LUND UNIVERSITY
School of Economics and Management

Master's Programme in Innovation and Global Sustainable Development

Would You Think We Are Doomed Because of Climate Change?

Risk Perception, Taking Action and Trusting Others in the Face of Different Climate Change Scenarios

by

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Abstract Members of the general public assess risks of climate change differently than experts. Increasing the perceived risk through communication of climate change has been debated as a viable strategy to promote more sustainable behavior. This thesis exposes 412 subjects to four different messages regarding varying the likelihood and severity of averse consequences of global warming. Analysis of a two-factorial between-subjects experiment indicates no adjustment in perceived risk as the result of treatment conditions. Perceived risk is, however, found to be a stable and important factor in explaining observed pro-climate behavior. The study also tests the influence of general interpersonal trust on collaboration in climate change mitigation efforts. Unlike perceived risk, this factor may only affect action of people with lower knowledge of climate change.

Keywords: Climate Communication, Risk Perception, Pro-Environmental Behavior, Social Trust

EKHS35
Master's Thesis (15 credits ECTS)
May 2021
Supervisor: Roel van Veldhuizen
Examiner: Kirk Scott
Word Count: 12,958

Acknowledgements

A special thanks belongs to my supervisor Roel van Veldhuizen for his enduring support and critical input over the course of this thesis. For their academic assistance, I want to also thank all those who helped me in data collection by taking, improving and forwarding the survey. Without you there would be no thesis.

Exceeding the scope of this thesis, as always, is my gratitude for my family and friends. For motivating me; for questioning me; for calming me; thank you Emmie, Papa, Mama, Malte, Franzi, Filippo, Jasmine, Philipp and everybody else. Much unlike the pessimistic frames used to prime my respondents, I believe that this world can be improved by people such as you; by staying compassionate, curious and ambitious as you are.

I also gratefully acknowledge the financial and immaterial support which I had the fortune to receive as a Klaus-Murmann-Fellow at the Stiftung der Deutschen Wirtschaft.

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Chapter 1

Introduction

Climate change is arguably the most significant global threat humanity faces (IPCC, 2018). But, because personal and collective interests regarding climate change are often at odds, climate change is a social dilemma (De Cremer, 1999), whose resolution is subject to intense debate inside and outside of academia. This thesis focuses on three aspects which have been proposed as possible remedies to overcome the social dilemma. The first is raising public incentive to act on climate change by increasing the risk associate with climate change through communicating its threats. The second concerns promoting individual behavior to avoid those risks and the third considers the fact that in collective action interpersonal trust may alleviate concerns of free-riding which otherwise prohibit individual action.

Effective climate change mitigation requires broad scale collective action (IPCC, 2018), but asymmetric costs and benefits of those actions create high incentives to free ride off others' efforts (Kundzewicz, Matczak, Otto, & Otto, 2020). While climate experts agree that the risks are high and warrant decisive action, (IPCC, 2018), the general public has been lagging markedly behind this assessment (Baiardi & Morana, 2021; Zhang et al., 2018). For example, Poortinga et al. (2018) find that only one in four Europeans state that they are very worried about climate change, even though 70% of respondents to the European Social Survey indicated they expected climate change effects to be bad or very bad. They conclude that, "Europeans are not very worried about climate change, and only feel a moderate responsibility to do something about it themselves" (p. 14). And although international awareness of climate change has been rising in recent years (Lee, Markowitz, Howe, Ko, & Leiserowitz, 2015), considerable variance still exists in the extent to which it is perceived to be a risk (Pidgeon, 2012). One possible explanation for this could be that climate change is a complex and psychologically distant issue, whose impacts are uncertain, affecting other places, people and times (Duan, Takahashi, & Zwickle, 2019; Singh, Zwickle, Bruskotter, & Wilson, 2017). Despite at times only feeling moderate responsibility to act, the ways individuals can influence the response to climate change are manifold; Support for policy change, acceptance of emission reduction pathways and not least concrete behavioral change, to name only three important levers (Poortinga et al., 2018). All of these, however, are to a significant extent dependent on an accurate public perception of climate change, its causes, and mitigation options (Siegrist & Árvai, 2020; van der Linden, 2015).

Bridging the gap between climate experts and general public perceptions of climate change related risks is therefore paramount in ensuring appropriate action.

And while a substantial body of research is dedicated to optimizing climate science communication, many of these studies are limited to stated preferences regarding cognitive, or affective outcomes of different communication strategies (Ropret Homar & Knežević Cvelbar, 2021). Nor is simply improving the overlap of public and experts' climate change perception sufficient to guarantee collaboration in collective action (Capstick, Whitmarsh, Poortinga, Pidgeon, & Upham, 2015).

For a person to take action, they need to also experience personal efficacy, a feeling that they can successfully perform a behavior, and believe that this behavior is effective in achieving the desired outcome (Bandura, 1986). In collective action, a positive outcome cannot be achieved by an individual alone. Therefore, the individual needs to trust that others will also act in the collective's interest (Mannemar Sønderskov, 2011). Despite the importance and prominence of risk perception and trust, more research is needed to understand how they interact in promoting pro-environmental action (Smith & Mayer, 2018).

1.1 Research Problem

Because climate change is a collective action problem, it ties individual beliefs – such as expectations regarding the severity of climate change outcomes and the likelihood that they can be avoided, – to expectations regarding other's behaviors. This interrelation is the source of the research questions for this thesis.

They ask:

1. Does framing climate change as catastrophic and inevitable lead to a higher subjective risk perception?
2. Is an individual who perceives climate change to be more risky, more likely to take action to mitigate it?

   And lastly,
3. Does the extent to which people engage in climate change mitigation depend on their general trust in others?

1.2 Aim and Scope

The aim of this thesis is to contribute to the debate about effectively communicating climate change to the general public. By testing if messages of an inevitable climate catastrophe lead to changes in cognition and behavior this thesis engages in a current and wide-spread debate within and outside academia. Other than most studies on the subject, this research observes concrete behavior instead of simply relying on stated climate- mitigation preferences.

This thesis speaks to scholars of risk analysis, climate communication and decision making science. It draws heavily on literature from those fields, with an emphasis on psychological theories.

1.3 Outline of the Thesis

The theory chapter reviews literature on decision making, risk perception, climate change communication and public good games. It successively builds a model of individual climate action contingent on an individual's level of perceived risk, beliefs about efficacy, and social trust in other's contribution. Previous research on climate change and theoretical foundations of key concepts are reviewed, before a summary ties the three aspects together and introduces corresponding hypotheses.

The derived hypotheses are tested in a 2 × 2 factorial between-subjects online-survey experiment. The methods chapter presents the questionnaire, and describes its development and analysis process. It also discusses strengths and drawbacks of the chosen items and analysis methods.

Data for this study were collected from an international convenience sample, of 412 finished surveys. The intended population was the general public. Review of the sample suggests that it is only partially representative for the intended population. Therefore, to strengthen the findings of this thesis, two sub-samples are created restricting the sample to low knowledge on climate science and less exposure to climate change news than the full sample.

Two-way ANOVA and MANOVA analysis of treatment conditions finds no consistently significant effects of main or interaction effects. Only in one sample led a catastrophic outcome message to higher perceived risk. Ordinary least square regression suggests that the perception of climate change risks is associated with the socio-demographic factors age, income and gender. Pro-climate behavior, as measured by donating to climate mitigation, was also not influenced by treatment conditions. Regression of the donation amount suggests that risk perception is a key predictor of such behavior and that social trust is associated with higher donations for people with low climate science knowledge.

The thesis concludes by discussing its internal and external validity, suggesting new research avenues and deriving some implications for effective climate change communication.

Chapter 2

Theory

2.1 Previous Research

Collective action problems are at the core of many social science disciplines. As such, the literature on the subject is abound. And on the surface, climate change meets all the characteristics of a conventional social dilemma (Ostrom, 2010). But, in a seminal contribution on climate change as a collective action problem, Ostrom (2010) outlined key differences which make climate change a special case.

A social dilemma, or social trap, refers to a situation in which uncoordinated decisions are marked by a conflict between individual short term outcomes and more optimal outcomes for the collective and / or the future individual (Ostrom, 2009). Thus, sub-optimal joint outcomes form a Nash equilibrium, from which no rational individual is motivated to deviate, given their expectation that other's will behave the same (Sandler & Sandler, 1997). Consistent with this structure is the tragedy of the commons (Hardin, 1968).

In global pollution, many individual agents make independent decisions which affect the release of green-house gasses without communicating with others making similar decisions. Restraint is costly and in the absence of a central authority enforcing external regulations, incentives to free ride are high. Hence,

> [t]he applicability of the conventional theory is considered to be so obvious by many scholars that few questions have been raised about whether this is the best theoretical foundation for making real progress toward substantially reducing greenhouse gas emissions and taking other actions to reduce the threat of massive harm brought about by climate change (Ostrom, 2010, p. 9).

Ostrom (2010), however, argues that for one, empirical evidence does not support the unambiguous prediction (that there will be no cooperation for reducing pollution) made by conventional social dilemma theory (Poteete, Janssen, & Ostrom, 2010). Moreover, Ostrom (2010) argues that the atmosphere as a global commons has various externalities on multiple – from individual to global – levels.

Accounting for these factors, Poteete et al. (2010) present an updated theory of collective action on climate change, giving more weight to the fact that some people are cooperate on the condition that others do so as well. Novel in their theory is the presumption that cooperation is not only possible, but will occur under the right circumstances. These circumstances include reliable and frequent information of the problem requiring action, information of other's agreement and monitoring of their conformance, which requires communication between at least a subset of participants (Ostrom, 2010). These three are preceded by the first conductive circumstance, "[m]any of those affected have agreed on the need for changes in behavior and see themselves as jointly sharing responsibility for future outcomes." (Ostrom, 2010, p. 12). This requirement echos Pendergraft (1998), who called for a shift from individual to collective interest, arguing that many seek to build collective action by, "[...] instigating changes in the way people see things [...]" Pendergraft (1998, p. 645).

2.1.1 Changing the Way People See Climate Change

Much of climate change communication science has aimed to change the way people see climate change to become more congruent with reality. As Kundzewicz et al. (2020) note, communicating climate change to the general public often requires to simplify carefully crafted statements of rigorous scientific into easily accessible pieces of information. A recent study found that mere exposure to the IPCC special report on 1.5° warming was associated with increased climate change concern and related threat perception (Ogunbode, Doran, & Böhm, 2020). Reporting of climate science by the IPCC has spurred further research, for example testing how lay-people perceive the careful expressions of uncertainty (Harris & Corner, 2011). The study finds that for lay-people outcome severity affects the meaning of verbal probability expressions; ceteris paribus, more severe outcomes are perceived as more probable than less severe outcomes despite equal verbal probability expressions (Harris & Corner, 2011; Weber & Hilton, 1990).

Before discussing the way people perceive risks, it is useful to establish two key concepts in decision making: uncertainty and risk. Uncertainty refers to situations in which the probability distributions of future outcomes states are either unknown / not knowable, or meaningless to the decision maker (Ellsberg, 1961). It can result from lack of information, or disagreement about outcome probabilities (Kunreuther et al., 2014). Risk on the other hand, refers to, "[...] the potential for adverse effects on lives, livelihoods, health status, economic, social and cultural assets, services (including environmental), and infrastructure due to uncertain states of the world" (Kunreuther et al., 2014, p. 155). Risk can also be subjective, in that individuals can have different likelihoods and outcomes, based on different knowledge and perception regarding a situation (Kunreuther et al., 2014).

Clearly, as illustrated by Harris and Corner (2011), despite its importance in influencing behavior, the way individuals perceive risks need not match their real risk (Weber, 2006), nor does more perceived risk always lead to behavior to reduce the risk (Reser & Bradley, 2017). In order to understand why this is the case, and how to influence the way people see climate change, it is necessary to first consider how perceptions of risks are formed.

Subjective Perception of Risk

Psychometric research on risk perception established that characteristics of a hazard play a crucial role in the way people reason about them (Siegrist & Árvai, 2020). Based on works by Fischhoff, Slovic, and Lichtenstein (1979) and Slovic (1987) hazards are frequently categorized in a two-dimensional way. The first factor categorizes a hazard as either known or unknown by the individual, the second maps its association with dread.

An unknown hazard is characterized by a tendency to be novel, (believed to be) incompletely understood by science or respondents, and lastly, psychological distance (Kunreuther et al., 2014). The latter refers to outcomes which are temporally or spatially far away from the respondent (Eyal, Liberman, & Trope, 2008).

A dreaded hazard is one which cannot be readily observed or controlled. Its outcomes are perceived as fatal and are highly salient. Exposure to its outcomes is involuntary and its magnitudes catastrophic (Siegrist & Árvai, 2020).

These hazard characteristics seem to matter more to lay-people than to domain experts, who assess the risk associated with a hazard from a more quantitative perspective of exposure probability and measurable consequence magnitude (Neil, Malmfors, & Slovic, 1994; Wilson & Arvai, 2006). This gap between experts and lay-people is repeatedly found to differ starkly across various hazards (Hartmann, Hübner, & Siegrist, 2018; Sjöberg, 1998; Visschers & Siegrist, 2018).

Domain expertise, as knowledge in general, also plays a prominent role in the second influential approach to understanding risk perception, which instead of the characteristics of hazards focuses on the characteristics of respondents (Siegrist & Árvai, 2020). The knowledge deficit model postulates that lay-people would arrive at similar conclusions regarding risks as experts, if they were more knowledgeable about the hazard (Bubela et al., 2009). However, this conceptualization has been criticized with evidence that individuals are not neutral to new information, and instead engage in motivated reasoning (Bolsen & Palm, 2019). Here, new information is processed in a manner congruent with pre-determined, desired conclusions (Bayes & Druckman, 2021). Information is sought out, processed and evaluated to serve and protect cultural (Kahan, Jenkins-Smith, & Braman, 2011), social (Kahan, 2015; Kobayashi, 2018) and personal identity (Ma, Dixon, & Hmielowski, 2019). Better factual knowledge of a hazard therefore does not necessarily lead to a higher perceived risk of the hazard.

Unsurprisingly, researchers have extensively considered other traits of risk perceivers such as demographic factors, personality traits, as well as cognitive and affective dispositions (Siegrist & Árvai, 2020). Purely demographic factors such as age, gender, or income have been found to play only a marginal role to explain variance in risk perception (Siegrist & Árvai, 2020). More important are the psychological and cultural factors which influence hazard reasoning (Siegrist & Árvai, 2020). In this context the optimism bias warrants an explicit mention. People may have a disposition to be overtly optimistic about personal risks, they view risks faced by themselves to be lower than the same hazards risk for others (Weinstein, 1989). Other core aspects are worldviews and value orientations (Siegrist & Árvai, 2020). The value orientations in primary focus are hierarchicalism, individualism, and egalitarianism (Dake, 1991). Hence, evidence also points to cross-cultural variance in the way different hazards are perceived, but not in the attitude towards the resulting perception (Weber & Hsee, 1998).

It is argued that especially lay-people often rely on heuristics, mental shortcuts, instead of more costly probabilistic information processing (for an overview of these two systems, see Kahneman, 2003). Heuristics serve to replace complex algorithmic analyses of inaccessible hazard attributes with a more intuitive perception informed by associative and affective responses (Benartzi & Thaler, 2007; Weber, 2017). It is important to stress that judgments following heuristic processes need not be wrong, and can in fact be advantageous to the decision maker, as they are very efficient and allow for quick adjustments in novel situations (Tversky & Kahneman, 1974). Siegrist and Árvai (2020) highlight three heuristics as especially influential on risk perception. First, the availability heuristic, which states that people base their frequency and probability assessment on the ease with which occurrences can be brought to mind (Tversky & Kahneman, 1973). This heuristic explains why people might object nuclear power plants while accepting coal power plants. Next, the natural-is-better heuristic has been shown to play a role when evaluating a wide host of climate change related risks, one example are hurricanes which are perceived as riskier if the risk perceiver beliefs climate change to be caused by humans (Hoogendoorn, Sütterlin, & Siegrist, 2020). Last, the affect heuristic. When making judgments regarding a hazard, people rely on a pool of comparable images attached with affects of varying degrees; more positive connotations lead to lower perceived risk (Finucane, Alhakami, Slovic, & Johnson, 2000). And while affects may play an important role in the formation of risk perception, care should be taken not to conflate affective dimensions such as concern or worry regarding a hazard with the perception of its risk (O'Connor, Bard, & Fisher, 1999). Siegrist and Árvai (2020) grant heuristics an important but unclear role in influencing risk perception. They argue that, although their predictive power is sometimes low, heuristics should not be used to explain study findings post-hoc.

Characteristics of Climate Change as a Hazard

Scientific consensus regarding the causes and consequences of climate change is overwhelming (IPCC, 2018). Among the high confidence consequences, meaning those for which evidence is robust and consensus is high (Mastrandrea et al., 2010), more frequent heatwaves in most land regions are already occurring, while increasingly frequent and intense heavy precipitation in several regions are expected to occur in a 1.5 degree warmer world. Risks to natural and human systems are with high confidence predicted to be lower in a 1.5 ° Celsius warmer world than at 2 °C average warming (IPCC, 2018). However, the consequences are expressed in carefully crafted uncertainty language, meant to convey specific corresponding statistical confidences in results (Mastrandrea et al., 2010). For lay-people, as established above, these quantitative risk expressions carry significantly less meaning than they do for climate experts (Harris & Corner, 2011; Siegrist & Árvai, 2020). While natural hazards rank across the entire scales of dread and unknown risks, climate change on its own has been found to be considered very unknown and not at all dreaded (Fox-Glassman, 2015; Thompson & Weber, 2014). It is unsurprising in this regard that heightened climate change concern is associated with personal experience and exposure to extreme weather events, independent of their actual association with climate change (Baiardi & Morana, 2021; Botzen, Aerts, & van den Bergh, 2009; Cardona et al., 2012). Waiting for extreme events of climate change to affect a sufficient amount of people to perceive climate change hazards accurately is unfortunately not a promising solution (Weber, 2010).

Individual Disposition to Climate Change

Instead, researchers have investigated various ways in which characteristics of risk perceivers may be leveraged into an increased perception of climate change risks (Weber, 2010, 2016). There are two main approaches in this regard. The first focuses on cognition. Learning about climate change, whether through personal experience, or statistical description is supposed to close the knowledge gap and thus, in line with the knowledge deficit model, assimilate risk perception between experts and the general public. On climate change, studies have focused especially on ensuring accurate communication of scientific evidence and consensus (e.g., Morton, Rabinovich, Marshall, & Bretschneider, 2011; Shi, Visschers, Siegrist, & Arvai, 2016).

The second, however, departs from the notion that lay-people rely to a larger extent on intuitive, associated and affect driven reasoning than experts (Weber, 2010). Here, quick and automatic associations translate adverse environmental features into feelings of fear, dread, or anxiety (Loewenstein, Weber, Hsee, & Welch, 2001). Such fear appeals have been found to be highly persuasive and motivating adaptive danger control actions (Witte & Allen, 2000). Narratives of climate doom with tangible and catastrophic outcomes of global warming are prominent in media coverage (Carvalho & Burgess, 2005; Shea, Painter, & Osaka, 2020; Tavares et al., 2020), internet discourse (Eck, Mulder, & Linden, 2021) and political activism (Vu et al., 2021) in text, graphical and video material (Ettinger, Walton, Painter, & DiBlasi, 2021).

However, researchers warn that relying on fear appeals to create climate action may have unintended consequences (Weber, 2016). While experimental studies suggest that turning fear, worry, or concern into action is promising, few studies investigate how exposure to such methods affects behavior over time (Weber, 2010). The finite pool of worry hypothesis states that as one risk increases in importance, others decrease (Weber, 2006). For climate change, this has been shown to occur, for example, in farmers who devalued other concerns as climate change became more important (Hansen, Marx, & Weber, 2004). Raising public risk perception of climate change may therefore come with unintended consequences such as lower risk for other sustainability goals. Overt use of threatening messages could also promote psychological reactance, an amalgamation of anger and negative cognition, creating a persuasive boomerang (Kim, Levine, & Allen, 2017). Lastly, it could also lead to feelings fatalism and powerlessness, inhibiting individuals to act on climate change (Aitken, Chapman, & McClure, 2011; Lipshitz & Strauss, 1997).

In summary, the way people perceive climate change matters for their motivation to act on it. Lay-people have been shown to reason differently about climate change than experts, relying to a larger extent on automatic and intuitive reasoning than complex deliberation. In practice, catastrophic characteristics of climate change are frequently highlighted in communication to the general public, in hopes of evoking an automatic and intuitive response against climate change threats.

So far, the focus has been on individual perception of risk as predictor for individual action. The next section examines what that action may look like and introduces a key factor in turning motivation to act into action.

2.1.2 From Problem Awareness to Action

Since this thesis focuses on behavior related to climate change, pro-environmental and pro-climate behaviors are introduced as specific types of behavior, before turning to theories of behavior.

Pro-Environmental and Pro-Climate Behavior

Unsustainable behaviors are at the heart of environmental sustainability issues (White, Habib, & Hardisty, 2019). Many of those behaviors occur frequently, in a repeated and ingrained manner, making them difficult to change (Kurz, Gardner, Verplanken, & Abraham, 2015). The focus of this study, however, is on behaviors as the result of a deliberation process.

For such climate change related decision making Orlove, Shwom, Markowitz, and Cheong (2020) offer a recent review of literature from the broad field of decision making research. They define climate change-relevant decisions as, "[...] decisions leading to actions that have consequences for climate change, particularly through mitigation and adaptation" (p. 272). Stern (2000) categorizes four different domains in which such decisions are made. First, political environmental activism; second, non-activist behaviors in the public sphere; third, private-sphere environmentalism; and last, other environmentally significant behaviors.

Engagement in such behavior is the result of a multi-step process and decision making research has firmly established that in many choice situations, preferences are not pre-determined but rather constructed ad-hoc as the need for them arises (Payne, Bettman, & Johnson, 1993; Slovic, 1995). For climate relevant decision this implies that a communicative intervention before a choice situation should be able to shift the decision makers preferences. The next section introduces a normative theory of behavior in such climate decisions and what it would predict for the influence of perceived climate-related risk.

Expected Utility Theory as a Normative Guide to Decision Making

For theoretical precision, climate change decisions are made under uncertainty because the true risks are unknown (Heal & Millner, 2014; Malik, Rothbaum, & Smith, 2011). The standard approach to normative guidelines in decision making under uncertainty is expected utility (EU) theory (Kunreuther et al., 2014). Expected utility theory has been proposed as an axiomatic theory to determine a person's subjective probability and utility functions from observed behavior (Ramsey, 1931; Savage, 1972; Von Neumann & Morgenstern, 1944). The model postulates that decisions should be made in a four step process. First, define a set of possible decision alternatives. Second, quantify uncertainties on possible states of the world. Third, evaluate outcome possibilities of each decision alternative according to their utility. Last, choose the alternative with the highest expected utility (Kunreuther et al., 2014).

Applying these steps in a stylized manner to climate change action could look as follows. Being faced with a decision to act on climate change, or remain inactive, an individual assesses their subjective risk of exposure to and the severity of climate change outcomes. Assuming that more severe climate change outcomes have a lower utility, the person would then choose to act on climate change, if and only if they believe their likelihood of being affected by severe climate change outcomes to be higher than those of less severe consequences.

While the theory of expected utility is neither the only (for an overview see Kunreuther et al., 2014), nor necessarily the most appropriate to guide, or even describe individual behavior in climate change (Heal & Millner, 2014), it continues to be an influential framework through which climate change decisions are described and recommended (e.g. Berger & Marinacci, 2020).

Apart from the psychological factors influencing the risk a person perceives, other aspects influences the probability term associated with possible outcome states. The next sections turns to one such factor: efficacy beliefs.

Efficacy Beliefs Link Risk Perception to Action

The value-belief-norm (VBN) theory of environmentalism presents a causal link from perceived adverse consequences for valued objects to a sense of obligation to take pro-environmental actions through the perceived ability to reduce threat (Stern, 2000). It models the influence of four types of causal variables – attitudinal factors, contextual factors, personal capabilities, and habit, or routine – in personal-contextual interaction. Of those, the focus here is on contextual factors and personal capabilities.

Contextual factors are external to the individual, including interpersonal influences, such as persuasion, messaging; public and social institutions, for example, social norms, laws; and various other features of social, economic and political importance, such as prices, public policies etc (Stern, 2000). Crucially, they include risk and mirror influences on risk perception.

Since these factors have been discussed at length, this section gives more space to the second important factor: personal capabilities. Stern (2000) include in these knowledge and skills needed to engage in a behavior, a temporal possibility and general resources such as financial and social capital to act. If these are lacking, an individual perceives themself's to be powerless (Aitken et al., 2011; Stern, 2000). Such a perception is characterized by the belief that one either has no option to take action, or that taking action will make no difference (Aitken et al., 2011). Such perception has been associated with decreased willingness to pay for environmental protection (Aitken et al., 2011; Haller & Hadler, 2008), while high levels of perceived personal efficacy have been associated with environmentally beneficial individual action (Eden, 1993).

Risk perception and efficacy beliefs have been well established as important factors for individual action on health threats (Brewer et al., 2007; Floyd, Prentice-Dunn, & Rogers, 2000; Witte & Allen, 2000). But research is still needed on their mechanisms in climate change domains (Reser & Bradley, 2017). In this context, the importance of efficacy beliefs is also central in criticism of evoking negative emotions such as fear and thus raising perceptions of climate change risks (O'Neill & Nicholson-Cole, 2009). Some authors argue that appealing to fear leads to climate fatalism, where uncontrollable uncertainty leads to a tendency in people to ignore it (Lipshitz & Strauss, 1997), deny the threat (Janković & Schultz, 2017), or paralyze the individual (Schaller & Crandall, 2003).

However, as argued in the introduction of this chapter, climate change is a collective action problem and individual action thus insufficient in addressing it.

Collective Efficacy

Extending personal efficacy to collective action, Bandura (2000) states that, "[p]eople's shared beliefs in their collective power to produce the desired results are a key ingredient of collective agency" (p. 75). Collective efficacy is not simply the result of aggregating individual efficacy beliefs, instead it is a group level property (Bandura, 2000). In a dualism between social structure and personal agency, beliefs about collective efficacy emerge from personal efficacy beliefs as well as beliefs regarding interaction and coordination at the group level (Bandura, 1986). While these two levels are closely linked, they need not be the same. An individual can believe themselves and/or their group members to have low individual efficacy, while believing that if the group as a whole coordinated, the desired outcomes could be achieved (Bandura, 2000). Conversely, a person can also believe that they or another person have high individual efficacy, but due to ineffective or non-existent interaction and coordination at the group level believe that the group is unlikely to achieve desired outcomes.

Perceptions of collective efficacy have been argued to affect choices made in public goods dilemmas (Kerr & Kaufman-Gilliland, 1997) and have been linked to actions on climate change mitigation (Aitken et al., 2011). Of the many different factors influencing a person's efficacy beliefs (for an overview, see Bandura, 1986, 1997), a key determinant in collective efficacy beliefs is group size (Kerr, 1989; Mancur Olson, 1971). This holds even if the group size does not actually affect objective individual impact (Kerr, 1989).

Since climate change requires action on virtually every level, the size of its "players" is perhaps the largest of any social dilemma, encompassing governments, communities, firms, families and individuals (Ostrom, 2010). Bandura (1986) argues that due to increases in scale and interdependence of social and economic life perceived collective efficacy decreases at the same time as the need for collective effort increases. There are, however, factors which counteract low efficacy beliefs in large group cooperation. Reputation, trust and reciprocity are at the core of structural factors explaining cooperation in social dilemmas (Ostrom, 2009). Of those, trust is presented in depth in the next section.

2.1.3 Trusting Others to Cooperate in Collective Action

Trust plays a central role in promoting collective action on climate change. On one hand, trust in institutions and science has been associated with accurate perception of risk (Siegrist, 2019). This is, for example, important when a hazard is unknown to the general public and reliance on expert knowledge is high in the formation of risk perception (Siegrist & Cvetkovich, 2000; Siegrist, Luchsinger, & Bearth, 2021). The extent to which an individual is in general trusting has also been argued to decrease the extent to which this individual perceives various hazards as risky (Siegrist, Gutscher, & Earle, 2005). The correlations between the two phenomena is, however, low (Siegrist, 2019). Instead of revisiting risk perception, the focus of this section is on the interplay of general interpersonal trust and collective action. Because interpersonal trust is a potential key factor in conditional cooperation in social dilemmas (Mannemar Sønderskov, 2011), the term conditional cooperation is introduced first.

Conditional Cooperation: I act on climate change if you act on climate change.

In a seminal contribution Fischbacher, Gächter, and Fehr (2001) showed that in single-shot games only about 30% of individuals act purely in their own interest and free-ride off other's contributions to a common goal. The average player contributes to the public good depending on other's contribution, although with a self-serving bias (Fischbacher et al., 2001). These (roughly 50%) players are conditional cooperators; willing to contribute more themselves the more others contribute (Fischbacher et al., 2001). Their finding has been stably replicated in various studies and under different situations (e.g., Thöni & Volk, 2018).

Attempts have been made to explain the existence of conditional cooperation, as well as the fact that it declines over time in anonymous interactions (Andreozzi, Ploner, & Saral, 2020), for example, with fairness preferences or motivation in its own (Fischbacher et al., 2001). Further, interpersonal trust has been put forward as an explanation for conditional cooperation and in promoting its stability across time and group-size (Mannemar Sønderskov, 2011).

Conceptualization of Interpersonal Trust

Interpersonal trust is frequently differentiated into two main types. First, social trust, which refers to a general trust towards other members of society. It is frequently also referred to as generalized trust, or a person's trust propensity (Thielmann & Hilbig, 2015). And for collective action on a global scale, this type plays the central role (Smith & Mayer, 2018). The second type, particular trust, refers to the trust an individual has towards members of their in-group, for that reason it is also frequently referred to as in-group trust (Smith & Mayer, 2018).

Various conceptualizations of each sub-type and interpersonal trust in general exist across different disciplines. However, they often share many core features. In an integrative review of trust literature from psychology, economics and decision making research, Thielmann and Hilbig (2015) define interpersonal trust as

> a risky choice of making oneself dependent on the actions of another in a situation of uncertainty, based upon some expectation of whether the other will act in a benevolent fashion despite an opportunity to betray(p.251).

In this conceptualization, three core aspects determine whether an individual will engage in trust behavior. The first core aspect is *uncertainty*. In a trust situation, this is the case because the trustor (the person trusting) cannot know the intentions of the trustee (the person being trusted) and thus does not know what behavior the trustee will show (Thielmann & Hilbig, 2015). As a result the behavior to trust is characterized by the second core of the trust conceptualization: *risk*, i.e., a possible loss stemming from a betrayal of the trustor by the trustee (Thielmann & Hilbig, 2015). The extent to which the trustor is *vulnerable* is the third core aspect; higher vulnerability to betrayal requires higher levels of trust (Thielmann & Hilbig, 2015). To betray trust necessitates that the trustee has an incentive to betray the trustor for personal gain (Malhotra, 2004).

In Thielmann and Hilbig's (2015) conceptualization the risk associated with a betrayal is the result of trustworthiness expectations and a persons' anxiety and fear dispositions. While the latter are stable traits, expectations about the trustee's trustworthiness are formed from trust cues as well as prior experiences and therefore vary across situations and time. Another influence on trustworthiness expectations is social projection, a heuristic of expecting others to behave as oneself would (Krueger & Acevedo, 2005), which is again trait-based (Thielmann & Hilbig, 2015).

Evidence on Trust in Collective Action

Social projection has been offered as one possible escape form social dilemmas (Krueger, DiDonato, & Freestone, 2012). They argue that in newly formed groups an individual has yet to gain information about the cooperative behavior of others. In absence of such information, the agent is inclined to belief that others will behave as themself would.

Building on social projection, it is predicted that a person would cooperate if they believe themself to be trustworthy and value fairness (Thielmann & Hilbig, 2015). Indeed, a person's trust propensity has been associated with a high willingness to cooperate dictator or prisoner dilemma games (Thielmann & Hilbig, 2015). Further, Mannemar Sønderskov (2011) show that people high in generalized trust cooperate more readily in large-N social dilemmas, "because most humans tend to cooperate when they expect others to do the same" (p. 66).

2.2 Summary of Previous Literature and Generation of Hypotheses

Global anthropogenic climate change is a special type of social dilemma. Opportunities to free-ride are high, yet aggregates of individual and collective action are needed to limit global warming below the crucial threshold of 1.5° Celsius. Research has shown that solutions to the dilemma may exist (Milinski, Semmann, Krambeck, & Marotzke, 2006).

The first lever to achieve widespread collaboration is to convince individuals that the risk of climate change is high (Milinski, Sommerfeld, Krambeck, Reed, & Marotzke, 2008). Unlike experts, the general public constructs perceptions of climate change risk in a more intuitive, and automatic manner. While experts favor expression of climate change risk in terms of quantified outcome probabilities, lay-people usually face verbal expressions, leaving room for personal interpretation of risk. Hence the general public might adjust their risk perception in response to stimuli, such as audio, video or text messages.

Thus, this research's first testable set of hypotheses states:

> H_1: When faced with messages on climate change, lay-people form subjective risk perceptions based on the wording of outcome severity and likelihood.

Specifically,

> H_{1a}: Language conveying high, i.e., catastrophic outcomes leads to a higher perceived risk than descriptions of non-catastrophic outcomes.

and, because averse outcomes which are inevitable tend to be ignored (Aitken et al., 2011):

> H_{1b}: Messages about climate change which communicate impossibility to limit climate change lead to a decrease of perceived risk.

Second, according to the theory of expected utility and congruent with the value-norm-behavior theory, an agent should act on climate change if they deem it more likely that acting on climate change has higher utility than not acting.

> H_2: Following exposure to relevant information, higher subjective risk perception increases the collaboration in climate change mitigation activities.

However, because climate change is outside of the influence of any single agent, pro-environmental and/or pro-climate behavior is best understood as cooperating in a collective action situation. An important determinant of cooperation is an individual's sense of efficacy.

> H_3: If climate change outcomes are described as inevitable, an individual will act less on climate change.

Whether or not an individual will act on climate change, does not only depend on their own risk perception and personal efficacy beliefs, but also on beliefs about the behaviors of others. The individual needs to expect others to act in the collective interest as well, instead of betraying one's cooperation efforts. For that, the last hypothesis considers the special role of general social trust:

> H_4: A person's general trust in others is associated with the extent to which the individual engages in collaborative climate change mitigation behavior.

These hypotheses are tested in two-factorial design, where respondents are primed by four messages of climate change outcomes before making a one-shot anonymous decision representing a trade-off between personal and climate utility maximization. The next section introduces the methods used in the experiment in detail.

Chapter 3

Methods

A 2 × 2 factor, between subjects experiment was embedded in an online survey to test the generated hypotheses. Only survey experiments have been argued to produce results comparable to those obtainable in laboratory settings (Horton, Rand, & Zeckhauser, 2011). In order to limit the possibilities for confusion about item and instruction wording the survey underwent several pre-test stages as described in section 3.2. The following section presents the items and instruments embedded in the questionnaire.

3.1 Instruments

The survey included one treatment with four conditions, three separate outcome variables with eight total items, and five additional measures.

3.1.1 Treatment

The treatment started with a short background information on climate change summarized from UNEP (2021) for all four conditions. The text, which is an almost verbatim repetition of the information found on the UNEP website, read:

> Every year the United Nations Environment Program publishes an up to date report regarding the current state of global warming. This "Emissions Gap Report" draws on the expertise of climate scientist across the globe. It provides regular scientific assessments on climate change, its implications and potential future risks. The report also puts forward adaptation and mitigation options.
>
> Important findings from the latest report are summarized below:
>
> 2019 concluded a decade of exceptional global heat, retreating ice and record sea levels driven by greenhouse gases produced by human activities.
>
> To prevent warming beyond 1.5°C, we need to reduce emissions by 7.6% every year from this year to 2030.
>
> Every fraction of additional warming above 1.5°C will bring worsening impacts, threatening lives, food sources, livelihoods and economies worldwide.

The information was chosen so as to maximize scientific authority without subtracting from the plausibility of each treatment condition. Therefore the use of concrete numbers to express severity or certainty of climate change outcomes was avoided. By providing information of necessary emission reductions in percent, non-experts were left without a clear expectation regarding the feasibility of this goal.

The information text was then followed with one of four possible vignettes, varying collective efficacy and consequences of global warming above 1.5°C (Table 3.1). The low efficacy condition presented climate change as inevitable, even if people were to take collective action, thereby promoting feelings of powerlessness (Aitken et al., 2011). An important feature of the vignettes is the emphasis that limiting global warming requires people to collaborate, but without specifying how exactly this collaboration ought to look like. This phrasing constrains the efficacy manipulation to be solely contingent on the expectations of other's behavior. The high severity condition presented climate change outcomes as catastrophic, a message which has been shown to induce adverse emotions such as fear and dread (Loewenstein et al., 2001). The treatment condition was emphasized with a bold typeface to reduce the probability that it would be overlooked.

The second concerns promoting individual behavior to avoid those risks and the third considers the fact that in collective action interpersonal trust may alleviate concerns of free-riding which otherwise prohibit individual action.

Table 3.1: 2 × 2 Factorial Design, Vignettes

	Inevitable	**Avoidable**
Doom	Even if people should work together, it will not be possible to limit global warming to under 1.5°C. Above 1.5°C, the impacts on ecosystems and societies will be nothing short of catastrophic.	If people work together, it will be possible to limit global warming to under 1.5°C. Above 1.5°C, the impacts on ecosystems and societies will be nothing short of catastrophic.
Gloom	Even if people work together, it will not be possible to limit global warming to under 1.5°C. Above 1.5°C, the impacts on ecosystems and societies will be significant, but far from catastrophic.	If people work together, it will be possible to limit global warming to under 1.5°C. Above 1.5°C, the impacts on ecosystems and societies will be significant, but far from catastrophic.

3.1.2 Scales and Items

Regardless of their treatment condition, all respondents then encountered the following questions.

Risk Perception

A seven item measure of risk perception was adapted from O'Connor et al. (1999). Perception of climate change risks is conceptualized as the as the perceived likelihood that negative consequences manifest themselves from climate change for the individual and society.

Their measure was adapted to fit the predominately European sample, replacing temperature increases from Degrees Fahrenheit to Degrees Celsius. Respondents were prompted to answer seven items to the question: "Suppose annual average temperature DOES increase by more than 1.5 degrees Celsius over the next 50 years. Then how likely do you think each of the following would be?".

The items were:

1. Many people's standard of living will decrease;
2. My standard of living will decrease;
3. Starvation and food shortages will occur in much of the world;
4. Starvation and food shortages will occur where I live;
5. It will be necessary for richer countries to make large donations of financial aid-to poorer countries;
6. Rates of serious disease will increase;
7. My chances of suffering from a serious disease will increase.

Each item was scored from one to five on verbal anchors from *Very unlikely* to *Very likely*. The items were than summarized into three Likert-scales. The first encompasses all items (Cronbach's $\alpha = 0.74$), the second represents the risk respondents perceived for themselves (Items 2, 3, and 7; Cronbach's $\alpha = 0.69$), the third included the four items which referred to consequences for others than oneself (Cronbach's $\alpha = 0.70$).

Some risk researchers argue that risk is best assessed as a single item measure (Ganzach, Ellis, Pazy, & Ricci-Siag, 2008), however, inline with van der Linden (2015) the chosen measure differentiates between dimensions of climate change risk perception. Yet, unlike van der Linden (2015), the seven items used in this study are argued to be conceptually distinct from environmental attitudes, making them better suited for the purpose of this study (O'Connor et al., 1999).

Trust

Like risk perception, trust is a multi-faceted construct with active debate regarding optimal measurement (e.g., Glaeser, Laibson, Scheinkman, & Soutter, 2000). The two main approaches are to measure trust using attitudinal survey questions (e.g., Smith & Mayer, 2018), and as an observable behavior, for example using trust games Glaeser et al. (2000). This, Glaeser et al. (2000) argues is the only way to accurately measure trusting behavior. Alternatively, it would be better to ask people about past situations in which they had to trust others. Hypothetical questions as they frequently are employed in surveys predict an individuals own trustworthiness better than their trust in others (Glaeser et al., 2000).

Nonetheless, a single item question was used in this survey to measure trust. The item asked respondents to rate the statement, "I assume that people have only the best intentions", on a 7 point scale *(Strongly Disagree – Strongly Agree)*. The item was taken from Falk et al. (2018), who, in a large cross cultural validation, found it to be strongly correlated with trusting behavior.

Cooperation in Collective Climate Protection

In the invitation to the survey, potential respondents were informed that by participating they had the chance to win a monetary reward of €100. Apart from an incentive to complete the survey, the lottery was also used as to elicit concrete pro-climate behavior. Respondents were informed that they received ten tickets and that one ticket would be randomly drawn to determine the lottery winner after the survey period terminated. They were then introduced to atmosfair – "[...] a German non-profit organization that actively contributes to CO_2 mitigation by promoting, developing and financing renewable energies in over 15 countries worldwide" (n.p.) – as an effective way to contribute to protecting the climate. An option to donate any amount of tickets to the charity was given along with the option to not participate in the lottery at all.

Thus, respondents faced a trade-off between maximizing their chances to win the prize money and becoming active to protect the climate. Donating money to climate change mitigation is one example for mitigation action in the private-sphere (Stern, 2000). The full text of the lottery instructions can be found in the appendix (subsection A.1.1).

Ordinary Climate-Science Intelligence Assessment (OCSI)

Participants were informed about the purpose of this study, their exposure to different treatment conditions and that these statements do not accurately reflect current scientific consensus regarding the likelihood and severity of climate change outcomes. Participants were then encouraged to test their knowledge of climate change science with a quiz. The quiz was a slightly modified version of the ordinary climate science intelligence (OCSI) assessment scale by Kahan (2015). Table A.1 displays the items used in the measure, the option which represents a correct answer as well as the share of correct responses in the original article by Kahan (2015) and this study. Missing answers were counted as incorrect. The first item was removed, as it did not accurately reflect the current consensus on climate change effects (see Kahan, 2014). Another question which could be seen as out-dated is, "Climate scientists believe that human-caused global warming has increased the number and severity of hurricanes around the world in recent decades." Recent studies suggest that tropical storms have indeed increased in frequency and strength due to anthropogenic climate change (Knutson et al., 2021), however, authorities such as the NOAA Geophysical Fluid Dynamics Laboratory maintain their stance that, "[...], it is premature to conclude with high confidence that increasing atmospheric greenhouse gas concentrations from human activities have had a detectable impact on Atlantic basin hurricane activity [...]"(n.p., 2021). Thus, the item was kept with *False* as its correct response as presented in Kahan (2015). It is interesting to note that, despite items generally being less difficult, the hurricane item and the item regarding positive climate change outcomes were less frequently answered correctly by people in the sample of this study than by the respondents in Kahan (2015). This could indicate that the measure has either lost some of its ability to accurately differentiate between climate science aptitude, or that opinions regarding climate change in this study's sample are more pessimistic than in the previous study.

Socio-demographic controls

Lastly, respondents were asked to answer some standard socio-demographic background questions regarding their (i) Gender, (ii) Age, (iii) Country of Residence, (iv) Education, (v) Employment status, and (vi) Income Status; factors which have been shown to influence risk perception (Siegrist & Árvai, 2020).

3.2 Questionnaire Development

The questionnaire was piloted with a convenience sample of 17 respondents, recruited from personal contacts. Special attention was paid to question and item clarity, about which the pilot participants were encouraged to leave comments. Resulting issues were reviewed and resolved accordingly. The updated questionnaire was again tested in two cognitive interviews to ensure that questions and information texts were understood as intended. Thinking-aloud by the two testers filled in the survey and verbal probing improved survey item quality, especially for the lottery mechanism (Ryan, Gannon-Slater, & Culbertson, 2012; Tourangeau, Rips, & Rasinski, 2000).

The final survey was implemented with SoSci Survey, resulting in a web-page containing the survey, which participants were able to access through a link in the invitation text at any time during the data collection period. On the first page potential participants were informed about the purpose, procedure and involved institutions of the survey. Replies were guaranteed to be anonymous and participants were thanked for their time and effort. After providing their informed consent participants were randomly assigned to one of four treatment conditions. Thereafter they answered the items outlined above in the respective order. The single trust item was assessed after the lottery decision so as to avoid any unintended priming effect. After collecting answers to the risk, donation and trust items, participants were made aware of the experimental condition and encouraged to test their knowledge of current scientific consensus. Lastly, they were asked to provide their socio-demographic data and to indicate whether their answers were honest and could be used for analysis. The final survey page displayed the lottery code and an option to leave contact data should they wish to participate in the lottery or if they wanted to receive updates about the study. The contact data were stored separately and could not be combined with any responses to the survey. Participants were again thanked for their time and told that their answered were saved.

3.2.1 Analysis Methods

The full as well as the two sub-samples are analyzed first with regards to treatment effects, then to uncover moderating effects of trust and risk perception on behavior. Last, some factors affecting risk perception are investigated.

All analysis was carried out in Team (2021); code and reproduction data can be found in the online repository of this thesis. The main analysis of treatment effects on total perceived risk and lottery donation is carried out by an unbalanced 2×2 Analysis of Variance (ANOVA). Using unbalanced ANOVA is necessary because of different treatment group sizes. To adjust for this difference type II sum of square adjustment was identified as the best option (Langsrud, 2003). ANOVA is an appropriate and frequently employed method to analyze 2 × 2 factorial designs (see Harris & Corner, 2011). To investigate potential differences in effects on perceived risk for oneself and for others, Multivariate Analysis of Variance (MANOVA) supplements the first analysis. Like ANOVA, MANOVA allows to investigate main and interaction effects of each treatment factor. In addition MANOVA allows to jointly analyze the closely related measures of risk for self and others, reducing the risk of inflated alpha errors from repeated testing (Cramer & Bock, 1966).

A battery of ordinary least square (OLS) regression was conducted to identify other predictors of risk perception than the treatment conditions.

To analyze the effects of risk perception and trust on pro-climate behavior, an ANOVA and another set of OLS regressions were estimated on the amount of lottery tickets donated to the charity.

3.3 Limitations

Although the methods of this thesis were chosen with care, it is important to note their limitations. As mentioned earlier, online experiments can introduce various unwanted biases (Horton et al., 2011). Apart from the aforementioned issues of inattentive response behavior, the possibility of repeated responses to improve one's chances of winning the lottery exists. However, no indications of such cases, for example duplicate email entries, could be identified. The lottery measure is also limited in the extent to which it accurately measures (a) pro-climate behavior. Some respondents could have chosen to donate all their tickets simply because they did not want to leave their contact information. To at least partially mitigate this concern participants were given the option to skip this question. Participants could also choose to donate to the charity for reasons other than to protect the climate. Giving to a charity could also be caused by social pressure to do so (Caviola, Schubert, & Greene, 2021). Respondents were reassured that their contact information would be stored separately and that their answers would remain entirely anonymous, to ease social pressure to donate. The most plausible alternative reason could be that the act of donating to a charity, regardless of its purpose, results in positive satisfaction, a "warm glow" (Andreoni, 1990). On the other hand, donating to the charity could be perceived as ineffective and therefore undesirable which would deflate the ability of the measure to detect pro-climate behavior (Caviola et al., 2021).

With these limitations in mind, the next section presents the collected data, and discusses its limitations.

Chapter 4

Data

Data were collected in the period from the 16th of April to the 3rd of May 2021. The sampling procedure relied on personal contacts, posts in public groups on social media and emailing previous respondents of an unrelated survey. To increase the incentive to participate, potential respondents were informed of the lottery with a price of €100. Including the lottery restricted the sample to individuals 18 years or older, the survey language restricted the sample to English speakers. The goal was to collect 100 responses per treatment group for a total of 400 responses. Additional responses during the collection period were accepted, to ensure that the sample goal could be reached after accounting for aborted surveys. The analysis was conducted only after the official survey period had closed and no additional responses were considered (Simmons, Nelson, & Simonsohn, 2011).

4.1 Sample

Of the 578 individuals that entered the survey, 412 finished all pages. At this stage each treatment condition contained an equal 103 respondents. A total of three people indicated that they did not take part seriously and were thus dropped from the data set. Inspection of the data revealed that the mean response time was 7 minutes 48 seconds. The lower quantile was 6 minutes and answers below this time were discarded, as it was judged implausible to complete the questionnaire attentively in this short amount of time, even for quick readers. The removal did not correlate with any treatment condition, nevertheless, section C.2 includes results without dropping responses. Accounting for these restrictions reduced the total sample to 309 completed surveys. The mean age of the sample was 29.84 years ($SD = 12.67$) and the majority of the sample were women (54%). 195 individuals reported to be holding at least a bachelor degree and the monthly net income mode was the 500 to 1000 € bin. At the time of their response, 138 people resided in Sweden, 112 in Germany, and 49 in other countries (Table B.1). While not a systematical comparison of intercultural differences, the international composition of the sample could be argued to reduce cultural influences on climate change risk perception (see Siegrist & Árvai, 2020).

4.2 Limitations of Sampling Procedure

Relying on convenience sampling comes with limitations to the internal and external validity of the data. First, due to its nature, the obtained data is not representative for any specific population and extrapolating the findings on different contexts should be done with care, if at all. The internal validity of this thesis relies on the extent to which the sample represents lay people in terms of climate change knowledge. Despite best efforts to reach a diverse set of respondents, it is likely that self-selection introduces bias into the sample. People with a higher affinity for, or stronger personal relationship to climate change are more likely to respond to a survey on the subject as it fits their interests.

A pre-screening of respondents climate change knowledge was not feasible in the present context. To control for subject expertise, an eight item measure was adapted from Kahan (2015) which is argued to accurately assess a person's knowledge of climate science, free of confounding influences. The measure is discussed in detail in section 3.1.2. Inspecting the measures results shows that this study's sample answered more questions correct than the respondents in the previous study (Table A.1). Potential explanations for the relatively better performance could be that the general public has become more knowledgeable about climate change, or that US and European samples differ in their base level knowledge. However, regardless of the cause, the measure shows that the sampling procedure did not only gather data from ill-informed individuals.

Furthermore, the data collection period spanned April 22. On this date media cover of environmental topics is especially pronounced as it is Earth Day. Inspection of the climate knowledge before and after April 22 revealed a statistically significant difference between the two sub-samples (Mann-Whitney-$U = 16284.0$, $p - value = 0.002$, before: $M = 4.73$, $SD = 1.3$; after: $M = 5.09$, $SD = 1.23$).

4.2.1 Accounting for Climate Science Expertise

To account for the bias in the full sample two sub-samples were created. The first isolates the 98 respondents who took part before April 22. This subset of the full sample was on average slightly less knowledgeable about climate science. The second subset explicitly accounts for results of the climate science intelligence assessment. It includes only responses of individuals who answered less than the median of five questions correctly. This sub-sample also counts 98 individuals. These two sub-samples although different are not mutually exclusive. Table B.2 and Table B.3 include further descriptive data for each of the samples.

All three sample sets will be analyzed with the same approach as outlined in the previous section.

Chapter 5

Empirical Analysis

For all analysis the null hypotheses are rejected at an alpha level of 0.05. Apart from the graphs presented in this section, additional material can be found in Appendix C. The additional material includes residual and mean plots for each ANOVA. Their inspection suggests homogeneity of variance and normally distributed residuals, thus meeting ANOVA assumptions for all considered models.

The first sets of hypotheses concerned the effect of the treatment conditions on perceived climate change risk. Hypothesis 2 predicts that after exposure to climate change information, lay people become more active if they perceive climate risks as high. Accordingly, hypothesis 3 stated that lower action efficacy leads to lower climate action. Lastly, hypothesis 4 predicts that general trust is associated with higher donations to the carbon offset charity.

5.1 Analysis of Full Sample

The full sample includes individuals who possess high knowledge of climate science as indicated by the OCSI.

5.1.1 Perceived Risk of Climate Change by Treatment Condition

Figure 5.1 displays the boxplots of each risk dimension for the four treatment conditions. Respondents perceived the risk of climate change for themselves ($M = 3.101$, $SD = 0.576$) as significantly lower than for others ($M = 4.076$, $SD = 0.852$), paired $t(305) = 25.721$, $p < .001$. The boxplot also indicates that there may be no systematic variation in risk perception between the treatment conditions.

Entering the full sample in a two-way ANOVA of total perceived risk revealed no statistically significant difference the risk perceived by those exposed to a doom condition, those exposed to the inevitable condition, nor its interaction (Table 5.1). Total perceived risk means by treatment group are reported in Table 5.2. The difference between main effects was 0.130 higher for responses from the doom condition and 0.052 higher for the main effect of inevitable condition.

The two sub-scales, perceived risk for others and for oneself, were jointly analyzed in a MANOVA, without finding a significant difference between the treatment conditions. Pillai's Trace was 0.010, with an $F_{\text{approximate}}\,(2, 301) = 1.62$, and $p = .198$ for the treatment condition doom; 0.003, with an $F_{\text{approximate}}\,(2, 301) = 0.677$, and

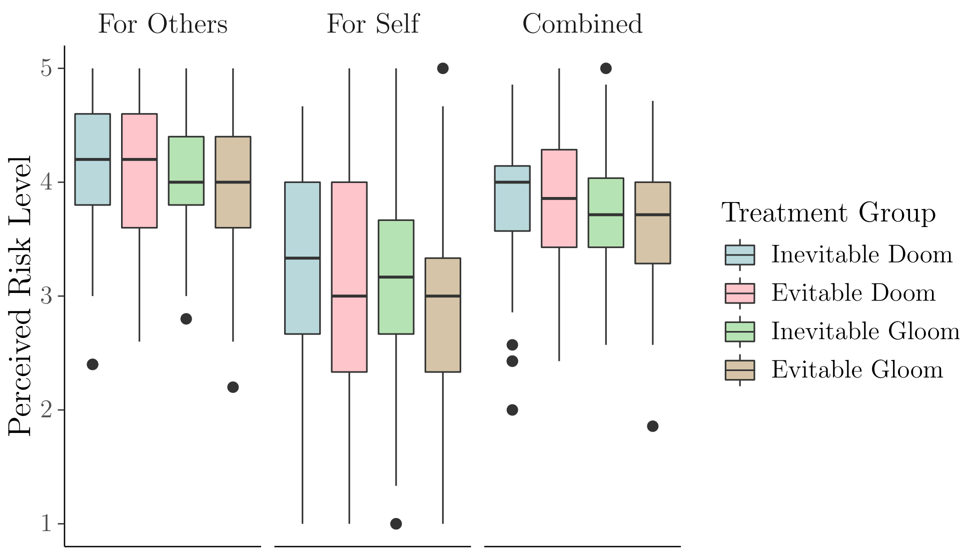

Figure 5.1: Boxplots of Risk Perception Do Not Show Systematic Variation Between Treatment Groups in Full Sample

Table 5.1: ANOVA of Total Perceived Risk by Treatment Condition

	Sum Sq	df	F Statistic	p-value
Full Sample				
Doom	1.285	1	3.778	.053
Inevitable	0.208	1	0.611	.435
Doom × Inevitable	0	1	0.001	.972
Residuals	102.741	302		
Before Earth Day				
Doom	1.98	1	5.879	.017
Inevitable	0.747	1	2.216	.14
Doom × Inevitable	0.059	1	0.176	.676
Residuals	31.668	94		
Low OCSI Score				
Doom	0.039	1	0.117	.733
Inevitable	0.039	1	0.117	.733
Doom × Inevitable	0.046	1	0.139	.71
Residuals	31.514	94		

Notes: Unequal group sizes adjusted using type 2 correction.

Table 5.2: Comparison of Risk Perception Means By Treatment Group And Sample

	Full Sample			Before Earth Day			Low OCSI Score		
Treatment Condition	N	Mean	SD	N	Mean	SD	N	Mean	SD
Total Perceived Risk									
Inevitable Doom	77	3.85	0.59	24	3.72	0.66	25	3.85	0.61
Evitable Doom	80	3.80	0.65	29	3.94	0.51	24	3.77	0.65
Inevitable Gloom	72	3.73	0.53	22	3.49	0.57	24	3.77	0.49
Evitable Gloom	77	3.67	0.56	23	3.61	0.58	25	3.77	0.55
Risk Perceived for Others									
Inevitable Doom	77	4.16	0.58	24	4.01	0.64	25	4.05	0.65
Evitable Doom	80	4.11	0.63	29	4.21	0.48	24	4.07	0.65
Inevitable Gloom	72	4.04	0.50	22	3.83	0.57	24	4.01	0.45
Evitable Gloom	77	3.99	0.57	23	3.90	0.68	25	4.03	0.55
Risk Perceived for Self									
Inevitable Doom	77	3.20	0.86	24	3.12	0.97	25	3.43	0.84
Evitable Doom	80	3.12	0.89	29	3.29	0.78	24	3.11	0.91
Inevitable Gloom	72	3.08	0.84	22	2.82	0.89	24	3.21	0.83
Evitable Gloom	77	3	0.82	23	2.99	0.77	25	3.28	0.81

$p = .677$ for the treatment condition inevitable global warming, and ¡0.00, with an $F_{\text{approximate}}\,(2, 301) = 0.009$, and $p = .991$ for the interaction of the two main effects.

In the full sample all null hypotheses are maintained, there appears to be no adjustment of risk perception in response to climate change communication. Mean plots for each outcome variable can be found in Appendix C.

5.1.2 Other Influences on Risk Perception Than Treatment Conditions

An ordinary least square regression was carried out to determine influences on risk perception, other than the treatment condition. Figure 5.2 shows the linear model fit of each risk scale and climate science knowledge as measured by the OCSI. The dashed lines indicate the 95% CI around the linear-model slope. The negative slope of perceived risk for oneself is found to be significant in the OLS. Table 5.3 displays the regression results. Income played a significant role in decreasing the perceived risk of climate change for others. And being male significantly reduced the perceived risk across all measured dimensions.

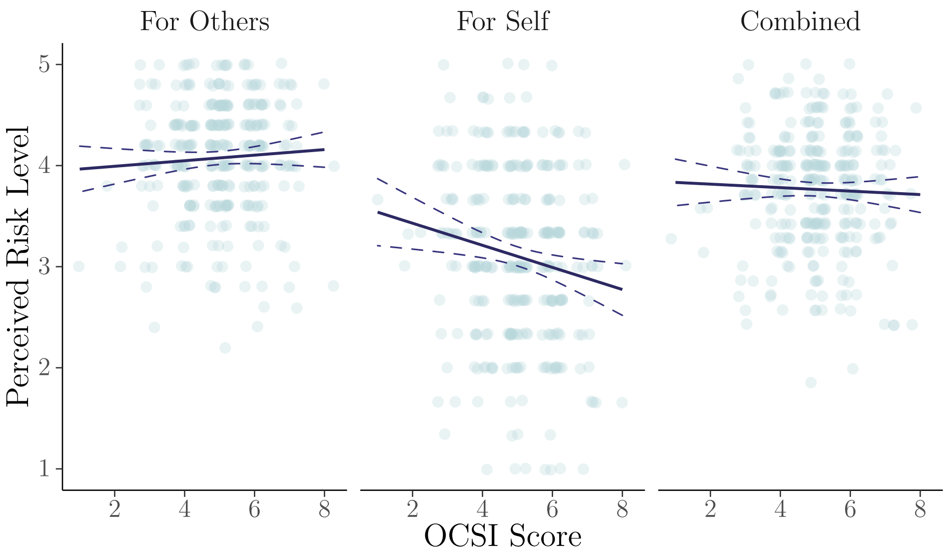

Figure 5.2: Perceived Risk of Climate Change and OCSI Score

Table 5.3: Analysis of Risk Perception Factors

	Full Sample			Before Earth Day			Low OCSI Score		
	Perception of Risk for:								
	Self	Other	Total	Self	Other	Total	Self	Other	Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treatment Condition:									
Doom	0.075	0.080	0.096	0.189	0.279	0.265	−0.227	0.019	−0.046
	(0.136)	(0.093)	(0.094)	(0.249)	(0.174)	(0.172)	(0.265)	(0.174)	(0.180)
Inevitable	0.056	0.029	0.030	−0.268	−0.107	−0.204	−0.078	−0.093	−0.050
	(0.139)	(0.095)	(0.096)	(0.266)	(0.186)	(0.183)	(0.257)	(0.168)	(0.175)
Inevitable × Doom	0.051	0.084	0.062	0.221	−0.031	0.076	0.513	0.144	0.241
	(0.196)	(0.134)	(0.135)	(0.368)	(0.258)	(0.254)	(0.379)	(0.248)	(0.257)
OCSI Score	−0.081*	0.016	−0.014	−0.055	−0.009	−0.014	−0.092	0.131	0.034
	(0.043)	(0.029)	(0.030)	(0.091)	(0.063)	(0.062)	(0.187)	(0.123)	(0.127)
Education	0.013	0.009	0.003	−0.004	0.044	0.014	−0.020	0.040	0.008
	(0.033)	(0.023)	(0.023)	(0.069)	(0.048)	(0.047)	(0.066)	(0.043)	(0.045)
Income	−0.008	−0.025**	−0.020	−0.004	−0.039*	−0.027	0.007	−0.031	−0.013
	(0.018)	(0.012)	(0.012)	(0.032)	(0.022)	(0.022)	(0.032)	(0.021)	(0.022)
Gender : Male	−0.226**	−0.124*	−0.172**	−0.269	−0.056	−0.157	−0.061	0.088	0.016
	(0.103)	(0.070)	(0.071)	(0.206)	(0.144)	(0.142)	(0.206)	(0.135)	(0.140)
Gender : Other	0.707	0.577	0.644				0.890	0.761	0.824
	(0.597)	(0.409)	(0.413)				(0.901)	(0.590)	(0.612)
Age	0.012***	0.005	0.008**	0.014**	0.004	0.009*	0.012	0.006	0.008
	(0.005)	(0.003)	(0.003)	(0.006)	(0.005)	(0.004)	(0.010)	(0.006)	(0.007)
Constant	3.132***	3.931***	3.692***	2.978***	3.925***	3.597***	3.324***	3.374***	3.467***
	(0.299)	(0.205)	(0.206)	(0.578)	(0.405)	(0.399)	(0.801)	(0.524)	(0.543)
Observations	294	294	294	90	90	90	91	91	91
R^2	0.081	0.057	0.075	0.139	0.121	0.167	0.067	0.079	0.051
Adjusted R^2	0.051	0.027	0.046	0.054	0.034	0.085	-0.037	-0.024	-0.054
Residual Std. Error	0.830 (df = 284)	0.569 (df = 284)	0.574 (df = 284)	0.843 (df = 81)	0.590 (df = 81)	0.581 (df = 81)	0.872 (df = 81)	0.571 (df = 81)	0.592 (df = 81)
F Statistic	2.765*** (df = 9; 284)	1.892* (df = 9; 284)	2.559*** (df = 9; 284)	1.631 (df = 8; 81)	1.388 (df = 8; 81)	2.035* (df = 8; 81)	0.642 (df = 9; 81)	0.768 (df = 9; 81)	0.488 (df = 9; 81)

Note: *p<0.1; **p<0.05; ***p<0.01

5.1.3 Influences on Lottery Decision

Figure 5.3 shows the amount of tickets donated to the CO_2 compensations charity. The measure appears to have worked as intended, with variance in the donation decision in each treatment group. The means of each group are presented in Table 5.4.

First, to investigate if the treatment conditions had an effect on the amount of donated tickets, an ANOVA of the donation reveals no significant difference in means between the main effects (catastrophic climate change outcomes [doom], inevitable global warming), or their interaction (Table 5.5).

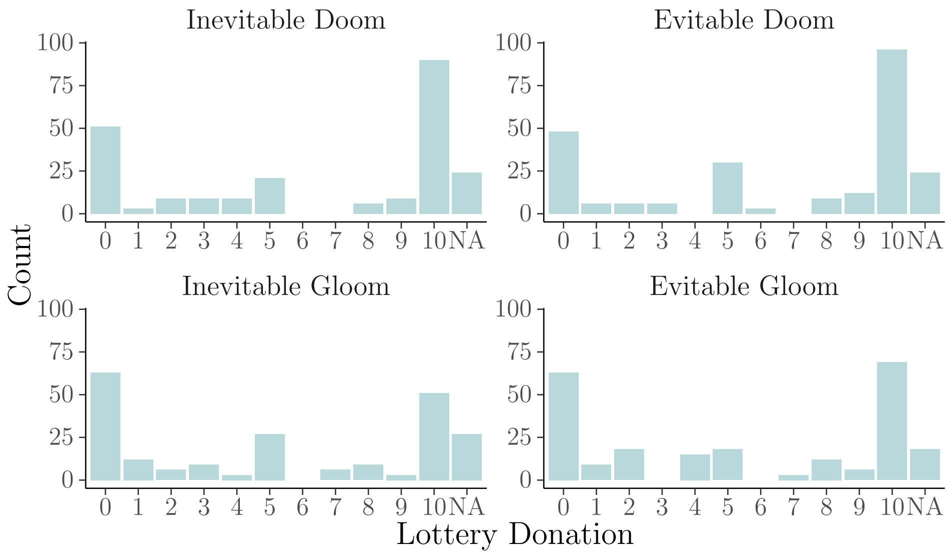

Figure 5.3: Distribution of Tickets Donated to Climate Change Charity by Treatment Group

Table 5.4: Comparison of Donated Lottery Tickets By Treatment Group And Sample

	Full Sample			Before Earth Day			Low OCSI Score		
Treatment Condition	N	Mean	SD	N	Mean	SD	N	Mean	SD
Inevitable Doom	77	5.88	4.28	24	7.25	3.81	25	5.63	4.10
Evitable Doom	80	6.22	4.18	29	8.50	2.60	24	6.43	4.34
Inevitable Gloom	72	4.49	4.17	22	6.46	4.24	24	4.35	4.42
Evitable Gloom	77	4.96	4.27	23	6.94	3.84	25	6.61	3.86

Entering the amount of donated tickets as the dependent variables in an OLS allows to investigate if risk perception and social trust had the predicted positive association. Table 5.6 shows that the effect of perceived risk is complex. While the magnitude of total perceived risk was 0.5, indicating a half -ticket increase in donations for every 1 point increase in perceived risk, it did not emerge as significant. However, when examining perceived risk in its two sub-dimensions, for oneself and for others, both are statistically significant. Additionally, they run in opposite directions. Higher risk perceived for others is associated with a donation increase of almost 2 tickets. However, higher risk perceived by the respondents for themselves led to a 0.94 ticket decrease. The moderation effect of social trust was not significant, nor is the coefficient of the expected clear positive magnitude. Instead, education, age and income level emerge as significant predictors for the amount of donated tickets.

For the full sample, the hypothesis that higher subjective risk perception increases the collaboration in mitigation actions received support. However, the support is contingent on the differentiation of perceived risk in two dimensions. The other hypothesis of collective action, namely that higher social trust moderates cooperative behavior receives no support.

Table 5.5: ANOVA of Donation Decision by Treatment Condition

	Sum Sq	df	F Statistic	p-value
Full Sample				
(Intercept)	1745.127	1	97.589	<.001
Doom	57.158	1	3.196	.075
Inevitable	7.239	1	0.405	.525
Doom × Inevitable	0.279	1	0.016	.901
Residuals	4846.136	271		
Before Earth Day				
(Intercept)	868.056	1	68.638	<.001
Doom	24.889	1	1.968	.165
Inevitable	1.76	1	0.139	.71
Doom × Inevitable	2.625	1	0.208	.65
Residuals	897.925	71		
Low OCSI Score				
(Intercept)	1004.522	1	57.606	<.001
Doom	0.356	1	0.02	.887
Inevitable	54.576	1	3.13	.081
Doom × Inevitable	11.029	1	0.632	.429
Residuals	1377.592	79		

Table 5.6: Analysis of Donation Decision

	Dependent variable:					
	Amount of Tickets Donated to Charity					
	Full Sample		Before Earth Day		Low OCSI Score	
	(1)	(2)	(3)	(4)	(5)	(6)
Total Perceived Risk	0.500		−0.123		0.092	
	(0.429)		(0.683)		(0.893)	
Perceived Risk for Self		−0.940**		−0.960		−2.025***
		(0.386)		(0.644)		(0.750)
Perceived Risk for Others		1.908***		1.346		3.083***
		(0.557)		(0.928)		(1.121)
Social Trust	0.064	0.096	0.339	0.329	0.697*	0.690*
	(0.165)	(0.162)	(0.275)	(0.271)	(0.378)	(0.356)
OCSI Score	−0.141	−0.260	−0.940**	−0.946**	−0.067	−0.471
	(0.212)	(0.212)	(0.390)	(0.385)	(0.932)	(0.894)
Education	0.323*	0.328**	0.648**	0.570*	0.094	0.011
	(0.164)	(0.162)	(0.323)	(0.322)	(0.341)	(0.324)
Income	0.199**	0.222**	−0.022	0.021	0.170	0.257
	(0.091)	(0.090)	(0.143)	(0.143)	(0.167)	(0.161)
Gender : Male	−0.214	−0.262	−0.134	−0.326	−0.942	−0.971
	(0.514)	(0.504)	(0.937)	(0.932)	(1.056)	(1.003)
Gender : Other	−2.358	−2.428			−5.564	−6.281
	(2.850)	(2.795)			(4.339)	(4.104)
Age	0.091***	0.097***	0.069**	0.075**	0.013	0.017
	(0.025)	(0.025)	(0.030)	(0.030)	(0.052)	(0.049)
Constant	−1.078	−3.940*	6.014*	2.929	1.706	−2.685
	(2.153)	(2.227)	(3.351)	(3.610)	(4.603)	(4.455)
Observations	264	264	69	69	78	78
R^2	0.172	0.205	0.270	0.299	0.135	0.236
Adjusted R^2	0.146	0.177	0.186	0.206	0.035	0.135
F Statistic	6.635*** (df = 8; 255)	7.268*** (df = 9; 254)	3.215*** (df = 7; 61)	3.199*** (df = 8; 60)	1.347 (df = 8; 69)	2.335** (df = 9; 68)
Note:						*p<0.1; **p<0.05; ***p<0.01

5.2 Analysis of Sub-Sample – Pre-Earth-Day

This sub-sample was collected before Earth Day (April 22, 2021). As such, it may represent the average exposure to climate change topics better than the previously analyzed full sample. The analysis is carried out in the same manner as above.

5.2.1 Perceived Risk of Climate Change by Treatment Condition

The means of each treatment group's perceived climate change risk are displayed in Table 5.2 and as boxplots in Figure 5.4. Risk for self was again significantly lower than the mean of perceived risk for others (paired $t(93) = 13.356$, $p < .001$). The ANOVA indicated that the treatment condition climate change doom differed significantly from the gloom condition (Table 5.1). The inevitable conditions remained insignificant, as did the interaction of doom and inevitable outcomes (Table 5.1).

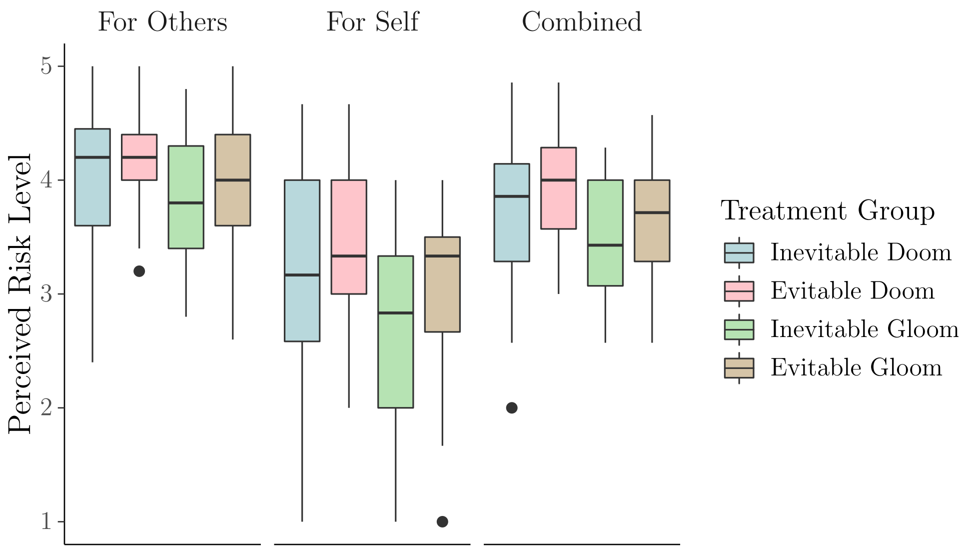

Figure 5.4: Boxplots Indicate a Difference in Risk Perception Between Treatment Groups in Pre Earth Day Sample Might Be Driven By Risk For Others

The means for each condition are plotted in Figure 5.5 and presented in Table 5.2. The difference between the doom condition and the other treatment conditions on the five point scale was 0.29 ($M_{\text{doom}} = 3.84$, $M_{\text{gloom}} = 3.55$). Inspection of the boxplots (Figure 5.4) and mean plots (subsection C.1.2) suggests the difference was driven by a heightened risk perception for others. As in the full sample, individuals in this sub-sample considered the risk for oneself to be almost one factor lower (mean of the difference 0.930) than that for others (paired-$t(97) = 13.356$).

The joined MANOVA of these dimensions did not point towards a significant difference in at least one risk-dimension between treatment conditions, varying the outcomes severity (Pillai's Trace = 0.047, $F_{\text{approx.}}(2, 93) = 2.306$, p-value = .105), or the efficacy condition (Pillai's Trace = 0.016, $F_{\text{approx.}}(2, 93) = 0.75$, p-value = .475), and consequently their interaction all remained above the 0.05-alpha (Pillai's Trace = 0.004, $F_{\text{approx.}}(2, 93) = 0.198$, p-value = .821). A follow up ANOVA, showed a significant difference for the doom condition (Table 5.7). The mean perceived

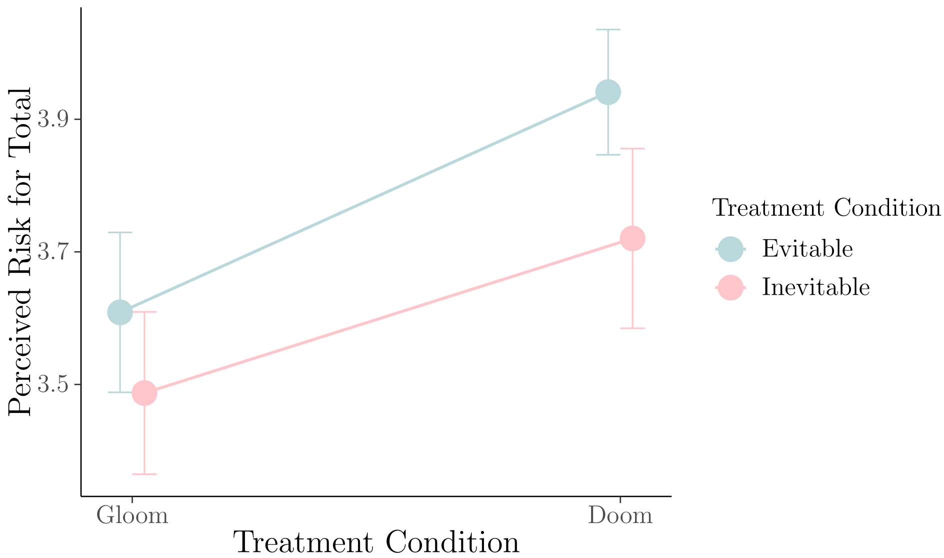

Figure 5.5: Distribution of Tickets Donated to Climate Change Charity by Treatment Group

risk for others was 0.250 higher on the 5-point scale for those respondents exposed to a message containing a description of catastrophic climate change outcomes. Respondents in this group also rated the risks for themselves as higher (difference in means = 0.310), however, this difference was not significant at the 5% level. No other significant differences were found.

Table 5.7: ANOVA of Perceived Risk by Treatment Condition and Risk Type – Earth Day Sample

	Sum Sq	df	F Statistic	p-value
Risk for Others				
Doom	1.461	1	4.176	.044
Inevitable	0.495	1	1.415	.237
Doom × Inevitable	0.089	1	0.256	.614
Residuals	32.89	94		
Risk for Self				
Doom	2.249	1	3.091	.082
Inevitable	0.661	1	0.908	.343
Doom × Inevitable	0	1	0	.989
Residuals	68.387	94		

Unequal group sizes adjusted using type 2 correction.

5.2.2 Other Influences on Risk Perception Than Treatment Conditions

Turning to other possible explanations of perceived risk, the regression results in Table 5.3 reveal once more that age had a small, but positive and significant effect on the perceived risk for oneself and the total perceived risk.

For this sub-sample the first set of hypotheses receives partial support. The individuals in this sample appear to have indeed adjusted their subjective risk perception of climate change outcomes based on the information presented to them in the treatment. As expected, the perceived risk increased with descriptions of catastrophic climate change outcomes compared to less drastic descriptions. The expectation that inevitable outcomes would lead to higher risk perceptions, however, received no support.

5.2.3 Influences on Lottery Decision

The ANOVA of donated tickets (Table 5.5) indicates no significant difference between treatment conditions. The same holds for the other main variables of interest to explain ticket the amount of tickets that were contributed to the climate charity, risk perception and social trust (Table 5.6). Total perceived risk changed in direction and magnitude, while these aspects stayed similar to the first sample for each of the two risk domains. Social trust increased in magnitude compared to the full sample. For this sub-sample of individuals, a higher knowledge of climate science as indicated by the OCSI was associated with a significant decrease in the amount of donated tickets. Age, and education once more contributed a significant small increase of donated tickets. A histogram of donated tickets is available in subsection C.1.2.

The hypotheses that treatment manipulations of perceived risk or efficacy would affect donation outcomes received no support. Neither did the hypothesis of social trust's positive effect on collaboration in climate mitigation.

5.3 Analysis of Sub-Sample – Low OSCI Score

After some significant finding in the sub-sample gathered before Earth Day, turning to the sub-sample with a below average OCSI score (less than five correct answers), could provide additional credibility of message content's impact on lay-people's reasoning about climate change.

Figure 5.6 displays once more the boxplots of perceived risk by treatment group and by risk type. Perceived risk for oneself was once again significantly lower (mean of differences = 0.78) than the risks of climate change perceived for others, paired-$t(94) = 11.458$, $p < .001$.

5.3.1 Perceived Risk of Climate Change by Treatment Condition

Beginning with the two-way ANOVA on total perceived risk, no significant difference in means was observed for any of the treatment conditions (Table 5.1).

The MANOVA did not indicate any significant differences between means of the risk perception sub-scales either (doom condition: Pillai's Trace = 0.001, $F_{\text{approx.}}(2, 93) = 0.052$, $p = .95$; inevitable condition: Pillai's Trace = 0.012, $F_{\text{approx.}}(2, 93) = 0.549$, $p = .579$; interaction doom × inevitable: Pillai's Trace = 0.021, $F_{\text{approx.}}(2, 93) = 0.986$, $p = .377$).

The first sets of hypotheses gain no support in this sample. Subjective risk perception did not significantly differ between treatment conditions, even for people with below average knowledge of climate science.

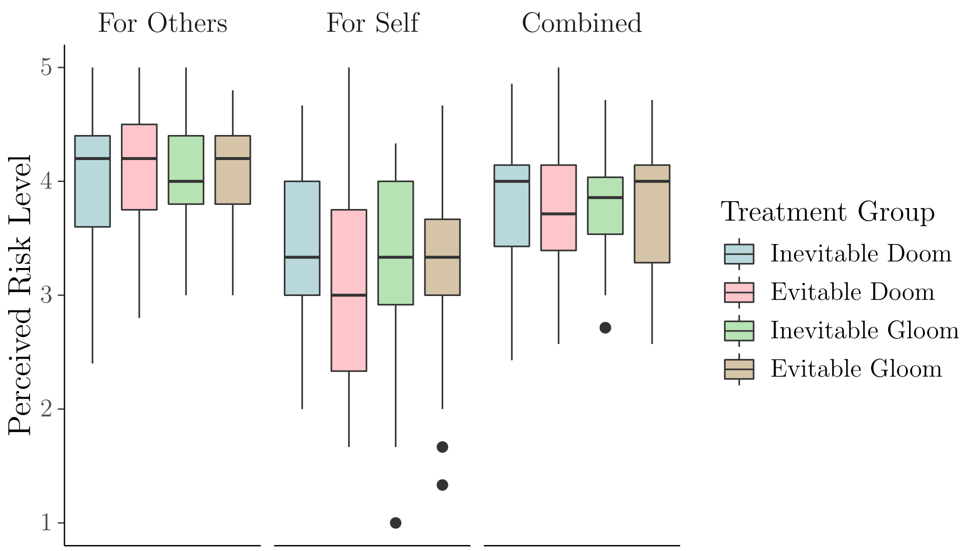

Figure 5.6: Boxplots Indicate No Systematic Difference Between Treatment Groups and Dimensions of Perceived Risk

5.3.2 Other Influences on Risk Perception Than Treatment Conditions

For below average climate science knowledge no recorded co-variate significantly predicts the perceived risk of climate change for either the full scale or the sub-scales self and other (Table 5.3).

5.3.3 Influences on Lottery Decision

The average amount of tickets donated varied between 4.35 (SD=4.42) in the treatment group Inevitable Gloom, and 6.61 (SD=3.86) in the treatment group Evitable Gloom. The same trend could be identified for the treatment condition doom, where respondents exposed to an inevitable outcome donated less tickets than those who were told cooperation between people could limit climate change from exceeding 1.5° Celsius ($M_{\text{inevitable}} = 5.63$, $SD_{inevitable} = 4.1$; $M_{\text{evitable}} = 6.43$, $SD_{\text{evitable}} = 4.34$). These differences, however, were not found to be significant (Table 5.5).

The OLS results (Table 5.6), show that while the total perceived risk remained insignificant and in magnitude close to zero, splitting risk into the dimensions self and others mirrors the findings of the full sample. Higher personal risk was associated with a significant and meaningful decrease in donated tickets. Higher risk perceived for others, on the other hand, seems to be associated with a 3 ticket increase to donating to charity. For the first time, social trust was significant in predicting a small increase of donated tickets in both model specifications.

This is the only sub-sample out of the three analyses in which the null-hypothesis that social trust does not increase the collaboration in pro-climate action could be rejected. The hypothesis that higher risk perception leads to more climate action is not supported. Neither is the hypothesis that an efficacy supporting message leads to higher mitigation, i.e., more donated tickets. However, the finding of contradicting effects for perceived risk for the self and for others merits thorough discussion.

5.4 Discussion

Consistent with other research (e.g., O'Neill & Nicholson-Cole, 2009; Whitmarsh, 2011) and the well recorded optimism bias (Weinstein, 1989), respondents in this study perceived the risk that others will be exposed to averse consequences of climate change as significantly higher than their own risk. This aspect of perceived risk was the only one robust across each considered sub-sample. The difference in means was close to one full scale point in each sub-sample. It is important to note that this study sampled pre-dominantly from developed countries, therefore such judgment may not be incorrect. Respondents may credibly assume that regions in which they live will, for example, not experience starvation or shortages of food. However, in this context it is also worth mentioning that there will not be a single above 1.5°C world and regional outcomes are difficult to predict, especially beyond eco-system tipping points (IPCC, 2018). In this regard it is also worth mentioning the somewhat surprising effect of climate science knowledge on the slopes of perceived risk for self and for others. In each considered sample specification, the slopes are opposing: higher OCSI scores lead to an increase in perceived risk for others and a decrease in risk perceived for self (Figure 5.2, Figure C.10, Figure C.19, the coefficients, however, remained mostly insignificant in the OLS reported in Table 5.3). Puzzling is that the OCSI score did not meaningfully correlate with socio-demographic data which would explain a lower exposure to averse climate change outcomes, such as the indicated age ($r_{\mathrm{p}} = -.054$), education ($r_s = -.072$), or income level ($r_s = -.083$; all values for full sample). One possible explanation could be a u-shaped relationship between climate science knowledge and perceived risk for oneself, where it decreases at first, but then increases again as people become so knowledgeable about climate change to consider tipping points etc. However, the present data does not suggest such a non-linear relationship. Perhaps the surveyed individuals with high climate science knowledge use their knowledge to support their personal optimism more than others, comparable to the motivated reasoning reported in Kahan (2015). As intriguing as this finding is, differences in perceived risk for self and for others were not the risk-perception adjustment of interest in this study.

5.4.1 Discussion of Risk Perception Adjustment Hypotheses

Surprisingly, given the broad support from previous literature, the use of different messages about climate change did not affect the risk respondents perceived. The identified effect in the sub-sample collected before earth day may suggest that the failure to support these hypothesis in the full sample could have been due to an unintended over-representation of lay-people with high knowledge about climate change. But considering that these effects failed to replicate in the low OCSI-score condition and the repeated hypotheses-testing, the higher perceived risk for others in the doom condition of the pre-earth-day sample may well be a statistical artifact.

Nevertheless, the fact that risk-perception-increasing effect of describing of climate change outcomes as catastrophic was only narrowly rejected in the full sample, works in favor of the fear appeals literature. It seems more probable that there a methodological explanations for the null result, than that there is no effect.

Methodological Reasons for the Null Result

It is possible that the effect of message content on perceived risk was not sufficiently large to lead to a significant result, despite the relatively large sample size. The most likely explanations for this being the case are: a sample not representing the general public in regards to knowledge, and therefore susceptibility to communication content; or a message which failed to register as expected with the recipients.

The first factor, a sampling error, cannot be discarded despite the steps taken to control for such a possibility. The sample was better informed about climate change than the comparison sample of Kahan (2015) and the heightened media exposure on earth day may additionally have led to heightened awareness of climate change topics. The change around earth day could indicate that a general exposure to climate reporting led to higher than normal salinity of the issue, without necessarily increasing respondents objective knowledge about climate change. Conversely, it could be that the salinity of the treatment was not sufficient to cause changes in participant's risk judgments. This could be due to ineffective wording, or insufficient attention to the stimulus. This goes especially for the efficacy manipulation, as it was – albeit deliberately – vague in its formulation. These two aspects are by no means exclusionary, but may in fact have co-occurred or reinforced each-other. Heightened climate change awareness of the sample would be expected to decrease the attention paid to additional information, consistent with the theories of a knowledge-deficit and motivated reasoning.

Other than treatment conditions, it is surprising that the predictive power of potential influences on perceived risk is low, as indicated by the poor model fits of the regressions displayed in Table 5.3. While literature suggests that many of the investigated covariates should explain individual risk perception, it should also be noted that other important factors remained outside this study's scope; first and foremost, political affiliation, but also general attitudes towards the environment (Siegrist & Árvai, 2020).

5.4.2 Discussion of Hypotheses About Individual Behavior

Given the null-result of risk-perception adjustment, it is not possible to assess the causal effect that a change in risk perception might have on pro-climate behavior. This is compounded by the fact that ANOVA of the experimental manipulation remained insignificant for all studied effects.

Null-Results of Treatment Manipulation

The null-result is especially surprising for the efficacy manipulation, given its solid establishment in theories across the social sciences. The most likely explanations are, as above, methodological. As for the adjusting of perceived risk following exposure to climate change communication, the trends in mean scores fits theoretical predictions. It is therefore likely that the failure to reject the null hypotheses of a causal effect lay in an effect size too small to detect with the methods of this study.

Nevertheless, this study can contribute some insights regarding the association of perceived risk with a respondent's willingness to forgo potential personal gains.

Association of Donation Decision With Risk Perception

The decision to donate was significantly correlated with various factors, most of which, such as income or age, are unsurprising. Interesting on the other hand is the aforementioned association of risk perception and donated lottery tickets. The contradicting effect of perceived risk for self and perceived risk for others is especially surprising. This association is by far the biggest in magnitude and was stable across the full sample and the sub-sample of low climate knowledge.

A tentative explanation could be that higher risk for others stimulates cooperation. It could, for example, be a social norm to help, or a perceived unfairness since the sample rated their personal risk to be less than that of others. Both would be in line with explanations of cooperative behavior in social dilemmas (Ostrom, 2009). At the same time, this would explain why the donated ticket-amount decreases as the risk perceived for oneself increases. This is somewhat paradox because it is expected that the donation to climate mitigation increases with the self-related risk perception, as it would then be in one's own interest to halt global warming.

One likely explanation to resolve this unexpected behavior is the instrument used to elicit behavior. Donating tickets to a lottery is an admittedly abstract approximation of climate-related decision trade-offs. Beliefs about the efficacy of carbon offsetting projects, and the competence of the chosen charity are serious hurdles to the donation decision.

Association of Donation Decision With Social Trust

While trust could also be key in overcoming these hurdles – for example, if general trust were to support a positive perception of the charity to which tickets were donated – its role in this experiment is unclear.

In light of the reviewed literature it is surprising that trust was only significantly associated with the amount of donated tickets in the sub-sample of low climate science knowledge. Reasonable explanations include that the with rising knowledge of climate change the decision to donate to the depends less on the suspected behavior of others and more on personal judgments regarding the donation. This could imply that social cues regarding pro-climate behavior, such as the trustworthiness expectations, matter more for those who know little about climate change.

Chapter 6

Conclusion

This thesis contributes ambiguous evidence to the debate about fear appeals in climate change communication. While the findings of the two-factorial between-subjects experiment do not point towards members of the general public adjusting their risk perception in response to climate change communication, the importance of this perceived risk for pro-climate behavior is evident. The importance of trust on cooperation in collective climate action is even less clear. Based on the findings of this thesis, it is neither possible to reject the notion that trust matters to motivate climate action, nor that it is central to promoting widespread pro-climate behavior.

These findings need to be considered especially in light of their limitations.

6.1 Limitations

Because methodological and data limitations have already been mentioned throughout the thesis, they shall only be summarized here and be put into context of this study's validity.

6.1.1 Internal Validity

The internal validity of this study is threatened from three main sources. First, the collected data, second the used methods and lastly the repetitive analysis.

The targeted population of this study were people with lay-knowledge of climate change. Despite the diverse efforts to ensure that the sample fits the population, its representativty needs to be questioned. The absence of effects from climate message variation could in part stem from a sample less responsive to message persuasion than the general public.

Great care should also be taken in interpreting the measure of behavior. While donating to climate mitigation efforts is a concrete pro-environmental behavior, it is admittedly flawed in isolating the revealed preference for climate mitigation from confounding factors such as altruism, survey-participation motivation, or lacking item comprehension.

The explanatory power of the methods used to analyze the experiment was relatively low, indicating that other variables than those considered influence perceived risk and the decision to donate. Omitting such variables – for example, political ideology, or attitudinal dispositions to the environment (Linde, 2020) – is a shortcoming of this study.

6.1.2 External Validity

This study is also limited in the extent to which its findings can be generalized to other contexts.

First and foremost is once more the used sample. For convenience sample such as this, it is extremely difficult to draw conclusions for people other than those who responded to the survey. While steps were taken to reach a diverse sample, the selection into the survey by respondents cannot be ignored. This study is also lacking responses outside a narrow group of high-income countries, with relatively homogeneous cultures in terms of their position on a spectrum of collective to individualistic value orientation (Elshirbiny & Abrahamse, 2020).

Moreover, relying on climate change communication as an isolated, singular message is a methodological restriction which does not generalize to more realistic situations. In reality, all communication competes for recipients extremely scarce attention and messages on issues such as climate change are often embedded in webs of opposing narratives (Hastings, Stead, & Webb, 2004). It has therefore been questioned if messaging effects prevail in the medium and long term outside controlled experimental environments (Bayes, Bolsen, & Druckman, 2020).

6.2 Research Objectives and Aims

This research, however, did not intend to investigate changes in risk perception and behavior over time. Instead, the first research question inquired if presenting climate change as an unstoppable doom-scenario leads to heightened risk perception in the general public. While the data does not support this conclusion, it is more likely that the effect was simply not pronounced enough in this sample, than it not existing.

On the other hand, this study does present evidence that individual risk perception is an important determinant of pro-climate behavior. A surprising insight is the opposing impact of perceived risk for oneself and to others on taking climate change mitigating action. Nevertheless, these findings indicate that people are willing to prevent others from being harmed, which could present an important turn on the use of fear appeals in communicating climate change. Fear appeals may be useful, if risk to others is heightened and if they are complimented with concrete actionable mitigation options.

The role of possible and effective solutions is the focus of the third research question. This study does not suggest that it is necessary for climate action that members of the general public are especially trusting of others. For some segments of the population, namely those with low understanding of climate science, trusting others might facilitate pro-climate behavior. But, overall the effect is dwarfed by the perception of climate change as a risk in need of halting.

6.3 Future Research

More research is certainly needed to understand the precise role of risk perception on pro-climate behavior. Foremost, practical and scientific advances may result from research into how risk perception diffuses through society. How, apart from personal experience, can a sufficient amount of people lastingly learn about the accurate risks of climate change. Research of climate change risk perception is certainly not a closed book, as the even small modifications to messages may impact recipients' reasoning. Especially interesting is the interaction between general public awareness and opinion on climate change and the effect of targeted message campaigns. Perhaps the differences in the data collected before and after earth day indicate such an effect. If repeated exposure to drastic climate change scenarios leads to a persuasive boomerang of ignoring the problem, research could help identify strategies to avoid or circumvent such fatigue.

Considering the emergence of sustained wide spread pro-climate activism, research should also investigate how such movements diffuse through societies. Perhaps a critical mass of well-informed individuals can lead to others cooperating out of trust, as indicated by the last low OCSI-score sub-sample. Investigating the interrelation of trust and risk perception is therefore another promising research avenue, not only in the realm of climate hazards.

Lastly, as with many other social science phenomena, research on climate change communication, risk perception and social trust, would benefit from concerted efforts to include countries and cultures outside the highly developed, western hegemony. This is especially important on such global threats as climate change.

6.4 Practical Implications: Communicate Climate Change Effectively

This thesis concludes by drawing some practical implication from the theory and the findings of its empirical contribution. While consensus among experts is clear regarding climate change, its causes and potential consequences, the general public continues to depend on serious and effective communication of these scientific insights to improve their knowledge and support better decision making.

Regardless of the message sender – be it scientists themselves, media or other institutions, business, activists or peers – there are some key points which can improve communication. While scaring people into action may seem like an effective, and perhaps even appropriate, strategy, communicating dooms day scenarios does not always result in sufficiently increased risk perception, as this thesis demonstrates. This is especially important considering the fact that heightened self-related risk may actually prohibit a person from taking action to limit global warming. On the other hand, this study also suggests that people care about the risk-exposure of others when deciding to engage in climate change mitigation.

And while the manipulation of efficacy did not play a role in increasing people's risk assessment or motivate them to take action, presenting people with easy options to mitigate climate change can lead to such action. Therefore, a cost effective way to increase pro-climate behavior is to add concrete and easily acted-upon mitigation options to climate messaging.

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Appendix A

(Appendix Methods)

A.1 Questionnaire

A.1.1 Lottery Donation

As appreciation for participating in this survey, you have the possibility to take part in a lottery to win €100.

The lottery works as follows:

Every participant receives ten tickets with an individualized code. After the study concludes, one winning ticket will be randomly drawn. The winning code will then be communicated via email, along instructions on how to claim the prize. If you wish to participate in the lottery, you will be asked to leave your email address at the end of the survey. Please note that your email will be stored separately; your answers to the questionnaire remain anonymous.

You can also choose to donate any amount of your ten lottery tickets to atmosfair. atmosfair is a German non-profit organization that actively contributes to CO_2 mitigation by promoting, developing and financing renewable energies in over 15 countries worldwide.

For example, if you choose to donate 5 of your tickets, you reduce your chances of winning the lottery by half, while increasing the chances that the prize will be donated to atmosfair. If you donate 0 tickets, you keep all of your chances; if you donate 10 tickets, the charity receives all of your chances.

I want to donate this many of my lottery tickets to the charity. *(0, ..., 10 — I do not want to participate in the lottery at all.)*

A.1.2 Ordinary Climate-Science Intelligence Assessment (OCSI)

Table A.1: Ordinary Climate-Science Intelligence Assessment (OCSI)

Item Wording	% correct in Kahan (2015)	% correct in sample (before / after April 22[1])
Climate scientist believe that that if the North Pole Ice Cap melted as a result of human-caused global warming, global sea levels would rise. [True or **False**] [2]	14	
Climate scientists have concluded that globally averaged surface air temperatures were higher for the first decade of the twenty-first century (2000-2009) than for the last decade of the twentieth century (1990-1999). [True or **False**]	69	90 (90 / 89)
Climate scientists believe that human-caused global warming will result in flooding of many coastal regions. [**True** or False]	81	96 (92 / 98)
Climate scientists believe that human-caused global warming has increased the number and severity of hurricanes around the world in recent decades. [True or **False**] [3]	21	11 (11 / 10)
Climate scientists believe that nuclear power generation contributes to global warming. [True or **False**]	52	73 (69 / 75)
Climate scientists believe that human-caused global warming will increase the risk of skin cancer in human beings. [True or **False**]	31	35 (30 / 37)
Climate scientists and economists predict there will be positive as well as negative effects from human-caused global warming. [**True** or False]	51	43 (41 / 45)
Climate scientists believe that the increase of atmospheric carbon dioxide associated with the burning of fossil fuels will reduce photosynthesis by plants. [True or **False**]	32	55 (49 / 58)
What gas do most scientists believe causes temperatures in the atmosphere to rise? Is it [**carbon dioxide**, hydrogen, helium, radon]	75	94 (91 / 96)

Note: [1] April 22 was Earth Day which heightened media attention of climate change and the environment.
[1] This item was removed from the original measure, as the formulation used is misleading and should not be used in a revised version of the measure (Kahan, 2014).
[2] Like [1], this item received criticism following the publishing of the original paper. Although recent evidence suggests that storms are indeed worsening due to climate change (Knutson et al., 2021), this item was kept with its original answer on the basis that there is of yet insufficient consensus regarding the scientific development (NOAA Geophysical Fluid Dynamics Laboratory, 2021).

Appendix B

(Appendix Data)

B.1 Respondents' Countries of Residence

Table B.1: Respondents' Countries of Residence

Country	N
Austria	2
Canada	1
Colombia	1
Egypt	1
France	1
Germany	112
Greece	1
Hungary	1
India	7
Ireland	1
Italia	1
South Korea	1
Mexico	1
Netherlands	2
Nigeria	1
Russia	1
Spain	1
Sweden	138
Switzerland	2
Ukraine	1
United Arab Emirates	2
United Kingdom	1
United States	18
Venezuela	1
No answer	0

B.2 Additional Descriptive Statistics

Table B.2: Age and OCSI Score by Treatment Group – Full and Sub-Samples

	Inevitable Doom		Evitable Doom		Inevtiable Gloom		Evitable Gloom	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Full Sample								
Age	29.77	12.37	31.39	13.96	29.71	13.15	28.49	11.32
OSCI	4.95	1.12	5.05	1.31	5.01	1.08	5.01	1.27
N	77		80		72		76	
Before Earth Day								
Age	32.54	15.88	40.45	17.02	36.27	16.58	33.5	14.87
OSCI	4.75	1.26	4.9	1.14	4.86	1.04	4.83	1.61
N	24		29		22		23	
Low OSCI Score								
Age	29.84	11.16	30.92	11.33	32.75	14.2	32.29	14.45
OCSI	3.64	0.57	3.42	0.65	3.79	0.41	3.56	0.71
N	25		24		24		25	

Table B.3: Frequency of Gender, Income and Educational Level in Full and Sub-Samples

	Full Sample	Before Earth Day	Low OCSI Score
Gender			
Female	167	50	61
Male	133	46	34
Other	2	0	1
Education			
Still in school	32	6	6
Finished school with no qualifications	6	2	3
Vocational secondary certification (completion of specialized secondary school/college)	11	4	5
A-levels/International Baccalaureate, High-School subject-related higher education entrance qualification	56	8	13
Bachelor degree	123	41	45
Master degree	63	28	19
PhD or comparable	9	5	2
Other school-leaving qualification	4	2	4
Monthly Net Income in €			
I do not have a personal income	44	12	14
less than 250	11	2	4
250 up to 500	26	7	8
500 up to 1000	52	6	14
1000 up to 1500	41	7	9
1500 up to 2000	22	6	7
2000 up to 2500	25	9	7
2500 up to 3000	17	8	5
3000 up to 3500	14	9	7
3500 up to 4000	7	4	2
4000 or more	18	11	6
I do not wish to answer	21	11	9

Appendix C

(Appendix Analysis)

C.1 Additional Graphs

C.1.1 Additional Plots for Full Analysis

Mean Plots

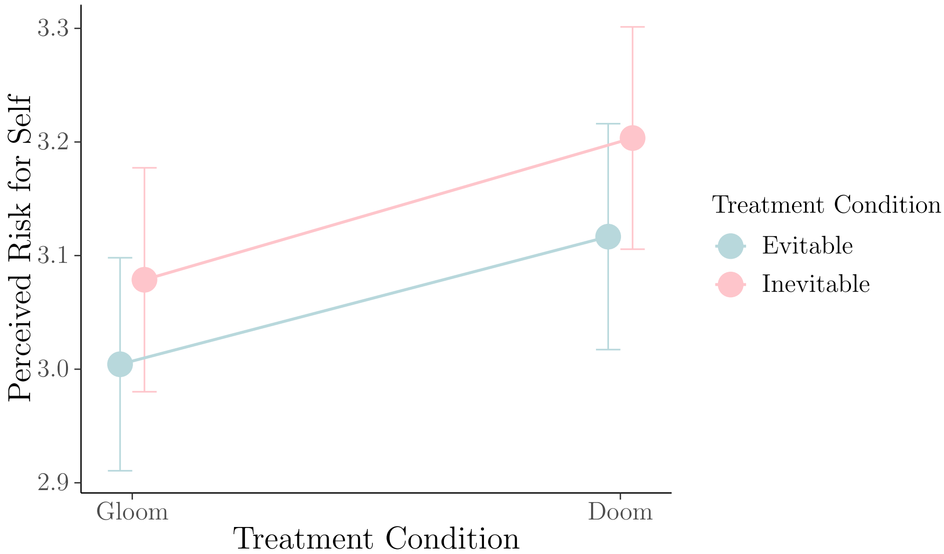

Figure C.1: Plot of Treatment Condition Means for Perceived Risk for Self – Full Sample

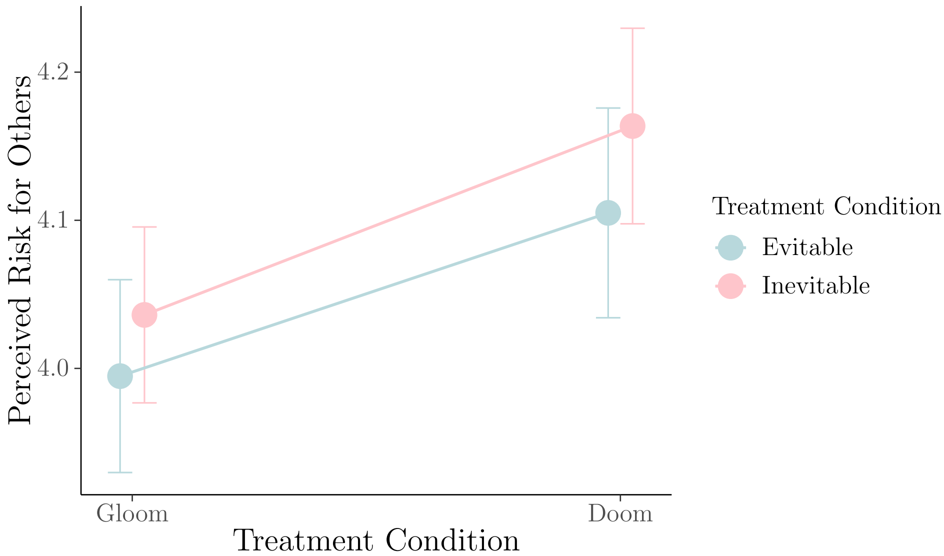

Figure C.2: Plot of Treatment Condition Means for Perceived Risk for Others – Full Sample

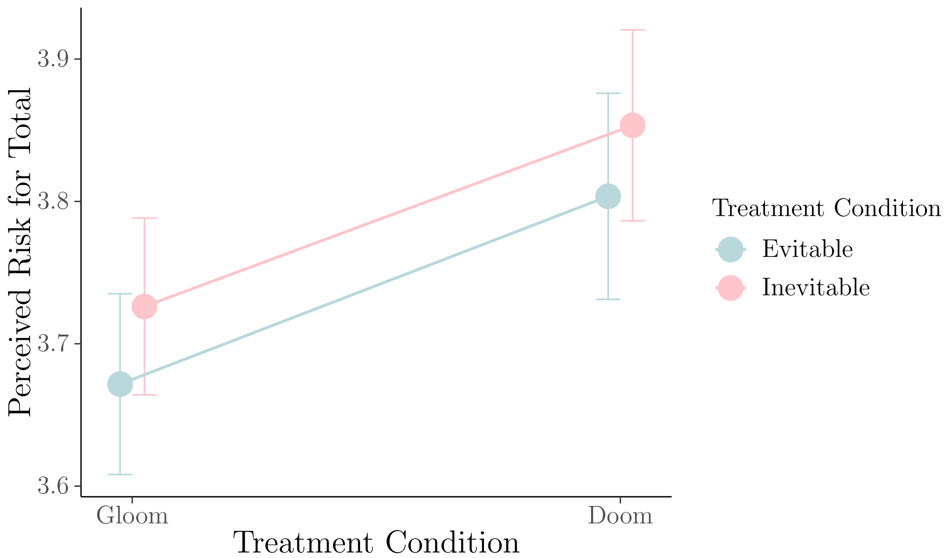

Figure C.3: Plot of Treatment Condition Means for Total Perceived Risk – Full Sample

ANOVA Residual Plots

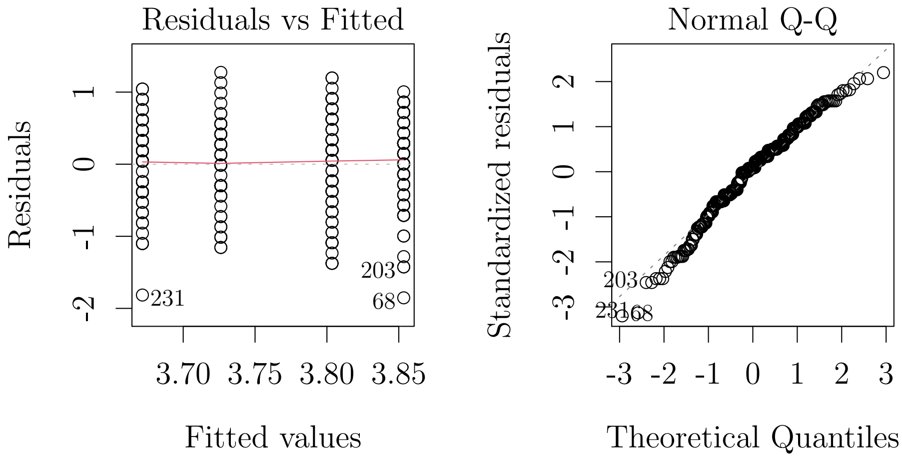

Figure C.4: Residual Plots: Total Risk – Full Sample

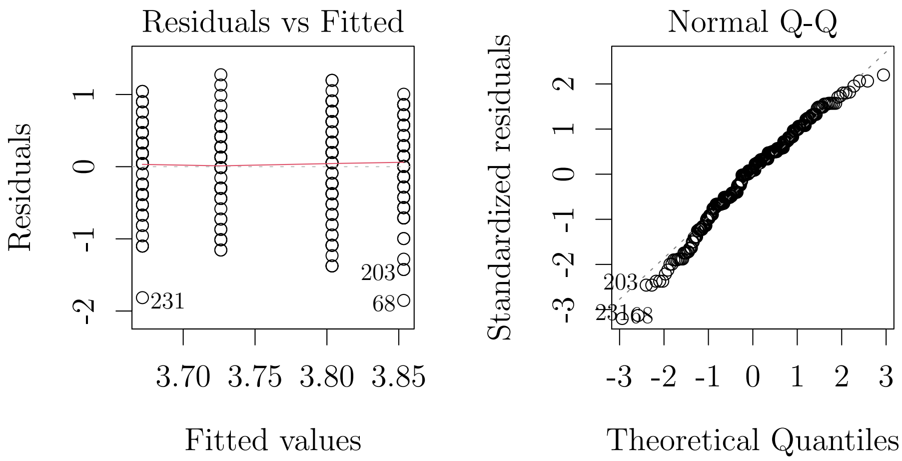

Figure C.5: Residual Plots: Lottery Donation – Full Sample

C.1.2 Additional Plots for Earth Day Sample

Mean Plots

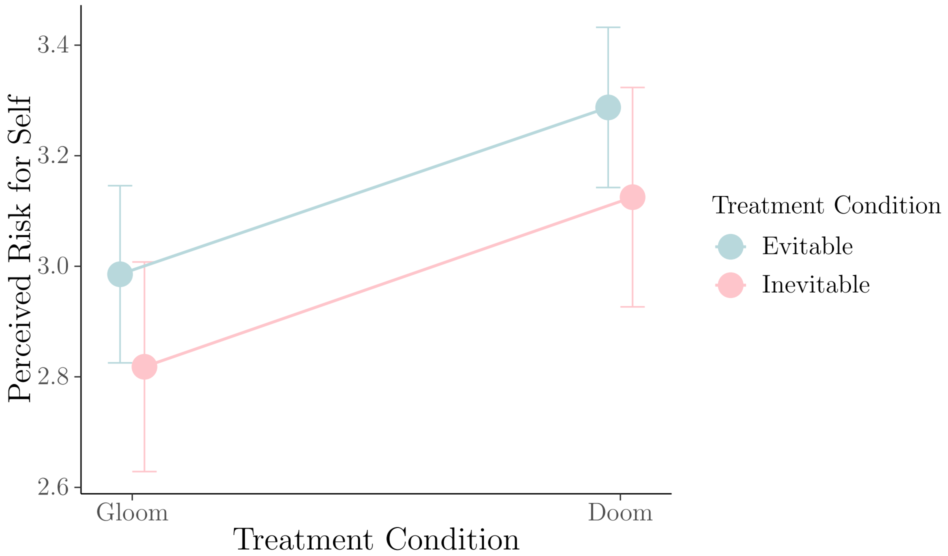

Figure C.6: Plot of Treatment Condition Means for Perceived Risk for Self – Pre Earth Day Sample

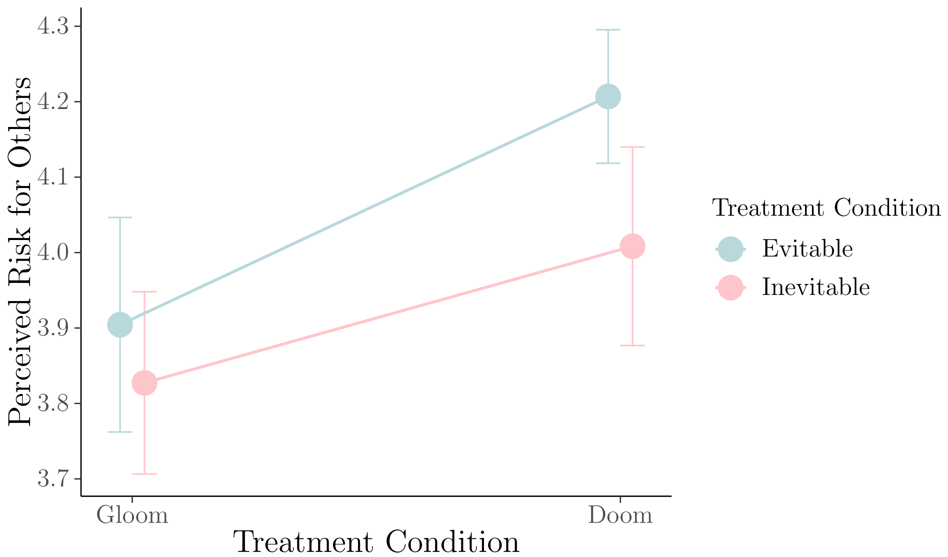

Figure C.7: Plot of Treatment Condition Means for Perceived Risk for Others – Pre Earth Day Sample

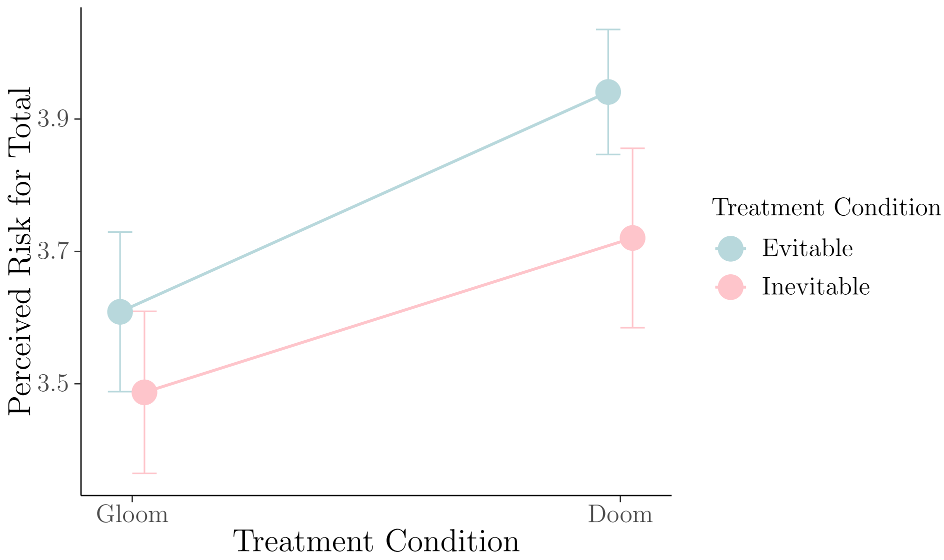

Figure C.8: Plot of Treatment Condition Means for Total Perceived Risk – Pre Earth Day Sample

Histogram of Donated Tickets

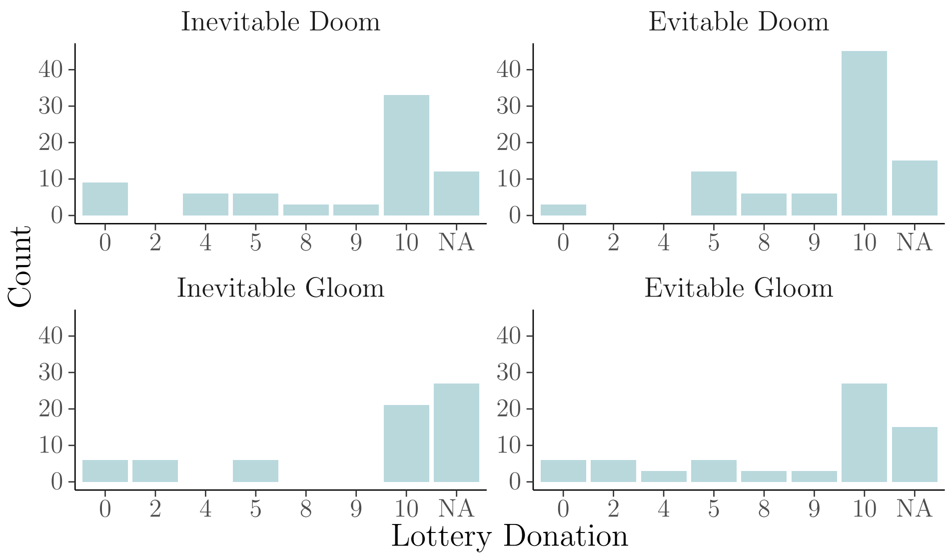

Figure C.9: Histogram of Lottery Tickets Donated to Climate Charity – Pre Earth Day Sample

Interaction Plot of OCSI and Perceived Risk

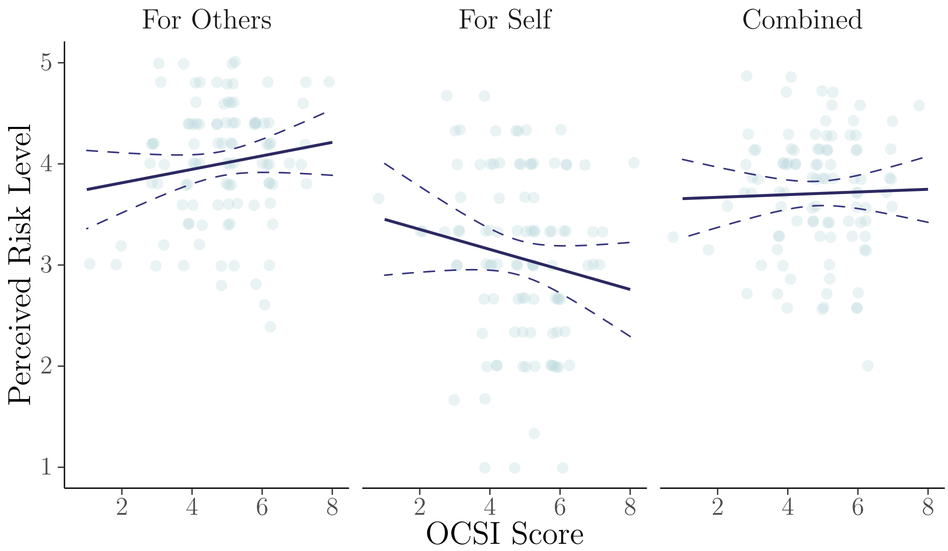

Figure C.10: Perceived Risk for Self, Others and Total by OCSI Score – Pre Earth Day Sample

ANOVA Residual Plots

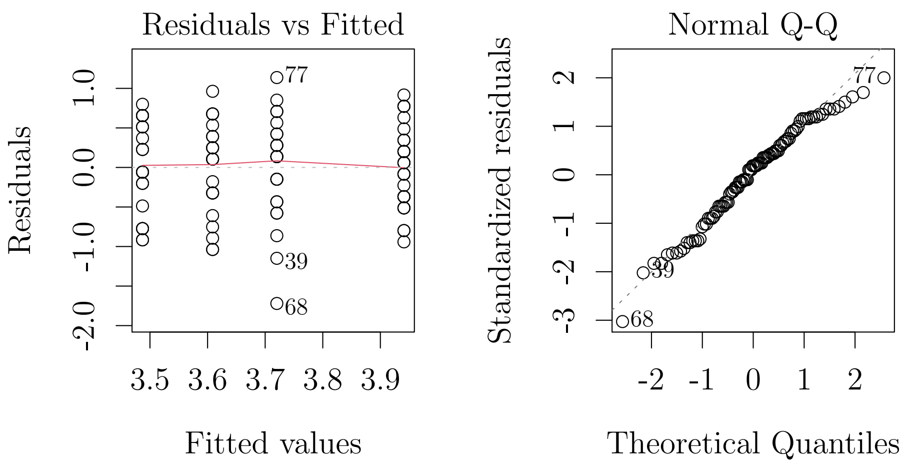

Figure C.11: Residual Plots: Total Risk – Pre Earth Day Sample

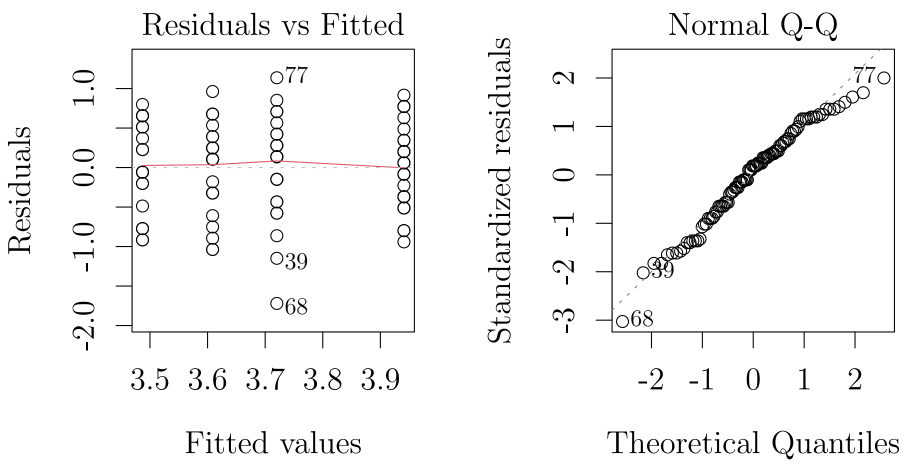

Figure C.12: Residual Plots: Lottery Donation – Pre-Earth Day Sample

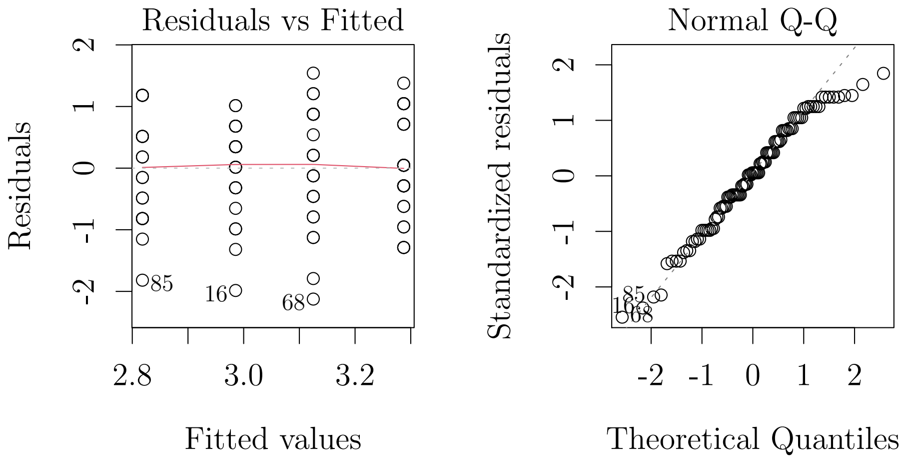

Figure C.13: Residual Plots: Risk for Self – Pre Earth Day Sample

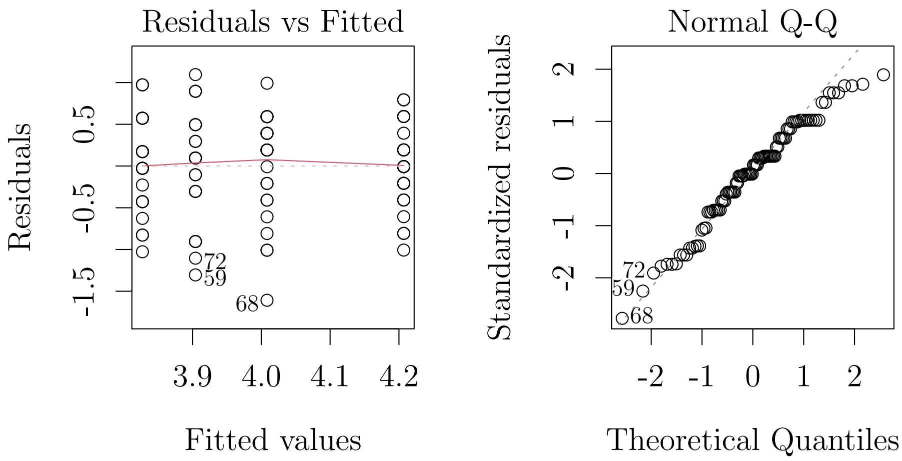

Figure C.14: Residual Plots: Risk for Other – Pre Earth Day Sample

C.1.3 Additional Plots for Low OCSI Score Sample

Mean Plots

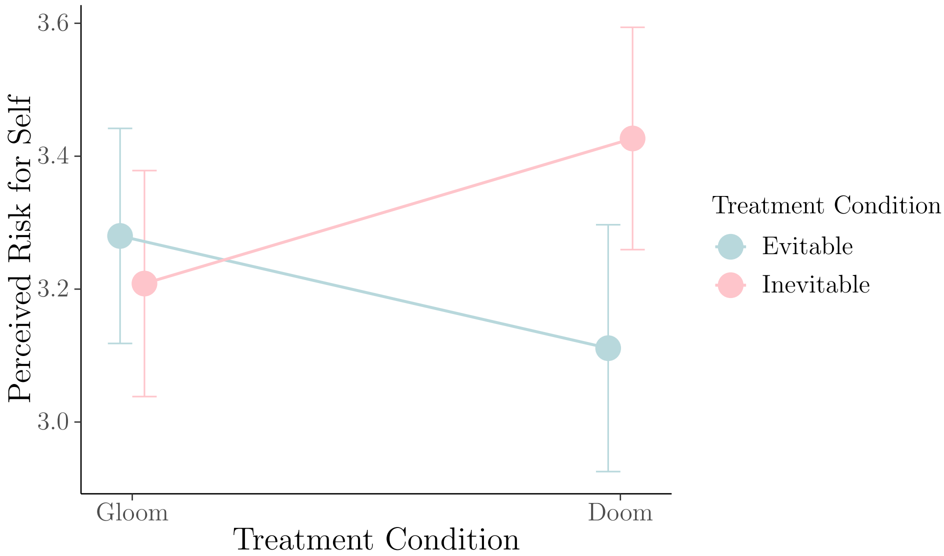

Figure C.15: Plot of Treatment Condition Means for Perceived Risk for Self – Low OCSI Score Sample

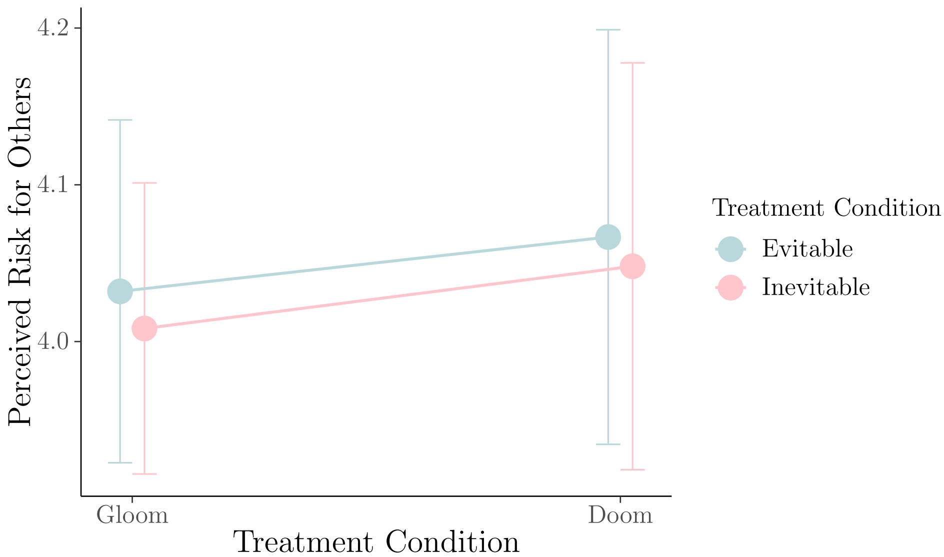

Figure C.16: Plot of Treatment Condition Means for Perceived Risk for Others – Low OCSI Score Sample

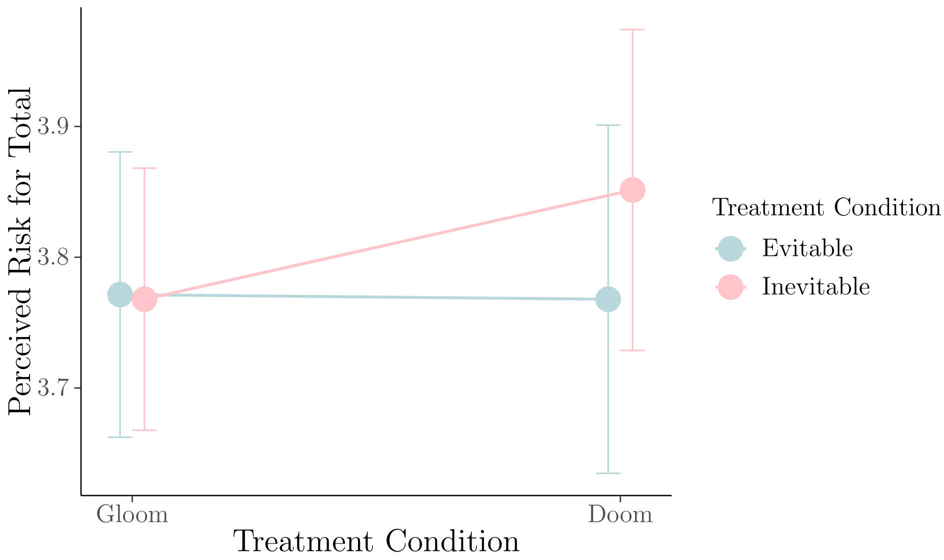

Figure C.17: Plot of Treatment Condition Means for Total Perceived Risk – Low OCSI Score Sample

Histogram of Donated Tickets

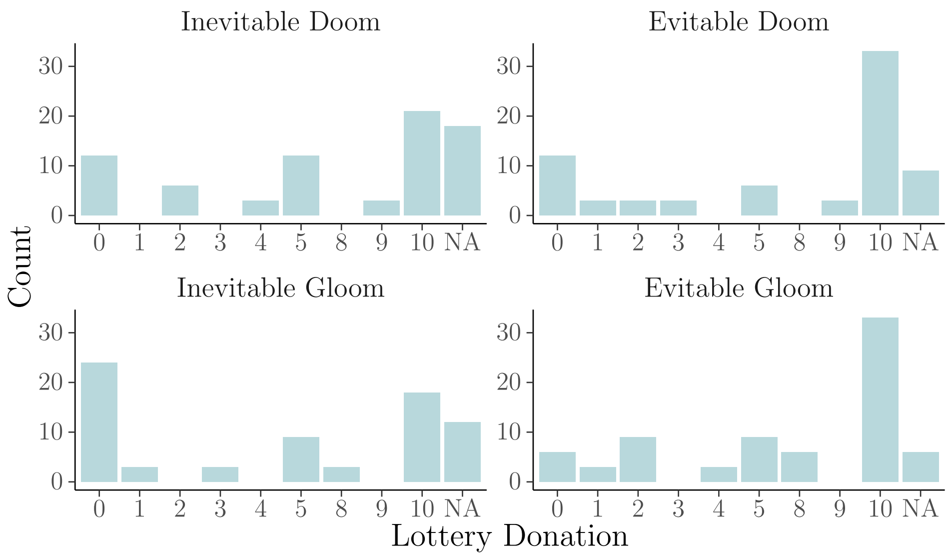

Figure C.18: Histogram of Lottery Tickets Donated to Climate Charity– Low OCSI Score Sample

Interaction Plot of OCSI and Perceived Risk

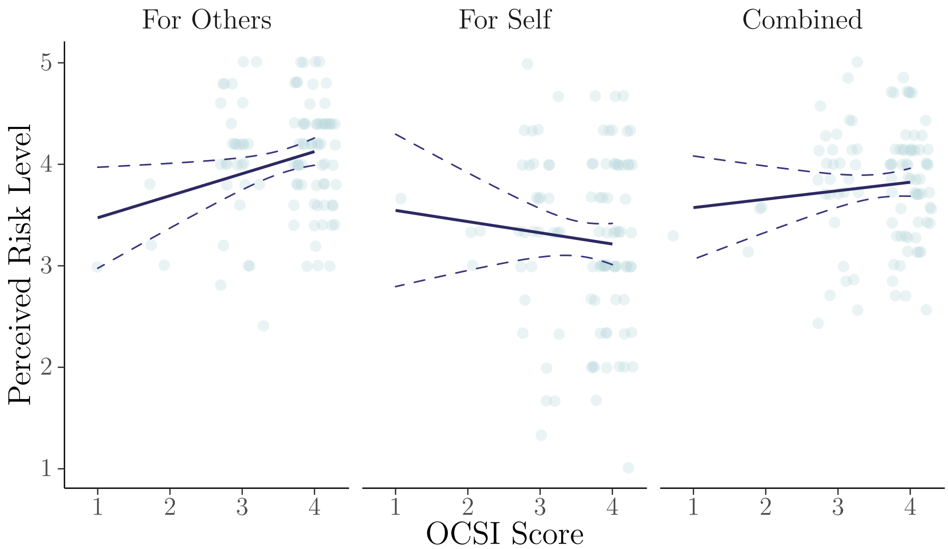

Figure C.19: Perceived Risk for Self, Others and Total by OCSI Score – Low OCSI Score Sample

ANOVA Residual Plots

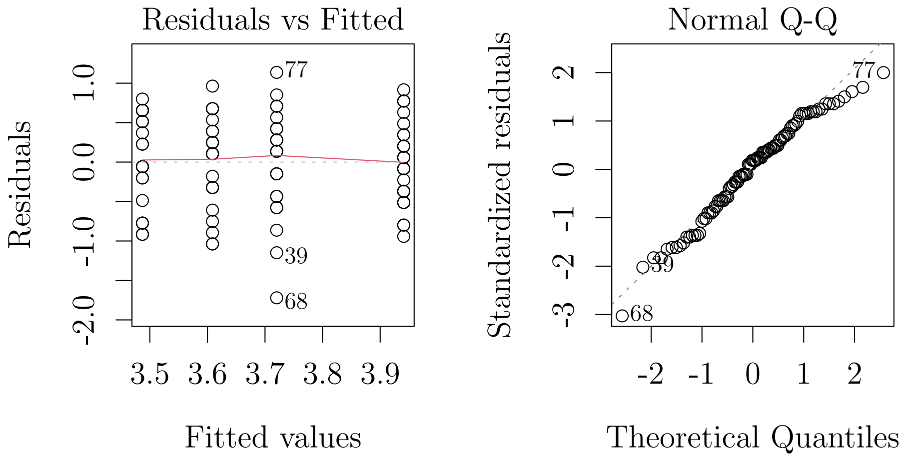

Figure C.20: Residual Plots: Total Risk – Low OCSI Score Sample

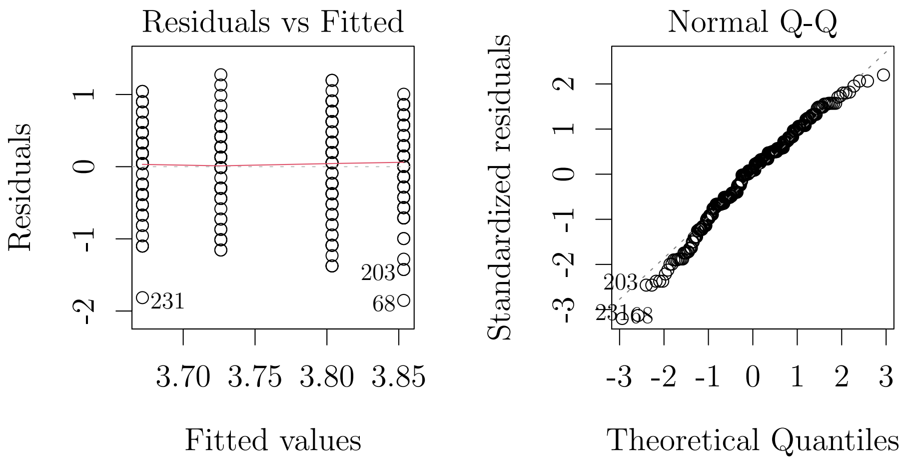

Figure C.21: Residual Plots: Lottery Donation – Low OCSI Score Sample

C.2 Additional Analysis of All Finished Questionnaires

C.2.1 Risk Perception

Table C.1: Comparison of Risk Perception Means By Treatment Group And Sample; No Dropped Cases

	Full Sample			Before Earth Day			Low OCSI Score		
Treatment Condition	N	Mean	SD	N	Mean	SD	N	Mean	SD
Total Perceived Risk									
Inevitable Doom	101	3.860	0.570	35	3.740	0.580	36	3.920	0.580
Evitable Doom	103	3.790	0.630	37	3.860	0.570	32	3.830	0.610
Inevitable Gloom	102	3.740	0.530	37	3.640	0.610	40	3.760	0.500
Evitable Gloom	103	3.700	0.560	36	3.740	0.630	37	3.860	0.590
Risk Perceived for Others									
Inevitable Doom	101	4.160	0.560	35	4.010	0.560	36	4.130	0.600
Evitable Doom	103	4.080	0.610	37	4.120	0.540	32	4.090	0.590
Inevitable Gloom	102	4.030	0.530	37	3.940	0.610	40	4.020	0.520
Evitable Gloom	103	4.010	0.570	36	4.020	0.660	37	4.100	0.580
Risk Perceived for Self									
Inevitable Doom	101	3.210	0.850	35	3.150	0.880	36	3.460	0.830
Evitable Doom	103	3.100	0.880	37	3.230	0.810	32	3.200	0.880
Inevitable Gloom	102	3.120	0.820	37	3.050	0.860	40	3.180	0.800
Evitable Gloom	103	3.050	0.830	36	3.210	0.870	37	3.410	0.840

Table C.2: ANOVA of Total Perceived Risk by Treatment Condition; No Dropped Cases

	Sum Sq	df	F Statistic	p-value
Doom	1.177	1	3.578	.059
Inevitable	0.308	1	0.936	.334
Doom × Inevitable	0.03	1	0.093	.761
Residuals	133.206	405		
Doom	0.458	1	1.29	.258
Inevitable	0.45	1	1.268	.262
Doom × Inevitable	0.004	1	0.011	.916
Residuals	50.089	141		
Doom	0.183	1	0.569	.452
Inevitable	0.003	1	0.009	.924
Doom × Inevitable	0.314	1	0.976	.325
Residuals	45.358	141		

Unequal group sizes adjusted using type 2 correction.

Table C.3: Analysis of Risk Perception Factors; No Dropped Cases

	Full Sample			Before Earth Day			Low OCSI Score		
	Perception of Risk for								
	Self	Other	Total	Self	Other	Total	Self	Other	Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treatment Condition:									
Doom	0.056	0.066	0.089	0.017	0.154	0.151	−0.125	0.045	0.032
	(0.116)	(0.080)	(0.079)	(0.205)	(0.146)	(0.144)	(0.213)	(0.142)	(0.143)
Inevitable	0.081	0.022	0.040	−0.107	−0.074	−0.093	−0.124	−0.070	−0.053
	(0.116)	(0.080)	(0.079)	(0.201)	(0.143)	(0.142)	(0.197)	(0.131)	(0.132)
Inevitable × Doom	0.033	0.087	0.049	0.095	−0.042	−0.005	0.416	0.125	0.177
	(0.165)	(0.113)	(0.113)	(0.286)	(0.204)	(0.202)	(0.296)	(0.197)	(0.198)
OCSI Score	−0.080**	0.004	−0.024	−0.103	−0.034	−0.063	0.098	0.129	0.103
	(0.035)	(0.024)	(0.024)	(0.067)	(0.048)	(0.047)	(0.127)	(0.084)	(0.085)
Education	0.030	0.024	0.021	0.036	0.076**	0.058	0.006	0.071**	0.039
	(0.028)	(0.019)	(0.019)	(0.054)	(0.038)	(0.038)	(0.051)	(0.034)	(0.034)
Income	−0.012	−0.021**	−0.019*	−0.015	−0.038**	−0.032*	0.009	−0.010	−0.002
	(0.015)	(0.010)	(0.010)	(0.024)	(0.017)	(0.017)	(0.024)	(0.016)	(0.016)
Gender : Male	−0.186**	−0.132**	−0.161***	−0.240	−0.091	−0.151	−0.109	0.011	−0.038
	(0.087)	(0.060)	(0.060)	(0.158)	(0.112)	(0.111)	(0.163)	(0.108)	(0.109)
Gender : Other	0.434	0.415	0.445	−0.033	0.275	0.230	0.373	0.498	0.473
	(0.475)	(0.326)	(0.326)	(0.837)	(0.596)	(0.590)	(0.599)	(0.398)	(0.401)
Age	0.013***	0.003	0.007**	0.013**	0.003	0.007**	0.009	0.0003	0.004
	(0.004)	(0.003)	(0.003)	(0.005)	(0.004)	(0.004)	(0.008)	(0.005)	(0.005)
Constant	3.059***	3.946***	3.682***	3.245***	3.994***	3.777***	2.607***	3.313***	3.132***
	(0.245)	(0.168)	(0.168)	(0.414)	(0.294)	(0.292)	(0.556)	(0.370)	(0.372)
Observations	393	393	393	134	134	134	134	134	134
R^2	0.075	0.051	0.071	0.106	0.091	0.119	0.049	0.083	0.060
Adjusted R^2	0.053	0.029	0.049	0.041	0.025	0.055	-0.020	0.016	-0.009
Residual Std. Error	0.813 (df = 383)	0.559 (df = 383)	0.557 (df = 383)	0.817 (df = 124)	0.581 (df = 124)	0.576 (df = 124)	0.830 (df = 124)	0.552 (df = 124)	0.556 (df = 124)
F Statistic	3.448*** (df = 9; 383)	2.302** (df = 9; 383)	3.237*** (df = 9; 383)	1.628 (df = 9; 124)	1.379 (df = 9; 124)	1.859* (df = 9; 124)	0.717 (df = 9; 124)	1.244 (df = 9; 124)	0.875 (df = 9; 124)

Note: *p<0.1; **p<0.05; ***p<0.01

C.2.2 Lottery Donation

Table C.4: Comparison of Donated Lottery Tickets By Treatment Group And Sample; No Dropped Cases

	Full Sample			Before Earth Day			Low OCSI Score		
Treatment Condition	N	Mean	SD	N	Mean	SD	N	Mean	SD
Inevitable Doom	101	5.580	4.280	35	6.610	4.100	36	5.180	4.200
Evitable Doom	103	5.700	4.240	37	8.030	3.180	32	6.100	4.180
Inevitable Gloom	102	4.990	4.180	37	7.110	3.990	40	4.470	4.200
Evitable Gloom	103	4.980	4.190	36	7	3.740	37	6.230	3.860

Table C.5: ANOVA of Donation Decision by Treatment Condition; No Dropped Cases

	Sum Sq	df	F Statistic	p-value
Full Sample				
Doom	39.043	1	2.191	.14
Inevitable	0.266	1	0.015	.903
Doom × Inevitable	0.384	1	0.022	.883
Residuals	6379.958	358		
Before Earth Day				
Doom	2.254	1	0.16	.69
Inevitable	13.432	1	0.953	.331
Doom × Inevitable	16.614	1	1.179	.28
Residuals	1536.313	109		
Low OCSI Score				
Doom	2.692	1	0.159	.691
Inevitable	56.913	1	3.367	.069
Doom × Inevitable	5.229	1	0.309	.579
Residuals	1994.687	118		

Unequal group sizes adjusted using type 2 correction.

Table C.6: Moderation Analysis of Donation Decision; No Dropped Cases

	Dependent variable:					
	Amount of Tickets Donated to Charity					
	Full Sample		Before Earth Day		Low OCSI Score	
	(1)	(2)	(3)	(4)	(5)	(6)
Total Perceived Risk	0.496		−0.428		−0.187	
	(0.376)		(0.640)		(0.715)	
Perceived Risk for Self		−0.516		−0.813		−1.371**
		(0.331)		(0.578)		(0.600)
Perceived Risk for Others		1.354***		0.925		1.884**
		(0.475)		(0.828)		(0.893)
Social Trust	0.047	0.060	0.269	0.287	0.517*	0.549**
	(0.141)	(0.140)	(0.246)	(0.246)	(0.278)	(0.272)
OCSI Score	−0.016	−0.097	−0.038	−0.070	0.221	−0.081
	(0.180)	(0.182)	(0.342)	(0.342)	(0.787)	(0.780)
Education	0.381***	0.379***	0.450	0.382	0.001	−0.083
	(0.140)	(0.139)	(0.282)	(0.283)	(0.266)	(0.262)
Income	0.275***	0.287***	0.108	0.142	0.358***	0.387***
	(0.075)	(0.075)	(0.119)	(0.119)	(0.128)	(0.125)
Gender : Male	−0.290	−0.280	−0.925	−0.969	−1.458	−1.502*
	(0.446)	(0.442)	(0.817)	(0.815)	(0.880)	(0.861)
Gender : Other	0.333	0.204	3.903	3.604	−0.433	−1.032
	(2.271)	(2.252)	(3.715)	(3.709)	(2.918)	(2.857)
Age	0.072***	0.076***	0.054*	0.056**	−0.024	−0.018
	(0.022)	(0.022)	(0.028)	(0.028)	(0.042)	(0.041)
Constant	−1.778	−3.664*	3.689	0.952	2.555	−0.322
	(1.880)	(1.925)	(3.145)	(3.260)	(3.801)	(3.746)
Observations	348	348	105	105	114	114
R^2	0.177	0.192	0.150	0.164	0.130	0.177
Adjusted R^2	0.157	0.171	0.079	0.085	0.064	0.105
F Statistic	9.094*** (df = 8; 339)	8.929*** (df = 9; 338)	2.117** (df = 8; 96)	2.073** (df = 9; 95)	1.958* (df = 8; 105)	2.480** (df = 9; 104)
Note:						*p<0.1; **p<0.05; ***p<0.01