average 3.00 points per player (*SD* = 3.59) were missing to succeed (Tab. 6).

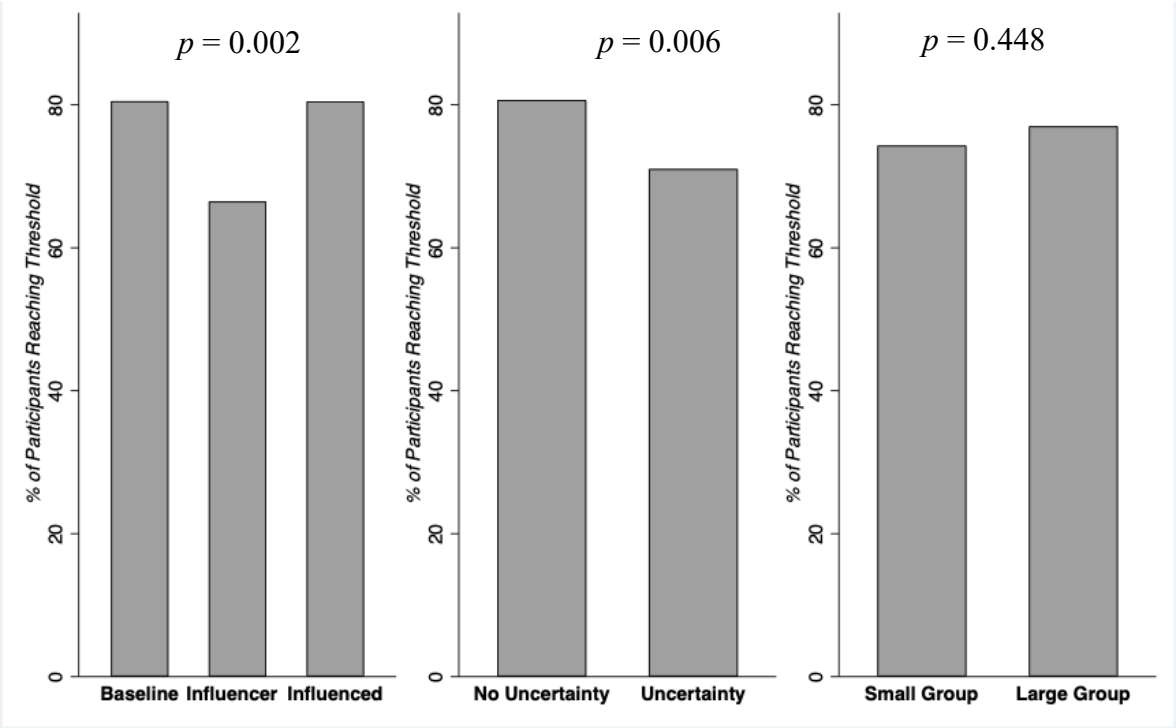

Fig. 11. Percentage of groups passing the threshold in the climate game by treatment.

Tab. 5 shows the results of this regression analysis in which the three barriers – marginality, uncertainty and immediacy – were regressed on the dichotomous variable whether groups surpassed the threshold. No personal factors were included, as the outcome was less dependent on personal characteristics than on the actions of the whole group. Passing the threshold was found to be 73.60% less likely in groups in the influencer condition.

Tab. 5. Linear Regression: Effect of treatments on passing and not passing the threshold.

	(a) Model 1
Marginality (large group)	0.175
	(0.310)
Uncertainty (Uncertainty)	-0.563
	(0.430)
Immediacy (Influencer)	-0.736**
	(0.359)
Immediacy (Influenced)	0.0317
	(0.447)
Constant	1.614***
	(0.292)
Observations	592

Notes: OLS regression coefficients in cells. Clustered standard errors (unit of clustering: session) in parentheses below. p-Values: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1'$

The regression analysis showed a strong effect of the influencer treatment on whether participants passed the threshold with their group. Therefore, the results are consistent with hypothesis (*H1a*). Influencer groups, that did not depend on their own outcomes but partly determined the outcomes for others, were found to have significantly lower percentages of reaching the threshold (Prediction *P1a*). In support of this finding, the proportions test showed that in the immediacy condition (Fig. 11), the players in influenced groups and baseline groups had similar rates of reaching the threshold (both 0.81, $SD = 0.40$, $N = 200$ & $N = 195$), while the influencer groups (0.67, $SD = 0.47$, $N = 197$), compared to the baseline, were less likely to reach the threshold ($z = 3.14$, $p = 0.002$). These results are further confirmed by the finding, that influencer groups missed the threshold by more points ($z = 2.53$, $p = 0.011$) than baseline groups (Tab. 6).

The results of the regression analysis are inconsistent with hypothesis *H2a*, as there was no significant effect of uncertainty on passing the threshold observable (*P2a*). Nonetheless, the proportions test indicated, that participants in groups with uncertainty of contribution (Fig. 11), had significantly lower probability ($M = 0.71$, $SD = 0.45$, $N = 297$) of reaching the threshold ($z = 2.74$, $p = 0.006$) than without uncertainty (0.81, $SD = 0.39$, $N = 295$). Without controlling for other variables, uncertainty therefore seems to have an impact, which is also in line with groups in the uncertainty treatment (Tab. 6) significantly missing more points ($z = 4.70$, $p < 0.001$).

Tab. 6. Points per player missing to reach the threshold.

Missing Points	*M*	*SD*	*N*
Marginality			
Small group	-3.04	3.61	66
Large group	-2.96	3.60	77
Uncertainty			
No uncertainty	-3.72	4.35	57
Uncertainty	-2.52	2.92	86
Immediacy			
Baseline	-2.59	2.76	38
Influencer	-3.91	4.49	66
Influenced	-1.84	1.84	39
Total	-3.00	3.59	143

The data collected in the present experiment does not support refuting the null hypothesis for *H3a*. Small and large groups passed the threshold with a comparable probability (Prediction *P3a*). In the regression analysis as well as in the proportion tests, there was no significant difference ($z = -0.76$, $p = 0.448$) between small groups ($M = 0.74$, $SD = 0.44$, $N = 257$) and large groups ($M = 0.77$, $SD = 0.42$, $N = 335$) in the marginality treatment

(Fig. 11). Moreover, small and large groups (Tab. 6) did not show differences in the missing points (z = -1.49, p = 0.136).

6.3. Individual Contributions

The results of this thesis present evidence for the negative effect of being an influencer on the sum of contributions, however not for uncertainty or group size. By employing the proportions test, for both the immediacy and the uncertainty condition, a tendency pointing towards an effect of the treatment were found. In line with the regression, no significant differences were found for group size (Fig. 12).

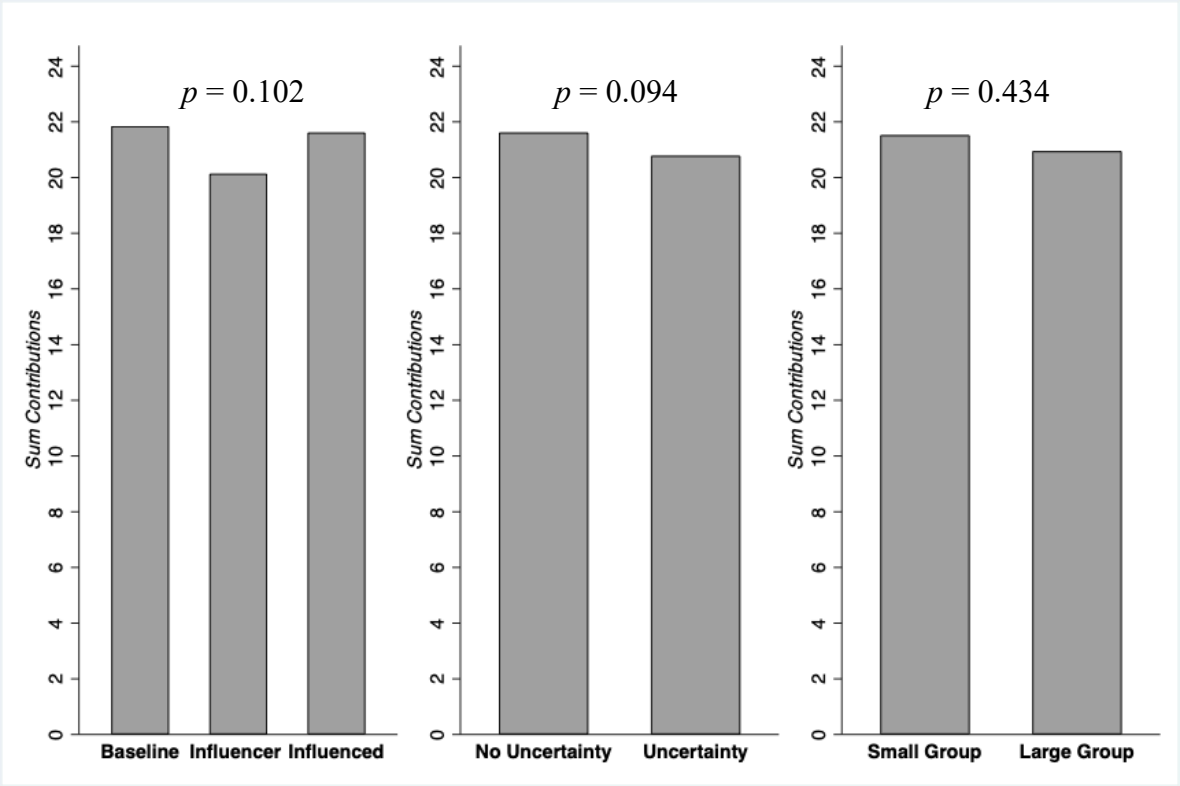

Fig. 12. Mean sum of contributions per player in the climate game by treatment.

Tab. 7 shows the results of the second linear regression which regressed several variables on the sum of contributions over 10 periods and confirms an effect of the influencer treatment. To analyze effect of control variables, several models were calculated. While model 1 (a) explores the effect of the three barriers on the contributions, the subsequent models include additional control variables, such as age, gender, education and socioeconomic status (b) and cognitive reflection, risk-preference, time-preference and trust in others (c). Across all three models, the significance of the effect of being in the influencer treatment, compared to the baseline, remained relatively constant, underlining

its importance. The influencer condition reduced contributions to the climate account, for example in (a) by 1.664 points ($p < 0.05$). For the sake of readability of depiction, not all variables were shown, however included in the calculation. For the full table of the regression analysis see Appendix (Tab. D1). The role of personal factors will be further investigated in the regression in Section 6.5.

Tab. 7. Linear Regression: Effect of treatments and personal factors on contributions.

	(a) Model 1	(b) Model 2	(c) Model 3
Marginality (large group)	-0.613	-0.519	-0.334
	(0.580)	(0.564)	(0.568)
Uncertainty (uncertainty)	-0.829	-0.793	-0.789
	(0.530)	(0.486)	(0.552)
Immediacy (influencer)	-1.664**	-1.657**	-1.490**
	(0.614)	(0.711)	(0.641)
Immediacy (influenced)	-0.201	-0.215	-0.0377
	(0.525)	(0.605)	(0.520)
Gender		X	X
Age		X	X
Education		X	X
Socioeconomic status		X	X
Cognitive reflection			X
Time preference			X
Risk preference			X
Distrust in others			X
Constant	22.62***	21.26***	12.39***
	(0.554)	(2.696)	(3.456)
Observations	590	587	586
R-squared	0.015	0.071	0.151

Notes: OLS regression coefficients in cells. Clustered standard errors (unit of clustering: session) in parentheses below. X depicts the values for variables that were included in the analysis, however omitted in the table. *p*-Values: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Consistent with *H1b*, the regression analysis proved significant effects of the influencer condition on contributions in the climate game. Employing the non-parametric Mann-Whitney-*U*-test on the difference in contributions to the climate account did not reach significance, however a trend towards lower contributions of influencers is observable (*P1b*). Contributions in the immediacy condition (Fig. 12) did not significantly differ ($z = 1.63$, $p = 0.102$), when comparing influencers ($M = 20.14$, $SD = 8.48$) to the baseline ($M = 21.85$, $SD = 7.41$), however pointing out a tendency. The contributions in the influenced groups ($M = 21.61$, $SD = 6.48$) were close to the baseline, yet slightly lower, indicating that being dependent on others might be of relevance when deciding.

Similar as before, also in rejection of *H2b* with reservations, regression analysis did not reveal an effect of uncertainty on contributions (*P2b*). In contrast, when employing bivariate tests (Fig. 12), in the uncertainty condition ($M = 20.78$, $SD = 7.49$) the

contributions were not significantly lower as in the certainty condition ($M = 21.62$, $SD = 7.52$), however pointing towards a tendency of being lower ($z = 1.67$, $p = 0.094$) and indicating, that uncertainty is of relevance, even though the risk of an unsuccessful contribution only amounted to 30%.

Supporting the null hypothesis of *H3b*, the regression analysis and in the comparison of the means showed a comparable contribution behavior in small and large groups (*P3b*). The contributions by group size did not significantly differ ($z = 0.78$, $p = 0.434$), with a mean of 21.52 points ($SD = 6.54$) for small groups and a mean of 20.95 points ($SD = 8.19$) for large groups (Fig. 12). As shown in the rest of the results, group size overall least affected the behavior of participants in the game. The cause for this might be a too small difference in the group size between groups of 3 and 6 players. This issue will be described in more detail in the discussion chapter.

6.4. Determinants of the Value-Action Gap

In the regression analysis as well as the Mann-Whitney-*U*-test, differences in the value-action gap could only be found for the immediacy treatment, while uncertainty and marginality did not show any significant differences, as shown in Fig. 13.

As for the contributions, a linear regression analysis consisting of three models was employed (Tab. 8). The value-action gap as the difference between hypothetical and actual investments ($M = -0.15$, $SD = 0.80$) in the climate game was regressed on a set of variables. As in the previous analysis, the influencer condition broadened the value-action gap, e.g. in (a) by 0.246 points ($p < 0.01$), which remains constant across all three models. Again, for the sake of readability of depiction, not all variables were shown, however included in the calculation. For the full table of regression analysis see Appendix (Tab. D2).

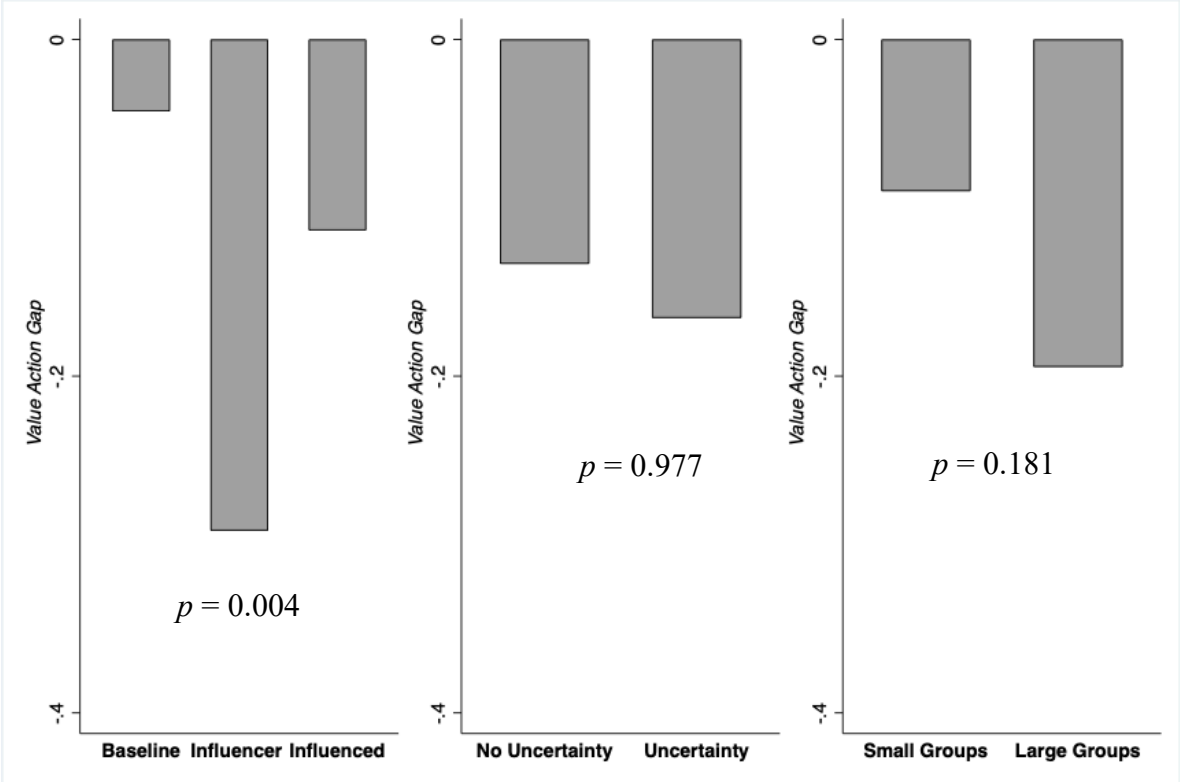

Fig. 13. Mean value-action gap per player in the climate game by treatment.

In consistence with *H1c*, there was a significant effect of the influencer condition on the value-action gap found in the regression analysis (*P1c*). In the immediacy condition (Fig. *13*), the value-action gap was significantly higher ($z = 2.86$, $p = 0.004$) in the influencer ($M = -0.29$, $SD = 0.87$) compared to the baseline groups ($M = -0.04$, $SD = 0.80$), which reached similar results as the influenced groups ($M = -0.11$, $SD = 0.72$). This supports the notion, that without direct impact on one's own outcomes, the gap between values and actual behavior increases substantially.

Inconsistent with hypothesis *H2c*, the value-action gap did not differ with uncertainty (*P2c*), which was confirmed by the regression analysis as it did not yield any significant effect of uncertainty. In the uncertainty condition ($z = -0.03$, $p = 0.977$), with a mean gap of -0.17 ($SD = 0.77$) facing uncertainty and -0.13 ($SD = 0.84$) not facing uncertainty did not have an influence on the value-action gap (Fig. 13).

Supporting the null hypothesis of hypothesis *H3c*, large and small groups showed the same value-action gap (*P3c*) and no effect of group size in the regression. The same holds true for the comparison of group means: no significant differences in the value-action gap ($z = 1.34$, $p = 0.181$) between small ($M = -0.09$, $SD = 0.79$) and large groups ($M = -0.19$, SD = 0.81) were found (Fig. 13). As mentioned before, this might have been caused by insufficient differences in the group size of the treatments.

Tab. 8. Linear Regression: Effect of treatments and personal factors on value-action gap.

	(a)	(b)	(c)
	Model 1	Model 2	Model 3
Marginality (large group)	-0.101	-0.102	-0.0934
	(0.0681)	(0.0720)	(0.0715)
Uncertainty (uncertainty)	-0.0269	-0.0258	-0.0259
	(0.0674)	(0.0649)	(0.0671)
Immediacy (influencer)	-0.246***	-0.252***	-0.245***
	(0.0719)	(0.0738)	(0.0740)
Immediacy (influenced)	-0.0659	-0.0721	-0.0519
	(0.0692)	(0.0713)	(0.0746)
Gender		X	X
Age		X	X
Education		X	X
Socioeconomic status		X	X
Cognitive reflection			X
Time preference			X
Risk preference			X
Trust in others			X
Constant	0.0256	0.0325	-0.223
	(0.0659)	(0.238)	(0.273)
Observations	590	587	586
R-squared	0.021	0.036	0.058

Notes: OLS regression coefficients in cells. Clustered standard errors (unit of clustering: session) in parentheses below. X depicts the values for variables that were included in the analysis, however omitted in the table. *p*-Values: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

6.5. The Role of Personal Factors

To infer about the role of personal factors on contribution behavior and the value-action gap, another regression analysis was employed. The analysis of the effect of personal factors on contribution behavior and the value-action gap showed substantial effects of cognitive reflection and time-preferences for both variables.

For both models of the analysis (Tab. 9), the same set of control variables was included. In model 1 (a), these were regressed on contributions and in model 2 (b) on the value-action gap. In addition to the variables necessary for testing hypotheses *H4* and *H5*, gender, age and children were added as controls to the models. Model 1 shows, that contributions decrease with cognitive reflection and increase with higher distrust in others. Interestingly, being male was linked to lower contributed sums, in (a) by 1.707 points ($p < 0.05$).

Contributions increased with preference for delayed reward and with self-reported environmental concern, however not with the concern index generated with a PCA. In model (2), having children and distrust in others decreased the value-action gap by 0.177 points ($p < 0.01$), while the gap became larger with higher cognitive abilities.

The data is consistent with hypothesis *H4a*, that contributions to the climate account increase with environmental concern and preference for delayed rewards (Prediction *P4a*). In the bivariate analysis, general concern regarding climate change, and the summed-up contributions were weak but significantly correlated ($r = 0.20$, $p < 0.001$). For the multiple-indicator concern measure this correlation was weaker and close to significance ($r = 0.08$, $p = 0.050$). This strengthens the notion, that concern still has an impact on pro-environmental behavior, which however in the regression was only found for self-reported concern. For more results on concern in correlation with stated and actual behavior from the questionnaire see Tab. D3 in the Appendix. Correlation and regression analysis showed that preference for delayed rewards was positively associated ($r = 0.20$, $p < 0.001$) with contributions (*P4a*). The more willing the participants were to give up something beneficial in the present, the more they contributed to reaching the climate goal in order to benefit from future outcomes.

In support of hypothesis of *H4b,* this relationship is non-existent for environmental knowledge (P4b). Both the self-reported knowledge on climate change ($r = -0.002$, $p = 0.956$) as well as the scored knowledge ($r = 0.03$, $p = 0.472$) did not significantly correlate with contributions nor showed effects in the regression. Thus, knowledge on climate change did not seem to be a driver for pro-environmental decisions in an online experiment.

With regards to hypothesis *H4c*, predictions on decreasing contributions hold true for cognitive reflection but not for the willingness to take risk and conservative political affiliation, which only showed significant effects in the bivariate test. Therefore, the results are not fully consistent with this hypothesis.

More in detail, the results of correlation analysis as well as regression analysis confirmed that with higher cognitive abilities, contributions to the climate account decreased (P4c). Cognitive reflection was negatively associated with contributions ($r = -0.17$, $p < 0.001$). However, on contrary to literature-based assumptions (Bernedo & Ferraro, 2016) risk-taking preferences showed no such effect (*P4c*) in the regression and in bivariate testing ($r = -0.03$, $p = 0.472$). When interpreting this result, it has to be considered, that a majority of the participant were indifferent or only indicated weak preferences, which might weaken the effect.

Tab. 9. Linear Regression: Effect of personal factors on contributions and value-action gap.

	(a) Model 1	(b) Model 2
Gender (male)	-1.707**	-0.0934
	(0.664)	(0.0748)
Age	0.0696	-0.00496
	(0.0450)	(0.00587)
Children (yes)	0.613	0.177*
	(0.793)	(0.0857)
Education (High School Degree)	-1.213	0.0388
	(2.484)	(0.195)
Education (College Degree)	-1.425	0.0310
	(2.014)	(0.196)
Education (Vocational School)	4.264	0.322
	(2.750)	(0.256)
Education (Graduate Degree)	-1.212	0.0654
	(2.166)	(0.166)
Education (other)	-3.251	-0.399
	(3.024)	(0.332)
Education (prefer not to answer)	0.795	-0.441
	(5.918)	(0.461)
Income (1000-2000£)	0.482	0.103
	(0.607)	(0.0707)
Income (2000-3000£)	-0.386	-0.00628
	(1.083)	(0.108)
Income (more than 3000£)	-1.557	-0.104
	(1.083)	(0.158)
Income (prefer not to answer)	0.133	0.0102
	(1.405)	(0.151)
Cognitive reflection	-0.0950**	-0.00640**
	(0.0368)	(0.00303)
Time preference	1.629***	0.0120
	(0.372)	(0.0414)
Risk preference	0.237	0.0229
	(0.254)	(0.0298)
Distrust in others	0.517***	0.0428***
	(0.157)	(0.0133)
Environ. concern (self-reported)	0.682**	0.00502
	(0.254)	(0.0291)
Environ concern (PCA index)	-0.179	0.00778
	(0.240)	(0.0350)
Knowledge on climate change	-0.884	-0.170
	(3.960)	(0.386)
Political affiliation	-0.366	-0.0111
	(0.322)	(0.0398)
Constant	8.846*	-0.179
	(4.789)	(0.489)
Observations	586	586
R-squared	0.160	0.045

Notes: OLS regression coefficients in cells. Clustered standard errors (unit of clustering: session) in parentheses below. Cognitive reflection: score from cognitive abilities test in questionnaire. Time preference & risk preference variable: 1 = very unwilling; 5 = very willing. Trust variable: 1 = trust everyone, 10 = careful. Political affiliation: 1 = very liberal; 5 = very conservative. *p*-Values: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Also, higher distrust in others positively correlated with the contributions ($r = 0.15$, $p < 0.001$), which means that with carefulness, contributions increase. Confirmed by the regression analysis, these results were surprising as they were in contrast to the hypothesized decrease with increasing distrust. Causes for this might be found in the nature of the inquired trust variable, as further discussed in Chapter 7.

Conservative political affiliation (*P4c*) turned out to be negatively correlated with contributions in the climate account ($r = -0.12$, $p = 0.006$), which however was not found in the regression analysis. Employing another regression analysis with each of the Likert-scale items as dummy variables would be proposed to further illuminate the relationship more in detail. Moreover, for the analysis it has to be considered that most of the participants indicated to be liberal and less than 20% pointed out being conservative.

In terms of the value-action gap, prediction *P5a* was not found to be accurate. The results were inconsistent with hypothesis *H5a*, since neither the regression nor bivariate test revealed an effect of concern ($r = 0.02$, $p = 0.572$), the index for concern ($r = 0.00$, $p = 1.000$) or time preferences ($r = 0.03$, $p = 0.503$). No effects of environmental knowledge (*P5b*) were found in the regression and correlation analysis, with $r = -0.05$, $p = 0.260$ and $r = -0.20$, $p = 0.634$, which is consistent with *H5b*.

As the calculated value-action gap is a negative value, the following negative correlation stands for an increased value-action gap with cognitive reflection: for hypothesis *H5c,* the regression analysis as well as bivariate tests, revealed effects on the value-action gap only for cognitive reflection ($r = -0.083$, $p = 0.044$) and distrust in others ($r = 0.12$, $p = 0.004$). Surprisingly, for the latter this effect was opposite as hypothesized based on literature (Hasson et al., 2010; Lo Iacono & Sonmez, 2020): distrust came with higher contributions and a smaller value-action gap. Thus, this hypothesis is rejected and possible reasons for this finding further illuminated in the discussion.

For the additional control variables, the following was found: the application of the non-parametric Mann-Whitney-*U*-test showed that participants with children ($M = 22.77$, $SD = 7.76$, $N = 168$) on average contributed more points ($z = 3.36$, $p = 0.001$) to the climate account than those without children ($M = 20.61$, $SD = 7.37$, $N = 420$) and also had a smaller value-action gap ($z = 2.19$, $p = 0.028$). Moreover, corresponding to model 1 of the regression, females ($M = 21.95$, $SD = 6.97$) tended to have slightly higher investments ($z = 2.36$, $p = 0.018$) than males ($M = 20.20$, $SD = 8.15$). However, this effect did not appear for the value-action gap ($z = 1.16$, $p = 0.245$).

7. Discussion and Outlook

The process of translating pro-environmental values to decisions is complex and multifactorial, depending on structural and psychological challenges. In order to allow an analysis of the latter without the influence of the former, this thesis conducted an online experiment simulating the following three barriers to pro-environmental decision-making: immediacy, uncertainty and marginality.

While previous studies mostly focused on one of these barriers, this thesis simultaneously investigated all three barriers together and found that immediacy and, in parts, uncertainty were found to have a significant negative effect on realizing pro-environmental values into actual behavior, and thus contributing to the value-action gap. No such effect was found among the differing group sizes in the marginality treatments. Moreover, personal factors, such as cognitive abilities, environmental concern, time-preferences or trust in others had a significant effect on contribution behavior.

This chapter will first discuss the impact of the three barriers on participants' decision behavior and the value-action gap (*Research Question RQ1*) and, second, the impact of personal factors on contributions (*Research Question* RQ2). Followed by a general discussion of the findings in light of the literature, finally, the benefits of this research and recommendations to reduce the existing value-action gap present will be presented.

7.1. Immediacy Showed the Strongest Effects in the Climate Game

The analysis provided substantial evidence of the effect of immediacy. The influencer groups, which partly determined the outcome of other groups, but did not depend on their own game results, passed the threshold in the climate game less often, contributed less and had a larger value-action gap. Therefore, hypothesis *H1* is accepted.

Jacquet et al. (2013) have shown the effect of immediacy by simulating inter- and intragenerational discounting by making rewards for defection immediate, whereas rewards for cooperation were delayed by one day. Fehr & Leibbrandt (2011) combined field and lab data and showed the importance of impatience in exploiting common pool resources. Others introduced imaginary representatives of future generations or bargaining (Kamijo et al., 2017; Wolf & Dron, 2020), which both highlighted positive effects of human interaction with others. In the present study, while participants were influencing the outcomes of real other players that followed after them, there was no possibility to

communicate with each other. The results showed that influencer groups displayed lower contribution behavior, which adds to previous findings. In contrast to Busse & Menzel (2014), who found no association of socio-temporal distance and willingness for PEB, the findings of the present study underline the effect of socio-spatial and temporal distance, thus confirming the results of Jones & Rachlin (2009).

The findings of this thesis are also in accordance with other literature. Throughout human history a preference of valuing immediate rewards over future rewards has existed (Friedman, 2005; Gifford, 2011; Griskevicius, Cantú, et al., 2012; Penn, 2003; Stoknes, 2015; Van Vugt et al., 2014). Spatial and temporal distance hinder the formation of reciprocal altruism, which is a prerequisite for cooperation (Nowak, 2006). Both were repeatedly discussed in behavioral economics (Croson & Treich, 2014; Gsottbauer & van den Bergh, 2011) and pose a risk for successful action against climate change (Lorenzoni et al., 2007; Van Lange et al., 2018).

It is interesting to observe, that the barrier, which was found to have the strongest effect, is the only barrier that solely affects the earnings of other participants, but not one's own earnings. Also, those participants who contributed zero or less than 10 points (free riders) were predominantly found in these influencer groups. Thus, for future research, another factor to consider might be altruistic preferences and intergroup effects (Van Lange et al., 2018).

7.2. Uncertainty Does not Reduce Willingness to Contribute

Based on the findings of this study, hypothesis *H2*, is rejected with reservations. The three regression analyses revealed no effects on passing the threshold, contributions or the value-action gap. Nonetheless, the employed bivariate tests pointed out, that uncertainty led to the threshold being surpassed less often, with significantly more points missing. Moreover, a tendency towards lower contributions was found.

Putting these results in context with previous literature is not directly possible, due to the novel approach of including uncertainty at the level of the action. Most authors found that uncertainty in MPCR (Fischbacher et al., 2014) or at the threshold and impact level (Barrett & Dannenberg, 2012; Barrett & Dannenberg, 2014; Dannenberg et al., 2011, 2015; Hurlstone et al., 2017) reduces the contributions.

These findings are also reflected in non-experimental literature. Mechanisms to cope with immediate and visible dangers reach their limits with climate change. Lacking perception of climate change fosters misjudgments (Gifford, 2011; Griskevicius, Cantú, et al., 2012; Penn, 2003; Van Vugt et al., 2014). The abstract nature of climate change is also accompanied with misinterpretations of personal affection (Gifford, 2011; Grothmann & Patt, 2005; Heal & Millner, 2014; Lorenzoni et al., 2007) or increased uncertainty about the impact of one's own behavior which in turn promotes self-interest or inaction (Gifford, 2011).

Having a closer look at the experimental results of Milinski et al. (2008), it can be observed, that the number of groups which failed to surpass the threshold did not decrease as much between the 10% and 50% as it did between the latter and the 90% condition. Therefore, it seems that the effect of uncertainty is weaker for lower probabilities of loss but increases when the uncertainty is high. Translating this to the results of the present experiment, where the probability of successful contribution is relatively high (70%, which could be interpreted as equal to 30% in Milinski's game), it could be concluded, that the impact of uncertainty at the action level would be more distinctive when reducing the probability to 50% or less. In line with the above-mentioned incongruences between the results of the regression analysis and bivariate tests, future studies might consider and explore different levels of uncertainty in more detail and thus find more pronounced results regarding the effect of uncertainty.

7.3. The Impact of Marginality

The data collected in the experiment is inconsistent with hypothesis *H3* and its three sub hypotheses. Small and large groups passed the threshold with a comparable probability, showed a comparable contribution behavior and presented the same value-action gap.

This is in contrast to a broad body of previous literature, which pointed towards an effect of group size, for example the propensity for self-interest as putting own interests before group interest, especially in interaction with non-relatives (Griskevicius et al., 2012) or the relevance of group size for cooperation (Boyd & Richerson, 1988; Pacheco et al., 2014; Santos et al., 2012). Also, the by-stander effect (Fischer et al., 2011), diffusion of responsibility (Saha, 2018; Wells et al., 2011) and perceived self-efficacy (Gifford, 2011; Hoffmann & Muttarak, 2020; Mock et al., 2019; Van Lange et al., 2018) lead to the conclusion, that with increased group size the participants' behavior will be negatively influenced. Other authors suggested that small and medium sized groups are beneficial for

global coordination efforts (Pacheco et al., 2014). Similarly, Santos et al. (2012) showed in an evolutionary game theory model, that small groups facing high risk were most successfully coordinated to prevent climate change.

In contrast, the increasing group size was also discussed as ambiguous depending on the context and interaction mechanisms (Barcelo & Capraro, 2015; Powers et al., 2019). In the context of the current experiment, the sizes of the groups were varied between 3 and 6 players. Following this line of thought and in accordance with the conclusion of Milinski et al. (2008) that 6 players are not necessarily representative of a real-world climate scenario, explanations for the non-significance are suggested. The most parsimonious explanation for the lacking effect could be that the differences between the two group sizes might not have been enough to simulate the dynamics of larger groups, and further insufficient to evoke a diffusion of responsibility or other above-mentioned effects of group size. Future works, therefore, should strongly increase the group size to make the results more reliable.

7.4. The Effect of Personal Factors

In addition to the examined barriers, several personal factors were considered to have a significant impact on contribution behavior in the experiment. Results confirm hypothesis *H4,* except for the association of risk-taking preferences and conservative political affiliation with contributions. However, in terms of effects of personal factors on the value-action gap, hypothesis *H5* was rejected as effects were only found for cognitive reflection and distrust, and, as hypothesized, no effects of knowledge were identified. The other factors were inconsistent with the expected results, which justifies the rejection.

More specifically, these results are in line with previous literature which has shown that concern is closely connected to pro-environmental behavior (Stern, 2000; Takács-Sánta, 2007; Tam & Chan, 2017). However, no correlation between concern and the value-action gap was detected. It seems, that with higher concern the willingness to contribute increases, yet concern is not sufficient to overcome the value-action gap imposed by the barriers. Moreover, neither contributions nor impact were shown to be influenced by environmental knowledge, mirroring previous studies (Gaspar, 2013; Gaspar et al., 2010; Kollmuss & Agyeman, 2002; Weber, 2018).

Closely related to the discussion of the marginality treatment (Croson & Treich, 2014; Fehr & Leibbrandt, 2011; Gsottbauer & van den Bergh, 2011), correlation and regression

analysis showed that preference for delayed rewards was positively linked to contributions, indicating that giving up benefits now for future benefits was reflected in the climate game and amplified pro-environmental behavior. In contrast, preferring immediate rewards was linked to saving the points in the personal account. The value-action gap, nonetheless, was not affected by time preferences.

According to previous literature (Dohmen et al., 2010) cognitive reflection was found to be correlated with risk aversion. However, in the data of this thesis, only cognitive abilities but not risk preferences, were negatively correlated to contributions and a more pronounced value-action gap. These results align with previous experiments, which showed that lower cognitive skills came with higher contributions if the money is not self-earned (Hackinger, 2016). In a real-life situation this would be in contrast to previous work (German National Academy of Sciences Leopoldina, 2019), which concluded that brain power is of relevance for combatting climate change due to increased adaptive capacity. A promising candidate to explain this effect would be education and environmental knowledge, however, the regression analyses have shown that both did not significantly influence contribution behavior. This triangle of cognitive skills, education and pro-environmental behavior poses a promising field for future research.

Despite the influence of cognitive abilities, risk aversion did not show any effect. On the contrary to literature-based assumptions (Bernedo & Ferraro, 2016), risk-taking preferences had no effect on contribution or the value-action gap. This might be due to the relatively neutral position of participants regarding risk-taking: the data showed that most participants indicated to be indifferent or had only weak preferences, while the strong preferences were chosen seldomly.

Another interesting point was, that in contradiction to the prediction, being careful in terms of trusting others positively correlated to contributions, which also held true in the regression analysis for contributions as well as the value-action gap. Surprisingly, with distrust, participants decided to contribute more, which was in contrast to the hypotheses based on previous literature (Hasson et al., 2010; Lo Iacono & Sonmez, 2020). One possible explanation is, that distrust in others did not, as expected, affect the contributions negatively since participants wanted to save their points, but because they wanted to reduce the risk of missing the threshold. Another reason for this finding might be, that the trust variable inquired in the questionnaire is not directly reflecting the actual trust in other participants. Especially in light of the findings, that contributions were relatively high in the first rounds, this might have built trust in other players, which in turn increases likelihood of collective action (Lo Iacono & Sonmez, 2020). However, the trust variable of the questionnaire remained unaffected by trust built in the game or the decrease of contributions in the second

half of the game. Thereby, a divergence between trust in other players in the game and the trust variable of the questionnaire might have occurred.

Farjam et al. (2019) reported a correlation of environmental attitude with political affiliation. Based on this, it was predicted, that with conservative political affiliation, contributions would be lower. However, these findings were only confirmed by the bivariate test but not by the regression analysis. Thus, this relationship might need further exploration in upcoming research.

When investigating the additional control variables, which were not part of the hypotheses, it was surprising to find, that women tended to contribute more to the climate account. This difference was not found for the value-action gap. Previous literature has been unable to point out clear gender differences in provision in public goods games (Cadsby & Maynes, 1998; Cox & Deck, 2007; Eckel & Grossman, 2008; Sell et al., 1993). Moreover, in the bivariate analysis, participants with children showed higher contributions, while the regression analysis revealed a smaller value-action gap for those with children. These findings could be interpreted in line with the interest for own children due to gene-interest (Dawkins, 1976; Van Vugt et al., 2014) and kin selection (Hamilton, 1964; Palomo-Vélez et al., 2020). In support of own future relatives, avoiding climate change would be a major concern. Yet, to make reliable conclusions, this would need further investigation.

7.5. General Discussion

Translating pro-environmental values and concern to actual pro-environmental behavior is a key factor for fostering a sustainable future. Based on and in line with previous research, this thesis shows the impact of three barriers on the essential step from values to action and, hence, also helps to understand the so-called value-action gap. The findings revealed that the immediacy of the impact when failing to reach certain climate goals, was the strongest barrier. Less pronounced, also uncertainty of actions was shown to be tending to have an impact in the climate game. However, it seemed, that marginality did not pose a significant barrier. Moreover, this research displayed the importance of personal factors, which in case of environmental concern, preference for delayed rewards and distrust in others, positively affected contribution behavior, while contributions decreased with higher degrees of cognitive reflection.

Failing to realize environmentally friendly behavior intentions is in literature well documented within the literature as the value-action gap (Blake, 1999; Kollmuss & Agyeman, 2002) and was investigated in several domains, as outlined in the literature

review. In line with previous literature (Kollmuss & Agyeman, 2002; Weber, 2018), the results confirm that environmental knowledge alone is not sufficient to close this gap. On the contrary, environmental concern increased contributions.

In light of the interdisciplinarity of this thesis, causes for the gap were sought in human evolutionary history, psychology and behavioral economics. As argued in the literature review, these three fields have their common denominator at the level of decision-making, using heuristics and rules of thumb, and the cognitive challenges arising from this (Clayton, 2019; Hutchinson & Gigerenzer, 2005; Witt, 2011). The three psychological barriers to pro-environmental decision-making (Gaspar, 2013; Gifford, 2011; Kollmuss & Agyeman, 2002), which were identified based on previous literature from the above-mentioned fields, represent the main challenge, since they can prevent individuals from grasping the implications of their behavior. The findings of this study mostly confirm the hypotheses and predictions derived from this interdisciplinary framework. Contributions were lower when facing immediacy, and, to some extent, when facing uncertainty and correlated with more groups failing to surpass the target amount of points in the climate account. Moreover, in case of failure, they missed more points. In general, and comparable to Milinski et al. (2008), it could be observed that contributions dropped after half of the rounds were played. This decline was stronger for groups in treatments simulating the barriers and changing the decision situation of whether to invest or not.

The collective-risk social dilemma (Milinski et al., 2008) is characterized by exactly this decision, whether to put self-interest before group interest. However, this decision becomes more tedious by introducing barriers, as they make it more complicated to estimate the outcomes regarding possible loss of points when failing to reach the group goal. Although the measurement of concern (Schultz, 2001) revealed that participants were more driven by altruistic and biospheric concern than by egoistic concerns, this tendency might not have been mirrored completely in the climate game. In the immediacy condition, where influencers themselves were not affected by failing, the contributions were found to be the lowest and selfish acts were most frequent.

Additionally, assumptions people make about their fellows' self-interest are of high importance. Van Lange et al. (2018) discussed, that uncertainty encourages decision heuristics such as the myth of self-interest, claiming that people do tend to overestimate the selfishness of others. This uncertainty was intrinsic to the experiment, as the players in the uncertainty treatment did not know whether a zero contribution was intentionally or whether the contribution was hindered by the random draw. It would be expected, that with lower trust in others, this effect would be reinforced, yet surprisingly, lower trust was correlated with higher contributions. This might point towards a learning effect in trust (Lo

Iacono & Sonmez, 2020), or possibly a mechanism that tries to reduce the risk of loss with higher contributions instead of keeping points.

One point to consider is the costs of selfish and altruistic behavior. While in the influencer conditions the costs for acting altruistic are high, for all other groups, altruistic behavior can be profitable due to the avoidance of loss when missing the target amount. In the literature, there is evidence, which suggests that translation of concern into action is realized in low-cost situations but not in situations where costs are high (Diekmann & Preisendörfer, 2003). In the experiment, the costs for altruistic actions were highest for the influencers, who would need to invest their own points for the benefit of other groups, while at the same time being unaffected of the consequences. Groups of all other treatments faced lower costs when investing, as it was for their own good. These findings add to the current experimental research of Farjam et al. (2019), who showed that individuals will decide to take action in low-cost situations, while the attitude-behavior gap is bigger when costs are high.

In the experimental setting of this thesis, the value-action gap was calculated as the difference between the investments that participants had intended to make and the actual investment that was made during the climate game after the barriers had been imposed. Therefore, the calculated result is not an absolute measure of the gap but a measure of the relative position of a participant within the distribution of all participants' value-action gaps. Another point to consider is, that hypothetical contributions slightly varied across treatments, although it would be expected that there is no difference as all participants were under the same conditions at the point of the hypothetical investment. Increased sample size might balance this and make the measure of the value-action gap even more reliable.

The online experiment resembled a collective-risk social dilemma (Milinski et al., 2008) setting under the influence of introduced barriers. The implementation encountered the difficulty of how to simulate these barriers most accurately. For the immediacy treatment, and to a certain extent for the uncertainty treatment, this simulation in the stylized game worked out better than for the marginality treatment, where group size and differences in group size were supposedly not large enough. In contrast, as discussed above in light of external validity, the results might not be transferable one-to-one to a real-life situation. Nonetheless, causal mechanisms can be examined in this controlled environment (Brent et al., 2017; Neuhofer, 2015; Zelditch, 2014). Thus, conclusions on the proposed psychological barriers might allow to come one step closer to explaining the value-action gap.

The findings that postulate more selfish actions from participants in influencer groups within the context of an anonymous experiment are particularly in line with the evolutionary perspective of self- or gene interest (Dawkins, 1976; Van Vugt et al., 2014). Humans can be extraordinarily cooperative (Axelrod, 2006), in particular given certain circumstances such as kin relationships (Hamilton, 1964; Palomo-Vélez et al., 2020) or reciprocity (Nowak, 2006), which, however, were not given in the present experiment. Yet, participants with children showed slightly different behavior in the game. However, the absence of reciprocity and anonymity of participants might still increase selfishness and undermine cooperation within a group of strangers. Moreover, incentives to forgo free riding were not part of the experiment, particularly in case of the influencers, which had no costs and could not be punished for keeping points to themselves (Boyd et al., 2010; Fehr & Gächter, 2000, 2002; Nowak, 2006).

Nonetheless, selfishness cannot be considered to be carved in stone or as an explanation for the full spectrum of human actions and behavior. The above-mentioned punishment or the possibility to build a good reputation (Griskevicius et al., 2010; Milinski et al., 2002, 2006; Nowak, 2006) can foster altruistic behavior. Bamberg & Möser (2007) stated that pro-environmental behavior is a result of both, self-interest and concern for others. Also, cooperation and altruism can be fostered in numerous situations, and pro-environmental behavior is further driven by various motivations and cultural factors. To shed more light on these, literature of psychology and behavioral economics was consulted. The results mirrored previous findings (Gaspar, 2013; Gaspar et al., 2010; Kollmuss & Agyeman, 2002; Weber, 2018), that knowledge alone is not enough to cause pro-environmental behavior. Yet, a variety of personal factors, attitudes, norms and capabilities (Bamberg & Möser, 2007; Blankenberg & Alhusen, 2018; Stern, 2000) and their interrelation were determinants of pro-environmental behavior.

This thesis analyzed the effect of environmental concern, which was confirmed to correlate with pro-environmental behavior (Stern, 2000; Takács-Sánta, 2007; Tam & Chan, 2017). Measures for concern were queried in the questionnaire, divided into three subdimensions: altruistic, biospheric and egoistic, as previously done by Schultz (2001). Similarly, environmental values were described by these three dimensions (de Groot & Steg, 2008, 2010). In the data, it was observable, that egoistic concern was the lowest. Moreover, it was found that participants believed that they are less affected by climate change now than they will be in the future. This brings up another issue closely linked to concern: the perception of climate change (Weber, 2010, 2018).

Again, starting with an evolutionary view to shed light on perception, humans are adapted to respond and survive innate environmental threats. Humanity has never seen such a fast

change in climate. However, from an individual human perspective this change is slow and impalpable as there are no mechanisms to sense this change or even alarm, which makes disregarding more likely (Gifford, 2011; Van Vugt et al., 2014). Switching to the present, the same conclusions were drawn on climate change being more of an abstract, statistical phenomenon which is not detected by human senses and therefore likely to be underestimated (Slovic, 1987; Weber, 2010, 2018). Going one step further, this could even be put in connection with ignorance, which poses a strong limitation to action (Clayton, 2019; Geiger & Swim, 2016; Gifford, 2011).

The abstract nature of climate change exacerbates perception, which in turn is related to pro-environmental behavior (Panno et al., 2015). Direct experiences of climate change evoke more concern than indirect experiences (Clayton et al., 2015). Although data and communication about climate change exist, the conscious perception of individuals seems to be lacking and hence also the perception of consequences for one's own life (e.g. disasters, droughts, etc.), as shown by the results on egoistic concern and being more affected in the future. It seems, results on concern and perception of climate change both point towards low egoistic concern in the present. Believing not to be affected by and concerned about climate change is resembled in the influencer groups in the experiment, which had the least need for concern and perception. The results confirmed that in this condition, the contributions were the lowest.

For the other treatments, risk of being affected was more present, as the loss of points was possible. It has been shown that the perception of climate change and its risks play a crucial role in (collective) action in terms of this challenge (Pacheco et al., 2014; Weber, 2010, 2018). From the evolutionary, psychological and the behavioral economical point of view, risk preferences have been shown to be crucial in heuristics of decision-making and behavior with regard to climate change. In the experiment these decision-making heuristics were challenged by the three simulated barriers in order to quantify the effect on pro-environmental behavior. Immediacy and, in parts, uncertainty were both restrictive to investing into the climate account, surpassing the necessary target amount and additionally enlarging the value-action gap. This effect could not be confirmed regarding marginality, which might be due to small group sizes.

The findings for immediacy are in line with the with the predictions of the Construal Level Theory on climate change (Brügger et al., 2015; McDonald et al., 2015; Schuldt et al., 2018; Spence et al., 2012). Influencer group were not affected by failure to reach the threshold, which might increase temporal, social and spatial distance (immediacy) and in turn decrease the willingness to contribute and in increase the value-action gap. In this study, the effect of hypothetical distance (uncertainty) could not be found as pronounced

as for immediacy. Yet, this does not necessarily mean, that this effect would not be found in a design with higher levels of uncertainty. As pointed out before, the marginality treatment did not reveal any differences, which, however, might be due to the experimental design. Nonetheless, it could be concluded that psychological distance, enforced by the introduction of the three barriers, might be a central driver of contribution behavior and the value-action gap.

Yet, pro-environmental behavior is the result of the interaction of a multifaceted set of factors. Personal factors such as concern were found to be crucial determinants of pro-environmental behavior. Environmental consciousness (Kollmuss & Agyeman, 2002) is considered to be influential in the online experiment. Moreover, in everyday life, further determinants, such as structural barriers (Gifford, 2011) or habits (Maréchal, 2009) come into play, which exacerbates the emergence of pro-environmental actions.

Nonetheless, this thesis presented an attempt to reduce the impact of these external factors to make a step towards better understanding of restrictive factors for actions. The results of this online experiment examined the impact of psychological barriers, which seemed to be relevant in terms of decision-making and the value-action gap. As discussed in the previous sections, these barriers resemble the difficulties individuals face when translating their pro-environmental values to behavior in a collective-risk social dilemma (Milinski et al., 2008), where individual interests oppose group interest and loss is at stake. In terms of environmental problems, social dilemmas and the arising difficulties in decision-making are claimed to be a substantial reason for current ecological challenges (Osbaldiston & Sheldon, 2002; Van Lange et al., 2013). Thus, collective action might be worth striving for in order to collectively overcome these cognitive barriers (Amel et al., 2017).

7.6. Benefits and Outlook

The results of this study contribute to the literature on pro-environmental behavior and come with several implications for informing policy design.

To the best of knowledge, this is the first study to examine the interrelated impact of marginality, uncertainty, and immediacy in a climate game in terms of the value-action gap. While previous studies mostly focused on one of these barriers, this thesis simultaneously investigated all barriers together.

In line with the open and interdisciplinary orientation of human ecology, this thesis builds on scholarly literature from different disciplines to offer a broad perspective (Bates, 2012;

Dyball, 2010; Freese, 2001; Giampietro, 2001). Based on the combination of research from the evolutionary, psychological and behavioral economical scholarly literature, this study empirically investigated underlying cognitive determinants of climate-friendly behavior and provided a deeper insight into the interactions between humans and the environment. In particular, the evolutionary background of pro-environmental behavior received little attention in sustainability sciences so far. This work tried to make a step towards the integration of an evolutionary perspective with regards to pro-environmental behavior.

Moreover, by applying an experimental method, it was aimed to broaden the methodological scope of environmental sciences that are often based on surveys that assess environmental behavior on the basis of hypothetical questions and the self-assessment of respondents (Osbaldiston & Schott, 2012; Peattie, 2010). The integration of laboratory experiments based on interdisciplinary state of the art, allows to transfer the results to all three disciplines and connects their insights, showing that barriers hinder the translation of environmental values to actual behavior. This thesis contributes to existing literature by examining the interrelation of these barriers, which were previously discussed in these disciplines, yet insufficiently examined empirically in an actual decision situation. Further, the experiment presented in this thesis adds to a broad body of literature on public goods games and collective-risk dilemmas (i.e. Milinski et al., 2008). Moreover, this thesis' empirical investigation supports previous literature regarding the effect of barriers on behavior in these situations.

This interdisciplinary approach integrated findings from different fields and consequently combined the best of knowledge, which supports the results of the study. Thus, application of different approaches based on multiple fields of research is further encouraged and supports the call to "*integrate strength of various disciplinary traditions*" (Nielsen et al., 2020, p. 24) to prevent climate change.

In light of the integration of different disciplines, links could also be made to more theoretical works such as the concept of the "Imperial Mode of Living" (Brand & Wissen, 2017, 2018), which could find resemblance in the immediacy treatment of this thesis' experiment and thus further pose a barrier to sustainability. Moreover, a multifaceted perspective on human sustainability promotes the departure from homo oeconomicus towards other concepts such as the homo sustinens (Siebenhüner, 2000b, 2000a).

Further, for future works, insights could be drawn from different populations, apart from the WEIRD populations. Environmental concern differs between countries (Franzen & Vogl, 2013) and its link pro-environmental behavior was shown to vary depending on cultural background (Tam & Chan, 2017). In this regard, Gifford (2011) further postulated, that the perception of barriers might not be the same across different societies. Further

works should delve deeper into the determinants of pro-environmental behavior in comparative analysis of different societies. Also, the multifacetedness of life circumstances as well as more variation in socioeconomic circumstances and cultural backgrounds should be considered (Nielsen et al., 2020). This international and intercultural perspective could help to reduce the WEIRD-sample bias (see the works of Henrich, 2010) and would be manageable due to the online nature of the experiment.

Moreover, the effect of the control variables gender and having children, which were found in this experiment, deserves further investigation. Closely related to the discussion of the immediacy treatment, other-regarding preferences and concern for future generations – especially in light of having children – might be an interesting starting point for this. Further experimental evidence and examination of pro-environmental behavior with regards to these two factors might deliver insights to pro-environmental behavior.

As already discussed above, experiments come with several advantages but face the questions of external validity and generalizability at a certain point (i.e. Goeschl et al., 2020). To address this issue, further research on the value-action gap should enrich lab results by other methods, such as empirical observations of actual behavior in the field (Nettle, 2013). To meet this claim, in spring 2021, the validation of lab results with a field experiment in a real-world scenario is conducted. Participants will be asked to donate money to environmental organizations and the barriers will be varied using a vignette design. In this study, the value-action gap will be examined as the difference between environmental values and actual donations. In doing so, drawing further conclusions on the three barriers as well as the value-action gap in a less context-free environment will be possible and external validity of the online experiment's results will be increased.

For the analysis of the gathered data, all groups, despite dropout, were included for this thesis. In light of peer-reviewed publications or future studies, the analysis should be twofold. On the one hand, including all groups and, on the other hand, including only those groups in which all players successfully finished all ten rounds. Possible differences and a closer examination of dropout effects should be included, which is, however, above the means of this thesis. Future studies following up on this work could refine the simulation of the treatments by adding different degrees of uncertainty of actions and by increasing the group sizes and differences in group size for the marginality treatments.

The work addressed the need of aligning action on environmental challenges (Penn, 2003) and sustainable policies (Van Vugt et al., 2014) with human nature, complemented by insights from psychology and evidence from behavioral economics. By shedding light on the individual psychological constraints of translating environmental knowledge and

consciousness into action, this work can help to improve successful environmental policy design on closing the value-action gap.

Based on the results of this study several implications to inform policy objectives can be formulated, which could help to design and communicate measures or frameworks for a westernized population.

Starting from the perception of climate change as a foundation for climate-friendly behavior, the indiscernibleness of climate change for individuals should be increased by the formulation of less abstract and more palpable cues of climate change for everybody. Examples could include showing changes in nature in the immediate vicinity of people, such as warmer winters with less snow, droughts in the country or, less directly, air quality. By this, concern could and should be increased to animate pro-environmental behavior, which in turn can further raise concern. At the same time, concern for future generations could be raised by highlighting the consequences for relatives (children, grandchildren, etc.). The emphasis of impacts on future generations might strengthen willingness to act, despite the perception that the current generation is not affected by the consequences of climate change.

The costs for free riding in terms of pro-environmental behavior should be increased. This could be put in practice in several ways, for example by implementing negative incentives on non-sustainable behavior, which could be realized by imposing taxes on goods and services with high negative environmental impact end external effects. Carbon taxes represent a much-debated example. More positive incentives could be created by the possibility of building a good personal reputation based on pro-environmental actions. Also, decreased costs for forgoing free riding, for example by reducing the price difference between sustainable and non-sustainable products or by providing attractive alternatives, such as inexpensive and fast train rides as opposed to airborne transportation, could prove beneficial.

Communication is the key to evoke actions in climate issues with regard to the three barriers. Uncertainty at all stages of the decision-making process should be reduced by the formulation of clear and unambiguous facts about the goals that need to be reached (e.g. 1.5°C). For this, it is of high importance to show the impact of individual actions and avoid uncertainty about the degree of impact personal actions have. Calculators for individual ecological footprints are one step towards this. Yet, more personal and immediate cues would help, for example by showing how much carbon dioxide and water could be saved when forgoing one meat meal a week or a domestic flight. Currently, new smartphone apps, which offer this possibility are entering the market.

Immediacy could be increased by higher integration of lay people into climate actions, for example in policy design, local environmental initiatives and concerning facts about the current impact of climate change on a country, which will only further accelerate for future relatives. Similar could be done with a global perspective, in that climate change will finally also personally affect people in currently less impacted countries through increased prices of imported goods, resource scarcity (e.g. cacao) or environmental migration.

Finally, the individual impact should be highlighted, and the notion of low perceived self-efficacy addressed. Diffusion of responsibility is well to be avoided, so that everyone feels responsible. Small to medium sized units of organization can help with this endeavor, while at the same time cooperation between groups in avoidance of intergroup effects is beneficial. This links back to the recommendations for addressing uncertainty, and, at the same time, comes with the necessity to foster collective action against climate change. Showing individuals that they are not alone in acting pro-environmentally and that impact of many makes a change, could motivate to act and reduce the value-action gap. Moreover, collectively working on one problem can help to overcome individual cognitive limits.

8. Conclusion

On the basis of this work's experimental approach a detailed and comprehensive picture of the cognitive determinants of the value-action gap in the lab was drawn based on an interdisciplinary perspective. An empirical understanding of the value-action gap and the role of three behavioral barriers was added to previous literature of evolutionary, psychological and behavioral economical sciences. The results showed that the immediacy of pro-environmental behavior had the strongest effect on contribution behavior and reaching the climate goal, thus enlarging the value-action gap in the experiment. Preference for delayed rewards and climate concern were found to positively correlate with action.

The results of this study allow a deeper insight into the obstacles and problems specific groups of people are confronted with when adopting pro-environmental behavior. Further, by shedding light on the individual constraints for translating environmental values into action, this work and the drawn insights from behavioral science can help to improve successful communication and environmental policy. By identifying the three barriers, and as such, substantial determinants of the value-action gap, communication strategies could be adapted by formulating powerful messages and framings to successfully animate pro-environmental behavior. This can make more feasible for people to bridge the value-action gap and "walk the talk".

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A. Appendix – Project Budget

For the data collection in the laboratory experiment, the participation of 576 subjects and a pilot study with further 48 subjects were planned. In order to be able to make statistically significant statements on comparisons between the experimental treatments, 48 subjects per condition were aimed for. To compensate for possible no-shows, 12 extra fees were planned for each condition. For calculating the budget, the average fee note for participants of economic laboratory experiments is 15€ per hour. For the online experimental platform Prolific.co, a service fee of 33% + 7% VAT of participants' payments had to be paid.

Tab. A1 summarizes the estimated project budget, which was covered with funding by the University of Vienna and the Austrian Academy of Sciences (OEAW) as depicted in Tab. A2. The laboratory experiment was conducted in cooperation with Roman Hoffmann of the Austrian Academy of Sciences. This gave the author access to an additional funding of 2000€ that have already been granted. Moreover, funding was provided by the University of Vienna (Förderungsstipendium nach dem StudFG[2], max. 3.600€). This funding was essential for the empirical part of this master's thesis and therefore a prerequisite for a successful completion of studies. As described above, the funding was necessary to remunerate the participants, because in comparison to self-reports and hypothetical questions, the applied experimental setting allowed to uncover barriers that cause individuals from their optimal choice in a real-life decision incentivized with money.

Tab. A1. Project Budget.

Material Costs	**Description**	**Amount in €**
Online Experiment	576 subjects, 30 minutes, average earnings £10.80/h	3 545.00
Pretest	48 subjects, 30 minutes, average earnings £10.80/h	295.00
Prolific Service Fee	33% + 7% VAT of all participant payments	1355.00
Buffer	Approximately 6% percent of all variable costs	355.00
	Total	**5 550.00**

[2] Website in German: https://studienpraeses.univie.ac.at/stipendien/foerderungsstipendien-nach-dem-studfg/

Tab. A2. Financing Plan.

Funding	**Location**	**Status**	**Amount in €**
Förderungsstipendium nach Studien-förderungsgesetz	Studienpräses | University of Vienna	Approved 06/2020	3 550.00
Funding	Austrian Academy of Sciences	Approved 03/2020	2 000.00
		Total	**5 550.00**

B. Appendix – Study Description on Prolific

Interactive Game: 2.50 – 9.00 £ for Completion
In this study, you will play an **interactive game** with other Prolific participants. Because the study involves live interaction among real participants, it is highly important that you are able to complete the survey without interruptions and with a stable internet connection.
If you join the study, you will go through the instructions of the game and you have to answer to test questions on the instructions. Afterwards, you will be sent to a waiting room until you are assigned to a group.
If there are not enough participants to form a group for 15 minutes, you are redirected to a final screen and receive a **payment of £ 2**. If there are enough participants to form a group, the interactive game starts, and you will be able to earn a variable **bonus payment of up to £ 5.00** in addition to a **fixed amount of £ 2.50**. Your bonus payment depends on your decisions and the decisions of other participants. Throughout the survey, there will be further possibilities to earn **additional payments of up to £ 1.50** in form of mini tasks. If you exit the study at any other point during the instructions, the waiting stage, or the interactive game **we will not be able to pay you**.

This study is scheduled to last about **25 to 30 minutes**. Since you will be playing live with other Prolific participants, you will regularly have to wait for others to take their decisions.

The task will only be available on **PC and tablet**, not on smartphones and does not support the browser 'Internet Explorer'.

Please **start the study immediately after reserving a place**. The link expires shortly after the study has been published. If you reserve a place but do not enter the study in time, you cannot participate, and we will not be able to pay you.

C. Appendix – Full Text of the Online Experiment

Stage: Welcome 1

Before the survey starts, please enter your **Prolific-ID** (24 alphanumeric characters). Please remember that we will only be able to pay you if you finish the entire survey. [enter ID]
Please make your decisions within the time limit shown on your screen. If you do not continue with the time limit, you will be redirected to a final page and we are not able to pay you
Information about data protection

-Your participation is voluntary.
-Your responses are anonymous and cannot be linked to your person.
-The data will be treated confidentially.
-The European General Data Protection Regulation (GDPR) applies.

If you have any **questions** about the survey, please use the „Contact Researcher“ Button in Prolific.
Thank you for your participation!

Stage: Welcome 2
In this survey, you will be playing an interactive game in a group together with other real people who are completing this survey at the same time as you.
Overall, completing this survey will take about **25 to 30 minutes**. During the survey, **please do not close this window** or leave the survey web pages in any other way. If you do close your browser or leave the survey, you will not be able to re-enter the survey and we will not be able to pay you!
Since you are playing in a group, it is important that you complete the game without interruptions. Please make your decisions within the time limit shown on your screen. Because participants progress through the game with varying speed, occasionally you might have to wait for others to take their decisions.
Before starting the game, you will be shown detailed instructions and test questions. Afterwards, you will be sent to a waiting room until you are assigned a group. If there are not enough participants to form a group for 15 minutes, you will be redirected to a final screen and receive a **payment of £ 2.00**. If you exit the waiting room before the 15 minutes are over, we will also not be able to pay you!
If there are enough participants to form a group, the interactive game starts and you will be able to earn a **variable bonus payment of up to £ 5.00** in addition to a **fixed amount of £ 2.50.** Your bonus payment depends on your decisions and the decisions of other participants. Throughout the survey, there will be further possibilities to earn **additional payments of up to £ 1.50** in form of mini tasks.
During the experiment we do not speak of Pounds, but of Points. At the end of the experiment, the Points earned will be converted according to the following exchange rate:
8 Points = 1 Pound (£).
Please take your time when reading the instructions and making your decisions. At no time during the game will your identity and your payment be revealed to other participants. Your anonymity towards the researchers and the other participants is guaranteed.

Stage: Game Instructions 1
Today, you will participate in a game that simulates **climate change**, which is a real environmental problem faced by humankind. Humanity significantly contributes to climate

change by producing CO2 as part of industrial processes or energy production as well as when using internal combustion engines in automobiles.
During the game, you will interact with the same participants in a group for **10 climate rounds**. The decision situation is the same for each player. At the beginning, an initial endowment of **40 Points will be credited to your personal account**. All the Points left in your personal account at the end of the game will be paid out to you as your bonus payment.
In each climate round, you can use your endowment to invest into a **climate account** in an attempt to avoid dangerous climate change. Among other things, climate change leads to serious economic consequences, which are simulated in this game through the loss of the Points in your personal account. Also, the other group members can invest Points from their personal account into the Climate Account.
At the end of the game, after 10 climate rounds, the Points invested into the climate account by all group members are compared to a **fixed threshold amount**. If the Points in the climate account do not reach the threshold amount, dangerous climate change occurs with 90% probability, that is in 9 out of 10 cases. If climate change occurs, participants lose all their endowment kept in the personal account. Your investments in the climate account can help to avert climate change and the economic loss, but the success of the prevention also depends on the contributions of other participants. Players can either keep their Points in their personal account to receive higher payouts, if no climate change occurs, or invest in the public climate account to support the group in preventing climate change.
In each round all participants will be asked at the same time: "How many Points do you want to invest into climate protection?". The possible answers are 0, 1, 2, 3 or 4 Points. As soon as every group member has made a decision, you will be informed about the total investments into the climate account and a new round will begin.
Please note: If a participant happens to drop out from the online survey, their investments to the climate account will be set to 0 for the remainder of the game.

Stage: Test Questions
To continue with the experiment, you have to answer the 7 test questions correctly.
1. How many rounds does the game last?
- 10 climate rounds
- 14 climate rounds
- 18 climate rounds
- 20 climate rounds

2. How can participants prevent dangerous climate change?
- By keeping Points in the personal account
- By investing Points into the climate account
- By keeping Points in the climate account
- By investing Points into the personal account

3. How many Points does each participant receive as an initial endowment?
- 20 Points
- 40 Points
- 60 Points
- 80 Points

4. What happens if the investments in the climate account do not exceed the threshold amount? Participants earn the Points in the personal account...

- ...with a probability of 90% or lose everything with a probability of 10%
- ...with a probability of 10% or lose everything with a probability of 90%
- ...with a probability of 90% or 40 Points with a probability of 10%
- ...with a probability of 10% or 40 Points with a probability of 90%

5. You are playing in a group of 3 players. The threshold amount needed to prevent climate change is 60 Points. Climate change can be prevented if…

- All three players contribute 1 Point each round to the climate account
- All three players contribute 2 Points each round to the climate account
- One player contributes 3 Points each round to the climate account and the other two players contribute nothing
- None of the players contributes to the climate account in any of the rounds

6. You are playing in a group of 3 players. The threshold amount needed to prevent climate change is 60. Imagine one player never contributes anything to the climate account. How much do the other two players have to invest at least each round to prevent climate change?

- 1 Point
- 2 Points
- 3 Points
- Climate change cannot be prevented

7. You are playing in a group of 6 players. The threshold amount needed to prevent climate change is 120 Points. Climate change can be prevented if…

- None of the six players contributes to the climate account in any of the rounds
- All six players contribute 1 Point each round to the climate account
- All six players contribute 2 Points each round to the climate account
- One player contributes 3 Points each round to the climate account and the other five players contribute nothing

Stage: Hypothetical Scenario

Before the actual game, we are interested in your personal opinion in a hypothetical situation. Please note: There are no true or false answers to the following questions. None of your answers on this page will affect your bonus payment.

Imagine you are playing in **a group of 3 people**, this is you and two other players. The threshold amount is 60 Points. Remember that all group members have an endowment of **40 Points** and can invest from **0 to 4 Points** into the climate account each round.

- How many Points would you invest in climate protection in each round? [0 to 4 points]
- How many Points do you think someone ought to invest in climate protection in each round? [0 to 4 points]

For the next two questions we are interested in what you think your group members replied to the previous questions. If you are in the range of -0.3 to +0.3 of the actual average in your group for both questions, we will add **2 extra Points** to your final payment at the end

of the survey. You will be informed about the average in your group and your extra payment at the end of the game.
Imagine you are playing in **a group of 3 people**, this is you and two other players. The threshold amount is **60 Points**. Remember that all group members have an endowment of **40 Points** and can invest from **0 to 4 Points** into the climate account each round.
What do you think your group members replied on average to the following question:
"How many Points would you invest in climate protection in each round?" [slider from 0 to 4 in 0.1 increments]

What do you think your group members replied on average to the following question:
"How many Points do you think someone ought to invest in climate protection in each round?" [slider from 0 to 4 in 0.1 increments]

Stage: Please Continue
By clicking "Continue" you are sent to the waiting room. The game will start once the waiting room hosts enough participants to form a group.

Stage: Lobby
You will now be assigned to your group. This might take some minutes.
In case that you are not assigned to a group within 15 minutes you will be forwarded to collecting a **payment of £ 2.00**. Once the interactive game starts, you will be able to earn a variable **bonus payment of up to £ 5.00** in addition to a **fixed amount of £ 2.50**. Throughout the survey, there will be further possibilities to earn **additional payments of up to £ 1.50** in form of mini tasks.
Remember if you exit the survey, we will not be able to pay you!

Stage: Treatment Instructions
Any decision you make from now on will be relevant for the bonus payment.
In the game, you will be playing in a group of **[3/6] participants** (this is you and [2/5] more participants) over **10 climate rounds**. The threshold needed to prevent climate change with certainty is **[42/60/84/120] Points**. The group members' investments in the climate account can help to prevent climate change.
[However, investments of the group members can get lost on the way and will be added to the climate account only with a **probability of 70**%. That is, only in 7 out of 10 cases, the Points you invest will be added to the climate account. In 3 out of 10 cases the Points you invest will be lost. After each climate round, you will only be informed about the successful investments into the climate account.]
[If the threshold is not reached, dangerous climate change will occur with **90% probability** (in 9 out of 10 cases). However, **climate change will not directly affect your group, but another randomly selected group**. If your group does not reach the threshold, the other group faces a 90% probability (in 9 out of 10 cases) to lose all Points left in the personal accounts. Not reaching the threshold has no effect on your own group, your private account and your bonus payment. Note: Your group is NOT affected by the outcome of another group. /
If the threshold is not reached, dangerous climate change will occur with **90% probability** (in 9 out of 10 cases). If climate change occurs all Points left in the personal accounts will be lost. In addition, **whether climate change occurs also depends on another randomly selected group** that is playing at the same time as you. If this group does not reach the threshold, your group also faces a 90% probability (in 9 out of 10 cases) to lose all Points left in the personal accounts irrespective of the outcome in your own

group. Thus, whether climate change occurs depends on your group as well as the other group. / If the threshold is not reached, dangerous climate change will occur with **90% probability** (in 9 out of 10 cases). If climate change occurs all Points left in the personal accounts of the members of your group will be lost.]

Stage: Decision Screen
How many Points do you want to invest into climate protection? [0 to 4 points]
This is climate round $period$ of 10.
Your Personal Account: $endowmentLeft$ Points.
Please keep this window open at all times.

Summary
You are in a group of **[3/6] participants**. This is you and [2/5] more participants. Every group member received an endowment of **40 Points** in the personal account.
Participants can invest Points from their personal account into a climate account to prevent dangerous climate change. [Investments can get lost on the way with a probability of 30% (that is in 3 out of 10 cases).] In order to prevent climate change, the Points in the climate account need to exceed a threshold amount of **[42/60/84/120] Points** at the end of climate round 10.
[If the Points in the climate account do not reach the threshold amount at the end of the game, dangerous climate change occurs with **90% probability**, that is in 9 out of 10 cases. If climate change occurs, the members of another group lose the Points in their personal accounts. / In addition, another randomly selected group also needs to reach the threshold. If the Points in the climate account of your group and/or the other group do not reach the threshold amount at the end of the game, dangerous climate change occurs with **90% probability**, that is in 9 out of 10 cases. If climate change occurs, all members of your group lose the Points in their personal accounts. / If the Points in the climate account do not reach the threshold amount at the end of the game, dangerous climate change occurs with 90% probability, that is in 9 out of 10 cases. If climate change occurs, all members of your group lose the Points in their personal accounts.]

Stage: Outcome Screen
[You have invested **$contributionInitial$ Points** to the climate account. / You chose to invest **$contributionInitial$ Points** into climate protection. A random number generator determined that your investment [will/will not] be added to the climate account.]
In total, members of your group have successfully invested sum Points into the climate account in this climate round.

So far, **$valueclimate$ Points** have been invested into the climate account in total.
Your group needs **[X/no] more Point(s)** to reach the threshold amount of **[42/60/84/120] Points** [with certainty. / However, remember that in order to prevent dangerous climate change with certainty, also another randomly selected group needs to reach the threshold.]
This was climate round $period$ of $numberPeriods$.
You have **$endowmentLeftRes$ Points** left in your personal account.
Please keep this window open at all times.

Summary

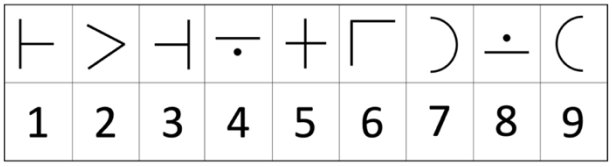
You are in a group of **[3/6|participants**. This is you and [2/5] more participants. Every group member received an endowment of **40 Points** in the personal account.
Participants can invest Points from their personal account into a climate account to prevent dangerous climate change. [Investments can get lost on the way with a probability of 30% (that is in 3 out of 10 cases).] In order to prevent climate change, the Points in the climate account need to exceed a threshold amount of **[42/60/84/120] Points** at the end of climate round 10.
[If the Points in the climate account do not reach the threshold amount at the end of the game, dangerous climate change occurs with **90% probability**, that is in 9 out of 10 cases. If climate change occurs, the members of another group lose the Points in their personal accounts. / In addition, another randomly selected group also needs to reach the threshold. If the Points in the climate account of your group and/or the other group do not reach the threshold amount at the end of the game, dangerous climate change occurs with **90% probability**, that is in 9 out of 10 cases. If climate change occurs, all members of your group lose the Points in their personal accounts. / If the Points in the climate account do not reach the threshold amount at the end of the game, dangerous climate change occurs with **90% probability**, that is in 9 out of 10 cases. If climate change occurs, all members of your group lose the Points in their personal accounts.]

Stage: Interactive Game completed
Before you receive your payment, we kindly ask you to fill out a brief questionnaire.
Remember that you will only be able to collect the fixed payment of £2.50 after careful completion of the questionnaire.

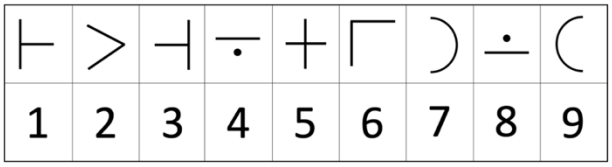
Questionnaire A: Risk and Time Preferences, Trust in Society
Please answer the following questions.
Generally speaking, would you say that most people can be trusted (1), or that you can't be too careful in dealing with people (10)? [Likert scale from 1 to 10]
How willing are you to give up something that is beneficial for you today in order to benefit more from that in the future? [5-Point Likert scale from very unwilling to very willing]
How willing or unwilling are you to take risks in general? [5-Point Likert scale from very unwilling to very willing]
How willing are you to punish someone who treats you unfairly, even if there may be costs for you? [5-Point Likert scale from very unwilling to very willing]
How willing are you to return a favour to someone who has done a favour for you? [5-Point Likert scale from very unwilling to very willing]

Questionnaire B: Cognitive Abilities and Reasoning
In the following task, you can earn additional Points. On the next page, you will be shown an overview table with symbols and numbers for 20 seconds. Each symbol is paired with a number. Please try to memorize the combinations of symbols and numbers.
After 20 seconds, you will automatically be directed to the next page where you will be shown a sequence of symbols without numbers in addition to the overview table. Each symbol has an empty field next to it. Your task will be to insert the correct number corresponding to each symbol. Speed is important for the game. In total, you have 90 seconds to enter as many numbers as possible next to the symbols. For each correctly placed number, you will receive an additional 0.1 Points as bonus payment. After 90 seconds, the game automatically ends and you are directed to the next questionnaire page.
Hint: To navigate to the first field and to move faster between empty fields, you can use the tabulate key on the left side of your keyboard depicted below.

To start the game, please press continue. You will be shown the overview table for 20 seconds before the actual game begins.
Please try to memorize the combinations of symbols and numbers.
After 20 seconds, you will automatically be to directed to the next page.



Please enter as many corresponding numbers. You do not need to confirm your responses with a button, the survey will save the values and continue automatically after 90 seconds.
Which number corresponds to this symbol? [repeated for 90 seconds with random symbols]



Questionnaire C: Environmental Concern
How much do you agree or disagree with the following statement:
Climate change is happening. [5-Point Likert scale from disagree strongly to agree strongly]
Generally speaking, how concerned are you about climate change, from not at all concerned (1) to very concerned (10). [Likert scale from 1 to 10]
How much do you agree or disagree with the following statements: [5-Point Likert scale from disagree strongly to agree strongly]

- Climate change affects me personally nowadays.
- Climate change will affect me personally in the future.
- We worry too much about the future of the environment and not enough about prices and jobs today.
- People worry too much about human progress harming the environment.

Questionnaire D: Environmental Knowledge
Generally speaking, how much do you feel you know about climate change?

- know nothing at all
- know a little
- know something
- know a lot
- know a great deal

How true do you think the following statements are? For each statement below, just tick the box that comes closest to your opinion of how true it is. [4-Point Likert scale from definitively not true to definitively true]

- Climate change is caused by a hole in the earth's atmosphere.
- Every time we use coal or oil or gas, we contribute to climate change.
- Since 1880, the global average temperature has increased by about 1° C.

- Climate change is mainly caused by natural processes, and not human activities.

Questionnaire E: Environmental Attitudes
How much do you agree or disagree with the following statements: [5-Point Likert scale from disagree strongly to agree strongly]

- I find it hard to know whether the way I live is helpful or harmful to the environment
- When humans interfere with nature it often produces disastrous consequences.
- Environmental problems have a direct effect on my everyday life.
- Humans are severely abusing the environment.
- My contribution to climate change is negligible.
- Despite our special abilities, humans are still subject to the laws of nature.
- My personal actions can contribute to prevent climate change.
- If things continue on their present course, we will soon experience a major ecological catastrophe.

People around the world are generally concerned about environmental problems because of the consequences that result from harming nature. However, people differ in the consequences that concern them the most. Please rate each of the following items from 1 (not important) to 10 (supreme importance) in response to the question: [each with Likert scale from 1 to 10]

- Plants
- Marine Life
- Birds
- Animals
- Me
- My lifestyle
- My health
- My future
- People in my country
- All people
- Children
- My children

Questionnaire F1: Environmental Behavior Intention [5-Point Likert scale from very unwilling to very willing]

- How willing would you be to pay much higher taxes in order to protect the environment?
- How willing would you be to pay much higher prices in order to protect the environment?
- How willing would you be to accept cuts in your standard of living in order to protect the environment?

Questionnaire F2: Environmental Behavior Reported Private Domain [Never/Rarely/Sometimes/Often/Always]

- How often do you make a special effort to sort glass or tins or plastic or newspapers and so on for recycling?
- How often do you make a special effort to buy fruit and vegetables grown without pesticides or chemicals?
- How often do you cut back on driving a car for environmental reasons?
- How often do you reduce the energy or fuel you use at home for environmental reasons?
- How often do you choose to save or re-use water for environmental reasons?
- How often do you avoid buying certain products for environmental reasons?
- How often do you re-use or recycle used products, such as clothes or furniture?
- How often do you avoid consuming meat products?

Questionnaire F3: Environmental Behavior Reported Public Domain [yes/no]

- Are you a member of an environmental organization whose main aim is to protect or preserve the environment?
- In the last five years, have you signed a petition about an environmental issue?
- In the last five years, have you given money to an environmental group?
- In the last five years, have you taken part in a protest or demonstration about an environmental issue?

Questionnaire G: Sociodemographics

What is your age? [enter age in years]

What is your highest degree or level of education you have completed?

- Less than a high school diploma
- High school degree or equivalent
- College degree or equivalent
- Vocational or commercial school
- Graduate degree
- Other
- Prefer not to answer

What is your current main occupation?

- Working full-time (35 or more hours per week)
- Working part-time (up to 34 hour per week)
- Student
- Student + working
- Unemployed, looking for work
- Paternal leave or retired
- Other
- Prefer not to answer

How much money do you have at your disposal every month?

- Less than 1000 £
- 1000 - 2000 £
- 2000 - 3000 £
- More than 3000 £
- Prefer not to answer

Do you live...

- Alone
- With your partner
- In a flat-sharing community
- With your parents
- Other
- Prefer not to answer

Do you have children?

- Yes

- No
- Prefer not to answer

How would you describe your political view?
- Very liberal
- Slightly liberal
- Slightly conservative
- Very conservative
- Prefer not to answer

Did you grow up in a city or a rural area?
- City
- Rural Area
- Prefer not to answer

Questionnaire H: Participation in the Game
Where were you during your participation in this experiment?
- At home
- Not at home

What are your social surroundings during the participation in this experiment?
- Alone with no one observing your decisions
- Observed by others who could see your decisions
- Prefer not to answer

Did you participate in this task with your...
- PC or Notebook
- Tablet
- Smartphone

How often did you already participate in similar interactive games online or in a laboratory?
- Never
- Once
- Twice
- Three times
- Four times
- Five times
- More than 5 times

If you cannot continue, please double check, whether you correctly replied to all questions.

Stage: Results of the Interactive Game
The total amount of Points in your personal account is: **$totalPoints$ Points.**
In total, your group has invested **$totalClimate$ Points** into the climate account.
The threshold to prevent dangerous climate change is at **[42/60/84/120] Points.**
[Your group failed to reach the threshold. Therefore, climate change occurs with a probability of 90% (that is in 9 out of 10 cases). As announced in the instructions this does

not influence your earnings. However, if climate change occurs another group that depends on you will lose the Points in their personal accounts. / Your group passed the threshold and climate change will not occur. As announced in the instructions this does not influence your earnings. However, the group that depends on you will keep their earnings, given they also reached the threshold themselves.]
[Your group failed to reach the threshold. As announced in the instructions your success will also depend on another group / Your group passed the threshold. As announced in the instructions your success will also depend on another group.]
[Your group failed to reach the threshold. Therefore, climate change occurs with a probability of 90% (that is in 9 out of 10 cases). If climate change occurs all members of your group will lose the Points in their personal accounts. A random draw determined that climate change [occurs/will not occur] and [you will lose the Points in your personal account/ all players of your group will keep their Points in their personal account.]
[Your group as well as the other group influencing your outcomes failed to reach the threshold. / The other group influencing your outcomes passed the threshold. However, your group failed to reach the threshold. / Your group reached the threshold. However, the other group influencing your outcomes failed to reach the threshold.
Therefore, climate change occurs with a probability of 90% (that is in 9 out of 10 cases). A random number generator determined that climate change [occurs/will not occur] and you will [lose/keep] the Points in your personal account.
[Your group as well as the other group influencing your outcomes reached the threshold and climate change will not occur. Therefore, all players of your group will keep their points in the personal account.]
Therefore, your final earnings from the game are **$finalPoints$ Points.**
These points are worth **£ $valueFinalPointsT$.**
These Points will be added up to the **fixed amount of £ 2.50.**

Stage: Results of the Hypothetical Scenario
Before playing the game, you had the chance to earn an extra payment in two small tasks.
In the first task, you were asked to estimate the average answer given by your group to the question:
"How many points would you invest in climate protection in each round?" Your response was: **$hypInvGroup$ Points.** The average answers in your group to these questions was **$hypInvAverage$ Points.** The range of +/- 0.3 around this average is: $min1$ to $max1$.
Your estimation [was/was not] within this range.
In the second task, you were asked to estimate the average answer given by your group to the question:
"How many points do you think someone ought to invest in climate protection in each round?"
Your response was: **$hypInvOughtGroup$ Points.** The average answers in your group to these questions was **$hypInvOughtAverage$ Points.** The range of +/- 0.3 around this average is: $min2$ to $max2$. Your estimation [was/was not] within this range.
[Both of your estimations were correct. Therefore, 2 Points will be added to your final payment. / Not all of your estimations were correct. Therefore, no Points will be added to your final payment.]

Stage: Results of Symbol Task
After playing the game you were asked to enter the corresponding numbers to symbols.
In this task you have entered **$bonusCogSum$ correct values.**

For each correct value you receive **0.2 Points.**
Therefore, rounded to the next integer, **$bonusCogSumPoints$ point(s)** with a value of £ **$valueCogPointsT$** will be added to your final payment.

Stage: Final Results
Your final Points from the game are **$finalPoints$ Point(s).**
Your final Points from the estimation questions are **$sumHypBonus$ Point(s).**
Your final Points from the problem-solving task are **$bonusCogSumPoints$ Point(s).**
In sum, these Points are worth: **£ $valuePointsT$.**
Your guaranteed participation fee is **£ 2.50.**
In total, your payment amounts to **£ $finalPaymentAmount$.**
This amount will be transferred to you Prolific Account, £ 2.50 Pounds immediately and the remaining difference to your earnings as a bonus payment shortly thereafter.
Please continue to the next page to be linked back to Prolific.

Stage: Link to Prolific
To collect your earnings, a pop-up window has opened now which will redirect you back to Prolific. In case this did not work: Please also check for blocked pop-up. Reload this page to renew the pop-up. Copy this link directly to a new tab in your browser: **https://app.prolific.co/submissions/complete?cc=123456XY** or enter this code in Prolific: **123456XY**. If none of these options work, please use the „Contact Researcher“ Button in Prolific. If you were able to collect the earnings, you can click "End".

Stage: Thank you for your participation.
In order to prevent future participants from being influenced, we kindly ask you not to discuss this experiment with other people. You can close this window now.

D. Appendix – Supplementary Results

Tab. D1. Linear Regression: Effect of treatments and personal factors on contributions.

	(a) Model 1	(b) Model 2	(c) Model 3
Marginality (large group)	-0.613	-0.519	-0.334
	(0.580)	(0.564)	(0.568)
Uncertainty (uncertainty)	-0.829	-0.793	-0.789
	(0.530)	(0.486)	(0.552)
Immediacy (influencer)	-1.664**	-1.657**	-1.490**
	(0.614)	(0.711)	(0.641)
Immediacy (influenced)	-0.201	-0.215	-0.0377
	(0.525)	(0.605)	(0.520)
Gender (male)		-2.002***	-2.100***
		(0.617)	(0.697)
Age		0.102**	0.0784*
		(0.0388)	(0.0381)
Education (High School Degree)		-0.831	-1.159
		(2.064)	(2.358)
Education (College Degree)		-1.359	-1.583
		(1.795)	(2.001)
Education (Vocational School)		3.672	4.177
		(2.520)	(2.890)
Education (Graduate Degree)		-0.957	-1.102
		(1.932)	(2.162)
Education (other)		-3.529	-3.296
		(2.855)	(3.031)
Education (prefer not to answer)		1.505	2.111
		(6.266)	(6.112)
Income (1000-2000£)		0.180	0.593
		(0.694)	(0.607)
Income (2000-3000£)		-0.187	-0.246
		(1.116)	(1.042)
Income (more than 3000£)		-0.209	-1.217
		(1.090)	(1.096)
Income (prefer not to answer)		0.162	-0.293
		(1.185)	(1.246)
Cognitive reflection			-0.0938**
			(0.0361)
Time preference			1.945***
			(0.375)
Risk preference			0.274
			(0.251)
Distrust in others			0.542***
			(0.151)
Constant	22.62***	21.26***	12.39***
	(0.554)	(2.696)	(3.456)
Observations	590	587	586
R-squared	0.015	0.071	0.151

Notes: OLS regression coefficients in cells. Clustered standard errors (unit of clustering: session) in parentheses below. Cognitive reflection: score from cognitive abilities test in questionnaire. Time preference & risk preference variable: 1 = very unwilling; 5 = very willing. Trust variable: 1 = trust everyone, 10 = careful. *p*-Values: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Tab. D2. Linear Regression: Effect of treatments and personal factors on value-action gap.

	(a)	(b)	(c)
	Model 1	Model 2	Model 3
Marginality (large group)	-0.101	-0.102	-0.0934
	(0.0681)	(0.0720)	(0.0715)
Uncertainty (uncertainty)	-0.0269	-0.0258	-0.0259
	(0.0674)	(0.0649)	(0.0671)
Immediacy (influencer)	-0.246***	-0.252***	-0.245***
	(0.0719)	(0.0738)	(0.0740)
Immediacy (influenced)	-0.0659	-0.0721	-0.0519
	(0.0692)	(0.0713)	(0.0746)
Gender (male)		-0.108	-0.114
		(0.0750)	(0.0752)
Age		-0.000379	-0.00163
		(0.00413)	(0.00459)
Education (High School Degree)		0.0246	0.0688
		(0.165)	(0.178)
Education (College Degree)		-0.0124	0.0281
		(0.186)	(0.195)
Education (Vocational School)		0.239	0.327
		(0.217)	(0.229)
Education (Graduate Degree)		0.0290	0.0724
		(0.149)	(0.160)
Education (other)		-0.365	-0.372
		(0.330)	(0.296)
Education (prefer not to answer)		-0.311	-0.203
		(0.391)	(0.366)
Income (1000-2000£)		0.116	0.131*
		(0.0761)	(0.0697)
Income (2000-3000£)		0.0705	0.0606
		(0.110)	(0.107)
Income (more than 3000£)		-0.00364	-0.0502
		(0.161)	(0.170)
Income (prefer not to answer)		0.0979	0.0532
		(0.152)	(0.150)
Cognitive reflection			-0.00582*
			(0.00298)
Time preference			0.0110
			(0.0374)
Risk preference			0.0198
			(0.0288)
Distrust in others			0.0462***
			(0.0114)
Constant	0.0256	0.0325	-0.223
	(0.0659)	(0.238)	(0.273)
Observations	590	587	586
R-squared	0.021	0.036	0.058

Notes: OLS regression coefficients in cells. Clustered standard errors (unit of clustering: session) in parentheses below. Cognitive reflection: score from cognitive abilities test in questionnaire. Time preference & risk preference variable: 1 = very unwilling; 5 = very willing. Trust variable: 1 = trust everyone, 10 = careful. *p*-Values: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

As shown in Tab. D3, the summarized scores of stated and actual behaviors were significantly correlated ($r = 0.40$, $p < 0.001$). Stated behavior tended to correlate slightly lower with contributions in the climate game ($r = 0.11$, $p = 0.006$) and the hypothetical investment ($r = 0.12$, $p = 0.003$) than actual behavior did ($r = 0.16$, $p < 0.001$ and $r = 0.13$, $p = 0.002$). Environmental concern (single-indicator and multiple-indicator measure) showed higher correlation with stated behavior ($r = 0.55$, $p < 0.001$ and $r = 0.46$, $p < 0.001$) than with actual behavior ($r = 0.45$, $p < 0.001$ and $r = 0.26$, $p < 0.001$).

Tab. D3. Correlation of behavior, contributions, hypothetical investment and concern.
The upper value shows the correlation coefficient and the lower value shows the p-value.

	Stated behav.	Actual behav.	Sum contr.	Hypoth. invest.	Environ. concern	Environ. concern (PCA)
Stated behavior	1.0000					
Actual behavior	0.4019 0.0000	1.0000				
Sum contributions	0.1138 0.0056	0.1638 0.0001	1.0000			
Hypoth. investment	0.1206 0.0033	0.1291 0.0017	0.4109 0.0000	1.0000		
Environ. concern	0.5458 0.0000	0.4407 0.0000	0.2009 0.0000	0.1821 0.0000	1.0000	
Environ. concern (PCA)	0.4582 0.0000	0.2644 0.0000	0.0805 0.0505	0.0831 0.0434	0.6058 0.0000	1.0000