VISUAL COMMUNICATION OF CLIMATE CHANGE: THE EFFECT OF CONSTRUAL LEVEL

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ABSTRACT

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There is widespread consensus among the scientific community that human-caused climate change is occurring and is one of the most urgent threats facing our planet in the twenty-first century. However, Americans' concern for climate change is relatively low compared to most regions around the world. Researchers have argued that one important reason for this indifference toward climate change may be the perception that the risk is abstract and psychologically distant, that is, its uncertain impacts will affect other people, will happen in other places or sometime in the future. Today, how to effectively communicate climate change in a way that makes the issue more real, local, urgent and relevant is a challenge.

Addressing this challenge, this study drew upon construal level theory to investigate the role of abstraction in the visual communication of climate change. Two online experiments were conducted to test how the level of abstraction and concreteness of climate change imagery affects viewers' psychological distance of climate change, concern for climate change, behavioral intentions toward climate change mitigation and adaptation.

This study firstly clarified how psychological distance should be conceptualized, operationalized and integrated into climate change communication efforts by demonstrating the distinction between egocentric and nonegocentric distances. This paves the way for broader applications of psychological distance in decision-making research. Second, results from this study showed abstract images (vs. concrete images) encouraged more abstract thinking, leading people to perceive greater spatial, temporal and social distance between climate change and

themselves. The greater psychological distance perceptions further discouraged people's concern for climate change and intention to act, though the effect was small relative to other environmentalism factors such as self-efficacy and self-transcendent values. These findings show the potential usefulness of abstract versus concrete messaging strategies for future environmental and behavioral research. Last, findings revealed that an image's level of abstraction moderated the effect of key sociopolitical factors (self-efficacy, self-transcendent values, political orientation) on climate change related attitudes and behavioral intentions. This finding expands the current literature by providing a clearer understanding of the psychological mechanisms in climate change visual communication; it emphasizes how previously identified communication strategies for concretizing climate change may backfire and how climate change interventions affect people differently.

Practically, this study provides evidence-based visual communication strategies to the newspaper and broadcasting industries, policy makers, and visual communication practitioners regarding how to more effectively design and use abstract and concrete visuals in communication campaigns aimed at influencing society's concern for climate change and perceived urgency of the issue.

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CHAPTER 1: INTRODUCTION

There is widespread consensus among the scientific community that human-caused climate change is occurring and is one of the greatest threats facing our planet in the twenty-first century. Many severe impacts of climate change have already been observed, such as extreme weather events, melting glaciers and coastal floods. Currently, it is urgent for both policymakers and citizens of the world to tackle this challenge (Pachauri et al., 2014). However, Americans' concern for the issue is relatively low compared to most regions around the world. About four in ten Americans (37%) believe the issue of climate change is either "not too" or "not at all" important personally (Leiserowitz, A., Maibach, E., Roser-Renouf, C., Rosenthal, S., Cutler, M., & Kotcher, J, 2018), and the majority of Americans view climate change as a low-salience issue that is often surpassed by more pressing concerns such as jobs and terrorism (Pew Research Center, 2018).

Researchers have argued that one important reason for the lack of concern about climate change is the perception that the risk is *psychologically distant*, that is, its uncertain impacts will affect other people, will happen in other places or sometime in the future (Brügger, Dessai, Devine-Wright, Morton, & Pidgeon, 2015; Spence, Poortinga, Butler, & Pidgeon, 2011). The concept of *psychological distance* explains how far a perceived event is removed from the direct experience of an individual (Liberman & Trope, 2008). As explained in Construal Level Theory (CLT), people's *psychological distance* to an issue is positively influenced by their *construal level* of that issue – the level of abstraction at which the issue is mentally represented. That is, compared to a lower level of construal, a higher level of construal is a more abstract, generic, superordinate, invariant, and decontextualized mental representation of an issue and can lead people to perceive greater psychological distance to that issue (Trope & Liberman, 2010).

The view of climate change as an abstract and psychologically distant risk is a major barrier to effective communication of the issue within our society. That is because it makes people discount the threat (Zwickle & Wilson, 2013), and implies little personal relevance, which could lead people to feel less motivated to take actions to address the risk (Brody, Grover, & Vedlitz, 2012). Until now however, there has been little research that examines how this popular view of climate change as a psychologically distant phenomenon could be formed under the influences of different abstract and concrete communication strategies. It is also unclear how construal level (e.g. abstract or concrete thinking) of climate change may influence people's concern about the issue, and their behavioral intentions related to climate change mitigation and adaptation strategies.

Addressing these issues, this dissertation draws upon Construal level theory (CLT) to specifically explore the effect of construal level in the visuals - the level of abstraction the visuals entail. The first part of the research looks at 1) how visuals help to abstract or concretize the issue of climate change, 2) how abstract versus concrete visual representations of climate change influence the public's psychological distance to the issue, including *egocentric distance* – distances that are mentally represented as distances from oneself, in the here and now, and *nonegocentric distances* – the distances that are construed based on other people's perspectives or other reference points in time. The second part of this project further asks how people's distant or proximal perceptions of climate change affect their responses to the issue, and how abstract versus concrete construals of climate change may differentially affect people's attitudinal and behavioral responses to the issue. This section also examines how construal level (abstract vs. concrete) may interact with values, self-efficacy, climate change concern, or political orientation to affect people's responses to climate change.

Effective climate change communication is a great societal challenge requiring appropriate translation and representation of abstract climate information. This dissertation is an initial attempt to explain the role of abstraction in effective visual communication about climate change. It advances knowledge in the following three areas: 1) The project clarifies how psychological distance should be conceptualized, operationalized and integrated into climate change communication efforts by exploring the distinction between the two sub-dimensions of psychological distance - egocentric and nonegocentric distances. This not only clarifies the complexity of construal level theory of psychological distance - how it should be incorporated into climate change communication research - but also paves the way for broader applications of psychological distance in decision-making research. 2) The study examines the role of abstraction and concreteness in influencing people's responses to climate change (e.g., perceived distance to the risk, concern and behavioral intention), which could demonstrate the potential usefulness of abstract and concrete messaging strategies for future environmental and behavioral research. 3) The exploration of the effect of abstract versus concrete visual representations of climate change on people's climate change perceptions develops a new direction for visual analysis in climate change research, contributing to the understanding of climate visuals' effects, a sub-area that is relatively underdeveloped in the field of climate change communication (Chapman, Corner, Webster, & Markowitz, 2016; Feldman & Hart, 2018).

The findings offer important evidence-based recommendations for communication researchers, climate change advocates, and media workers, which could help them more effectively design and use abstract and concrete visuals in communication campaigns aimed at influencing society's concern for climate change and perceived urgency of the issue. The focus

on abstraction in climate change visual communication could also be useful in promoting further research in the communication of other complex environmental issues.

This dissertation is divided into five chapters. Chapter 2 presents the theoretical framework used in the study and previous literature relevant to the study, which includes construal level theory of psychological distance, construal level and climate change communication, psychological distance of climate change, climate change visual communication, climate change and values, self-efficacy and other environmentalism factors. Chapter 3 presents the methods used, which includes two online experiments. In Chapter 4, results from two pretest experiments, interviews and two main test experiments are reported. Chapter 5 focuses on discussion, implications, limitations, as well as suggestions for future research.

CHAPTER 2: LITERATURE REVIEW

Construal Level Theory of Psychological Distance

Construal level theory (CLT) argues that people only directly experience the here and now. To transcend here and now to think about other places and future objects, people need to form abstract construals of those distal entities (Trope & Liberman, 2010). The term psychological distance reflects the perceived gap between the event and an individual on spatial, temporal, social, and hypothetical (e.g., level of uncertainty) dimensions (Trope & Liberman, 2010). Spatial distance refers to the perceived geographical distance between the individual and the event; temporal distance refers to the perceived length of time between the individual's present time and the event; social distance is the extent to which an individual perceives himself/herself as resembling the persons in the event; and hypothetical distance reflects the perceived level of certainty/likelihood of the event occurring.

In CLT, the four dimensions of psychological distance are believed to be interrelated (Bar-Anan, Liberman, & Trope, 2006). Spatial distance indicates social distance, for example, choosing a more spatially distant seat from another person usually reflects social distancing from that person (e.g., Macrae, Bodenhausen, Milne, & Jetten, 1994; Mooney, Cohn, & Swift, 1992; Trope & Liberman, 2010). Social distance is also positively affected by temporal distance - the distance in time from the expected social interaction with the persons (Stephan, Liberman, & Trope, 2011). CLT also explains that these four dimensions of psychological distance all positively relate to construal level, that is, more distant events would be mentally represented by people at higher levels of construal in more abstract ways (Trope & Liberman, 2010). For example, spatially distant events are associated with abstract, high-level of construals, (Fujita, Henderson, Eng, Trope, & Liberman, 2006) and temporally distant perspectives can facilitate

abstract thinking (Förster, Friedman, & Liberman, 2004). In addition, the relationship between construal level and psychological distance is bidirectional: not only are more distant events construed in more abstract ways, but also thinking abstractly would increase individuals' perceived psychological distance to the event (Liberman, Trope, McCrea, & Sherman, 2007; Shapira, Liberman, Trope, & Rim, 2012; Trope, Liberman, & Wakslak, 2007; Wakslak & Trope, 2009).

Psychological Distance and Climate Change Communication

In the field of climate change communication, recent studies have drawn upon insights from construal level theory of psychological distance to explore the effectiveness of distant versus proximal framing strategies in promoting public engagement with climate change (van der Linden et al., 2015). They have looked at how various dimensions of psychological distance can be applied to climate change messaging strategies (e.g., spatial distance, Haden et al., 2012; temporal distance, Pahl & Bauer, 2013; uncertainty, Lorenzoni, Nicholson-Coleb, & Whitmarsh, 2007; and social distance, Manning, et al., 2018).

These studies reported that climate change-related concerns, as well as willingness to act, could be enhanced if people's psychological distance to the issue was reduced (e.g., Evans, Milfont and Lawrence, 2014; Jones, Hine, & Marks, 2016; Nicolaij & Hendrickx, 2003; Rickard, Yang, & Schuldt, 2016), especially if the spatial and temporal distances (Rickard et al., 2016; Roh et al., 2015; Spence & Pidgeon, 2010), and perceived certainty (hypothetical distance) (Singh et al., 2017; Spence & Pidgeon, 2010) were reduced. But studies also found that people who perceived less (vs. greater) psychological distances to climate change did not necessarily have higher intention to engage in climate change mitigation and adaptation behaviors, such as

"choosing a car that gets good fuel mileage" or "repainting (future) house in a lighter color (less heat absorption in the summer)" (Brügger et al., 2015; 2016), and they did not always have higher support for climate change mitigation and adaptation policies (Schuldt, Rickard, & Yang, 2018). Instead, the relationship may be affected or moderated by a variety of other factors, such as self-efficacy (e.g., whether or not believing that their own actions could contribute to solving climate change - a collective problem, McDonald et al., 2015; Singh et al., 2017), individuals' cognitive style (e.g., holistic vs. analytic, Sacchi, Riva, & Aceto, 2016), or political ideology (e.g., Hart & Nisbet, 2012). The rest of this section reviews the literature on how the four psychological distance dimensions have been integrated into climate change communication research, and why reducing psychological distance did not always necessarily lead to increased level of behavioral intention.

Spatial Distance. In terms of spatial distance, Scannell and Gifford (2013) claimed that place attachment (emotional and cognitive bonds with a particular place) and local (vs. global) messages were effective in promoting climate change engagement (Moser, 2014). Likewise, Spence and Pidgeon (2010) found that messages on local impacts of climate change were perceived as more personally relevant than those about distant locations, and these local messages could help to promote action. Distancing the negative impacts of climate change may decrease people's moral concern for the issue (Markowitz & Shariff, 2012), and distant impacts are commonly thought of as other people's responsibilities, leading people to feel powerless to respond (Rickard et al., 2016; Uzzell, 2000). But it is also argued that local impacts of climate change are not always alarming, as people tend to view them as less serious than global impacts (Leiserowitz, 2005; Spence & Pidgeon, 2010).

Temporal Distance. In regard to temporal distance, findings are also mixed. On the one hand, highlighting more immediate and concrete consequences of environmental problems would make environmental issues more personally relevant (Carmi, 2013). In the context of climate change, viewing climate change as a temporally close risk was found to be linked to greater concern (Spence et al., 2012) and would encourage more motivations to perform pro-environmental behaviors (Bashir, Wilson, Lockwood, Chasteen, & Alisat, 2014). On the other hand, Roh et al. (2015) found that the effectiveness of temporally proximal framing was contingent upon participants' partisanship, which brought a boomerang effect among Republicans and increased their backlash to the temporally proximal messages.

Social Distance. In terms of social distance, it was found that considering the perspective of other human victims of environmental change (reducing the social distance between self and others) could strongly increase people's engagement with environmental issues (Pahl & Bauer, 2013). But this effect could be contingent upon partisanship, as being exposed to messages that showed socially distant groups was found to amplify political polarization about climate change (Hart & Nisbet, 2012). Other research has discussed the impact of social distance from the perspective of attribution theory, suggesting that being exposed to energy use information related to in-group (socially close group of people) make people attribute climate change to uncontrollable (natural) causes, while being exposed to energy use information related out-group (socially distant group of people) can encourage people to think climate change as a human-caused problem (Jang, 2013).

Hypothetical Distance. While the certainty of climate change is no longer a scientific question, the communication of the impacts of climate change often involves uncertainty (Morton, Rabinovich, Marshall, & Bretschneider, 2011). Emerging research on construal level

theory and climate change has focused on the role of hypothetical distance, namely, the level of uncertainty of particular impacts. Results on the effect of uncertainty communication is somewhat conflicting. Communicating uncertainty about climate change and its impacts can arouse skepticism about the issue and undermine people's policy support, but this effect would be reversed if the lay public understand that uncertainty is inherent in the scientific process (Rabinovich & Morton, 2012; Retzbach & Maier, 2015). Morton et al. (2011) argued that uncertainty could be carefully framed or communicated in a way that makes people feel capable to respond and willing to act, and in that way, communicating uncertainty might not necessarily lead to less responsive actions.

Overall, studies in the field of psychological distance of climate change have shown that the reduction of psychological distance does not always have the expected positive effects on individuals' climate change mitigation or adaptation behavioral intentions (Brügger, Morton, & Dessai, 2016; Jones, Hine, & Marks, 2016; Sacchi, Riva, & Aceto, 2016; Spence & Pidgeon, 2010). One possible explanation is that psychological distance, although defined as an egocentric concept, has not been consistently operationalized egocentrically in past communication studies, and it has not been differentiated from the concept of *nonegocentric distance* - the distances that are construed based on other people's perspectives or other reference points in time. (Liberman & Förster, 2009, 2011). The next section reviews the literature on how the egocentric and nonegocentric psychological distances differ in CLT and how they should be incorporated into climate change communication.

Egocentric and Nonegocentric Psychological Distances of Climate Change

In CLT, the concept of psychological distance is defined to be egocentric, subjective and relative (Trope & Liberman, 2010). It should be measured from the self, in the here, now and the experienced reality. Distances that are considered in other alternative ways (e.g., from other people's perspectives or other time points) are termed as nonegocentric distances (Liberman & Förster, 2009; Trope & Liberman, 2010). For example, in terms of social distance, people use egocentric thinking to estimate how close they are to their family doctor, but they use nonegocentric mindset to think about how close their best friend is to his or her family doctor (Liberman & Förster, 2009). Similarly, in terms of temporal dimension, people use egocentric mindsets to imagine how much time from *now* they would do a free eye exam. Whereas, in nonegocentric thinking, they imagine getting an invitation for a free eye exam in the future and how much time after receiving that invitation they will go for the exam. The two types of distance differ with regards to the reference point. Egocentric distance relies on the perspectives taken from an egocentric anchor - the experienced self in the here and now. Whereas, nonegocentric distance relies on a nonegocentric reference point - the unexperienced others in the future and other places (Epley, Keysar, Van Boven, & Gilovich, 2004; Liberman & Förster, 2009). That is, this nonegocentric distance refers to a certain perspective-taking and is different from the concept of altruism - the concern for others' welfare.

In the context of climate change, existing studies have not consistently operationalized psychological distance of climate change as an egocentric construct and have not differentiated between egocentric and nonegocentric distances. For example, the perception of psychological distance of climate change has been measured with multi-question Likert-type scales which consisted of attitudinal statements such as "to what degree do you believe climate change is

happening right now," "to what degree do you believe we must tackle the issue right now (e.g., Jones et al., 2016; Spence et al., 2012)". These questions may conflate the egocentric and nonegocentric psychological distances because the statements are not anchored on all the egocentric references points, such as self and the experienced reality. While responding to these attitudinal statements, participants may shift reference point(s) and mentally assume things from other people's perspectives (e.g., thinking climate change is happening right now to other people using nonegocentric viewpoints).

This distinction matters in the studies of CLT and climate change communication. On the one hand, in psychological research, Liberman and Förster (2009, 2011) found that construal level affected only the egocentric distance but not nonegocentric distance, because a person's high-level construal requires mentally distancing oneself from the object of construal and does not require distancing that object of construal from others. This mechanism could possibly apply in climate change context. On the other hand, mixed results have been reported regarding whether reducing psychological distance could increase people's level of concern or behavioral intention. The conflation of egocentric and nonegocentric distances in recent climate change research may explain the conflicting results reported in this literature. To gain some clarity on this line of thinking, this dissertation explores how egocentric and nonegocentric psychological distances should be conceptualized, operationalized and integrated into climate change communication research and practice. To do this, this study proposes two sets of statements that measure egocentric and nonegocentric distances respectively, which indicate how the two types of distance differ in the context of climate change communication (See Table 1 below for details).

The Effect of Construal Level

As aforementioned, there have been mixed findings in recent research concerning the behavioral or attitudinal consequences of manipulating the psychological distance of climate change (e.g., Rickard et al., 2016; Sacchi et al., 2016; Singh et al., 2017; Spence & Pidgeon, 2010); one possible explanation for the inconsistency is that psychological distance is a subjective experience (Trope & Liberman, 2010) that varies individually by a host of factors (e.g., personal experiences) and is hard to manipulate consistently and effectively. In that way, it is difficult or incorrect to forcefully manipulate people to make them believe climate change is either distal or proximal, as climate change could appear psychologically proximal to some group members but far away for others who have different personal experiential backgrounds. As a global risk, climate change is occurring both here and there, now as well as in the future, affecting everyone. In terms of the certainty, while the existence of climate change itself is certain from a scientific standpoint, many of its impacts are still uncertain (unpredictable). Therefore, framing climate change as either distal or proximal to influence climate concern and behavioral intention may not be appropriate and/or effective, as the latter are complex decision-making processes possibly involving interactions of psychological distance and a variety of other social psychological factors (e.g., ideology, see McDonald, Chai, & Newell, 2015). In summary, there are both accuracy and conflation problems when trying to frame climate change as a psychologically proximal risk (McDonald et al., 2015; Zwickle, 2014).

Instead of manipulating psychological distance to influence people's responses to climate change, this study proposes that a more appropriate and reliable research angle is to examine the potential effects of construal level on people's responses to the issue (McDonald et al., 2015). This is because construal level (vs. psychological distance), by definition, is less subjective,

being “more closely related to the event’s inherent properties” (p. 4, Trope & Liberman, 2010). The concept of construal level is different from psychological distance, although they are related (p. 4, Trope & Liberman, 2010) and are often used interchangeably in environmental communication (e.g., Chang, Zhang, & Xie, 2015).

Construal level has been central to research in psychology; it is found to be able to influence people’s information recall as well as learning outcome. For example, abstract information (vs. concrete information) is found to be less available in people’s memory (Johnson & Kisielius, 1985). Past psychological research has also investigated how people’s prediction, evaluation and behavioral intention are affected by construal level (Fujita & Carnevale, 2012; Trope et al., 2007). For example, it has been found that people tend to have more confidence in their predictions of future outcome when being activated by higher level, more abstract, construals (vs. lower level, more concrete, construals) (Nussbaum, Liberman, & Trope, 2006). When evaluating issues/events that contain both a central and a peripheral aspect, higher level construal (vs. lower level construal) can promote more thinking of the central, primary aspects of the issues/events (Trope & Liberman, 2000). In the risk communication process, how concretely or abstractly people view an issue can greatly impact how they perceive the costs and benefits associated with the risk, and this construal level effect could arguably apply to risk communication in the context of climate change (Zwickle & Wilson, 2013).

However, to date, this construal level effect has been rarely tested in climate change domain. Among the limited available research, it is argued that each kind of (abstract and concrete) construal could have both advantages and disadvantages in promoting pro-environmental attitudes, behaviors and policy support. Prior research suggests local-based messages are more likely to promote people’s concerns about climate change (Bloodhart,

Maibach, Myers & Zhao, 2015; Spence et al., 2012), fear, worry about the issue, and their willingness to act. Portraying climate change as a local issue may also make people think the issue requires individual actions, which could enhance people's perceived self-efficacy (Spence et al., 2012). Specifically, farmers activated by lower-level construals (vs. higher-level construals) of climate change would think more concretely to safeguard their self-interests (vs. collective interests) related to climate change – they tend to have stronger intention to adopt self-protective climate adaptation practices (Haden, Niles, Lubell, Perlman, & Jackson, 2012). To the contrary, prior research also shows that greenhouse gas mitigation is a collective action problem that requires cooperative behaviors; higher level, more abstract construals (vs. lower level, more concrete construals) could be more effective in terms of encouraging farmers' intention to adopt climate change mitigation practices (Haden et al., 2012).

In addition, past research suggests that construal level may interact with other factors to affect people's responses to climate change, and factors may include values, self-efficacy, and climate change concern. **1) Values.** It has been found that high-level abstract construal leads people to focus on broad categories of events rather than single instances. It can promote sensitivity to the broad implications of behaviors, which makes people exhibit behaviors pertaining to their core values (Ledgerwood, Trope, & Chaiken, 2010; Trope & Liberman, 2010). Researchers have discussed that for people whose core values are congruent with environmentally friendly behaviors, they would be more motivated to take mitigation actions when being presented with global frames or stories of climate change (Schoenefeld & McCauley, 2016; Spence et al., 2012). When evaluating green product benefits, abstract construals (vs. concrete construals) could encourage more pro-environmental behaviors among individuals who have the self-transcendent motive - to benefit the environment (Goldsmith, Newman, & Dhar,

2016). **2) Concerns.** Construal level could presumably interact with people's concerns and influence their behavioral intention. For example, concrete construals (vs. abstract construals) were found to encourage more pro-environmental behaviors when people were motivated by immediate economic benefits or concerns (Bloodhart, Maibach, Myers, & Zhao, 2015; Spence et al., 2012). **3) Self-efficacy.** Researchers also discussed that concrete construal may also make people think more about the difficulty of performing the action, immediate concerns, and their capability of addressing the issues (Liberman & Trope, 1998). It is thus arguably likely that more self-efficacious people's pro-environmental behavior intention is stronger than that of less self-efficacious people, and this difference could be enlarged when people are activated by a concrete construal (vs. abstract construal).

Despite the discussion of the potential role that construal level plays in environmental and climate change communication, previous studies have not empirically tested how this construal level can affect people's responses to climate change, how it interacts with other factors to make an impact, and how these mechanisms apply to the visual communication domain. Building on previous work, this dissertation attempts to extend the theoretical and empirical evidence on the role of construal level in climate change visual communication.

Visual Communication of Climate Change

Zillmann (1999) proposed exemplification theory to explain that compared to events portrayed with statistical information and general terms, events portrayed with examples in a vivid and concrete manner can last longer in one's memory, having stronger perceptual influence and attracting disproportional attention from the audience.

In today's society, visual exemplification (the use of visual exemplars) is particularly often seen in the communication process, and they can often generate stronger framing effects than texts (Powell, Boomgaarden, De Swert, & de Vreese, 2015). These visual exemplars are more concrete in people's minds when compared to words (Carnevale et al. 2014). Using the autism vaccine controversy as a case study, Dixon et al. (2015) found that readers would become more convinced of a consensus among scientists if they saw that visual exemplars were used to accompany "weight-of-evidence" information – information that states two sides of the issue but supports only one with scientific consensus. In the case of communicating about genetically modified foods, it was also found that including visual exemplars of a scientific consensus could improve the persuasive effectiveness of that consensus message (Dixon, 2016).

Visuals are used particularly frequently and prominently in media communication of climate change (Metag, Schäfer, Füchslin, Barsuhn, & Königslöw, 2016; O'Neill & Smith, 2014). Although visuals have been found to play a substantive role in influencing people's climate change perceptions and policy support (Feldman & Hart, 2018; Hart & Feldman, 2016), existing studies on climate change primarily focused on textual information on the issue. Research on effective communication of climate change in the visual domain has been limited (Chapman et al., 2016; Hart & Feldman, 2016). In recent years, an increasing number of studies have started to look at visuals in climate change news stories (e.g., O'Neill 2013; Rebich-Hespanha et al. 2015; DiFrancesco & Young, 2011). Scholars have studied various components of these visuals of climate change, such as visuals' themes, frames (O'Neill, Williams, Kurz, Wiersma, & Boykoff, 2015; O'Neill, 2013; Rebich-Hespanha et al., 2015), emotional components (e.g., fear, O'Neill & Nicholson-Cole, 2009; e.g., hope, fear, and anger, Feldman &

Hart, 2018), self-efficacy (Hart & Feldman, 2016) and the interplay between visuals and texts (e.g., DiFrancesco & Young, 2011; Hart & Feldman, 2016).

Compared to studies of media's visual coverage of climate change, much less research has been conducted to examine how people perceive these visuals (Metag et al., 2016). Building on media effects theories, recent research has started to narrow this gap by exploring how various visual components influence the public. It has been found that visuals could either promote public understanding of climate change (Hart & Leiserowitz, 2009; Lester & Cottle, 2009) or discourage the public's climate change concern and actions. Visuals of severe consequences of climate change motivate people to seek for more information about the issue (e.g., *The Day After Tomorrow*, Hart & Leiserowitz, 2009). Images showing fear or guilt are likely to promote feelings of helplessness and provoke low self-efficacy, which could lower public engagement with the issue (Metag, Schäfer, Füchslin, Barsuhn, & Kleinen-von Königslöw, 2016; Nerlich & Jaspal, 2014; S. O'Neill & Nicholson-Cole, 2009). Overall, different components involved in framing images may initiate different cognitive and affective processing of the information about climate change to either encourage or discourage people's engagement with the issue.

The Role of Abstraction in Visual Imagery

To explore why visuals can either bring the issue closer or make it more distant, scholars have been increasingly recognizing the role of abstraction in visual communication. There are different types of visual exemplars (statistical information, personified example), and they were found to differentially interact with and influence viewers' perceptions (King, 2016). For example, Lundell, Niederdeppe, and Clarke (2013) suggested that communicators should be

cautious with the use of statistical image exemplars when reporting on social determinants of health and health disparities, since people could treat these statistical images unfavorably, thinking that the images oversimplify a complex issue.

Messaris (1997) proposed visual persuasion theories, claiming that images can be classified into two categories: *iconic* images, such as maps, symbols that contain a shared meaning through an established symbolism, and *indexical* images, such as photographs of people, nature that reflect reality and serve as proof of some phenomenon. Building on these theoretical perspectives, Rickard, Schuldt, Eosco, Scherer, and Daziano (2017) studied strategic design of risk-related visual messages and found that: 1) when communicating skin cancer detection, viewers' perceived interplay between images and text interacted with the type of visual exemplar to affect message persuasive power. 2) When communicating the hurricane risk, people who viewed indexical images generally perceived the greatest risk, and the type of visual exemplars (iconic vs. indexical) interacted with people's past hurricane-related experience to influence their risk perceptions. For example, risk perception was the highest among people in the indexical (vs. iconic) condition reporting fewer personal experience with hurricanes.

In the context of climate change, DiFrancesco and Young (2011) found that visuals in the media could give audiences personal meanings of climate change, concretizing the issue (DiFrancesco & Young, 2011) by reducing the psychological distance between the audience and the object in the image. Smith and Joffe (2009) reported that images of immediate and local impacts of climate change could concretize the risks associated to the issue, bringing the threat closer to home (Smith & Joffe, 2009). Images that personalized climate change, showing the affected public could also concretize the issue by attaching more personal meanings to the issue (O'Neill & Nicholson-Cole, 2009). But some climate change visuals were found to have a

"distancing" frame which may disengage the public. For example, images of politicians may make laypeople construe climate change as an elite issue and make them feel disconnected or disengaged (O'Neill et al., 2013). The lay public tend to view images of protestors or campaigners less favorably, and localized images were found to sometimes make people view the issue as less severe and even feel less concerned (Chapman et al., 2016). The overwhelming portrayal of the "globalness" of climate change could also help people form an abstract understanding of the issue (Rebich-Hespanha et al., 2015).

While the role of abstraction in visual communication of climate change has been increasingly discussed in recent years, scholars have not yet examined how people are affected by climate change images' level of abstraction, that is, the level of construal an image is likely to be construed at by a viewer. They have not tested how abstract versus concrete visuals of climate change may influence people's perceptions about the distance between climate change and themselves, how they may influence people's concern about the issue, and behavioral intention. The abstraction or concretization process may interact with a variety of human values (e.g., self-transcendence, self-enhancement values) and other individual-level social psychological factors (e.g., self-efficacy, concern, or political orientation) to affect people's decision-making, but such complex relationships have not yet been examined in climate change visual communication, especially using theoretically driven lenses and approaches. This dissertation attempts to address this gap by drawing upon construal level theory.

Research Questions and Hypotheses

This dissertation manipulates climate change related images' level of abstraction (abstract, high-level construal versus concrete, low-level construal). Based on CLT, this study

predicts that the level of abstraction of climate change images will positively affect people's egocentric psychological distance to climate change, including egocentric spatial, temporal, social and hypothetical distances. Past research on CLT (Liberman & Förster, 2009, 2011) also suggests that construal level should not affect people's nonegocentric distances, that is, the distances that are represented in other alternative ways, such as distances measured from other people's points of view, other time points, etc. Therefore, this study predicts that climate change images' abstraction level will have a greater positive effect on people's egocentric psychological distance of climate change than on their nonegocentric psychological distance of climate change. It is hypothesized that this differentiated effect of abstraction level will apply to each psychological distance dimension:

H1a: The egocentric spatial distance of climate change will increase as the level of abstraction of climate change images increases.

H1b: The egocentric temporal distance of climate change will increase as the level of abstraction of climate change images increases.

H1c: The egocentric social distance of climate change will increase as the level of abstraction of climate change images increases.

H1d: The egocentric hypothetical distance (perceived uncertainty) of climate change and its effect will increase as the level of abstraction of climate change images increases.

H2a. Abstraction level will not affect nonegocentric spatial distance.

H2b. Abstraction level will not affect nonegocentric temporal distance.

H2c. Abstraction level will not affect nonegocentric social distance.

H2d. Abstraction level will not affect nonegocentric hypothetical distance.

H3a. Abstraction level will have a greater positive effect on egocentric spatial distance than on nonegocentric spatial distance.

H3b. Abstraction level will have a greater positive effect on egocentric temporal distance than on nonegocentric temporal distance.

H3c. Abstraction level will have a greater positive effect on egocentric social distance than on nonegocentric social distance.

H3d. Abstraction level will have a greater positive effect on egocentric hypothetical distance than on nonegocentric hypothetical distance.

The empirical research suggests competing predictions for how psychological distance is related to climate change concern and behaviors. Different psychological distance dimensions were found to relate to climate change concern (Brügger et al., 2015) or policy support in different ways (Singh et al., 2017). Thus, the following research questions are proposed to address how climate change concern and behavioral intention are related to egocentric psychological distances.

First, how is climate change *concern* affected by people's egocentric spatial distance (**RQ1a**), temporal distance (**RQ1b**), social distance (**RQ1c**), and hypothetical distance (perceived uncertainty) (**RQ1d**) of climate change, respectively?

Second, how is climate change *mitigation behavioral intention* affected by people's egocentric spatial distance (**RQ2a**), temporal distance (**RQ2b**), social distance (**RQ2c**), and hypothetical distance (perceived uncertainty) (**RQ2d**) of climate change, respectively?

Last, how is climate change *adaptation behavioral intention* affected by people's egocentric spatial distance (**RQ3a**), temporal distance (**RQ3b**), social distance (**RQ3c**), and hypothetical distance (perceived uncertainty) (**RQ3d**) of climate change, respectively?

As aforementioned, in addition to predicting egocentric psychological distance, construal level could also relate to people's decision-making on environmental issues, and each kind of construal (abstract and concrete construals) could have both advantages and disadvantages in promoting pro-environmental attitudes, behaviors and policy support. Concrete construals are able to promote a sense of worry and fear to encourage people's concern and willingness to act (Bloodhart et al., 2015; Scannell & Gifford, 2013); abstract construals could make people behave in a more cooperative (vs. more competitive) way and thus enhancing the persuasiveness of the information. Abstract and concrete information was also found to promote farmers' climate change mitigation and adaptation behaviors respectively (Haden et al., 2012). Therefore, in the context of climate change, the following three research questions are proposed:

RQ4: How is the level of abstraction of climate change images related to people's climate change concern?

RQ5: How is the level of abstraction of climate change images related to people's intention to mitigate climate change?

RQ6: How is the level of abstraction of climate change images related to people's intention to adapt to the negative effects of climate change?

All the hypotheses and research questions mentioned above are visualized in Figure 1. In addition to the aforementioned relationships, this dissertation also examines the moderating effect of construal level by addressing the following hypotheses and research questions (See Figure 2 for a summary of proposed moderation effects).

Self-reported concern for climate change may not necessarily translate into people's behavioral intention because there are several psychological barriers to behavioral intention and behavioral change (Gifford, 2011; Gifford & Nilsson, 2014). This study theorizes that construal

level can moderate the relationship between climate change concern and behavioral intention. As explained by CLT, a person's environmental values are relatively abstract, because they are de-contextualized and invariant (Liberman & Trope, 1998). People who are activated with abstract construal will report behavioral intention that is more reliant upon or more congruent with their core desirability concern (e.g., the desirability of addressing climate change) (Liberman & Trope, 1998; O'Connor & Keil, 2017). This mechanism could possibly apply to climate change communication – it is predicted that abstract construal of climate change images will strengthen the effect of concern on behavioral intention.

In addition to desirability concern, people also have perceived self-efficacy, which is the immediate feasibility concern, referring to the evaluation of one's capabilities to perform a particular behavior (Bandura, 1982). Past studies have found a positive association between self-efficacy and environmental engagement and willingness to act on climate change (Hines, Hungerford, & Tomera, 1987; Milfont, 2012; Spence et al., 2011). They have also shown that people who were activated with concrete construal would report environment-related behavioral intention that was more reliant upon or more congruent with their immediate feasibility concern (Liberman & Trope, 1998; O'Connor & Keil, 2017). Hence, building on CLT (the positive relationship between construal level and psychological distance), it is reasonable to also predict that a decrease in construal level would lead to psychological distance perceptions or behavioral intention that is more reliant upon perceived self-efficacy. Therefore, the following hypotheses are proposed:

H4a: The abstraction level of climate change images will moderate the effect of climate change *concern* on climate change mitigation behavioral intention. The effect of concern on

mitigation behavioral intention is stronger when abstract construal is activated than when concrete construal is activated.

H4b: The abstraction level of climate change images will moderate the effect of climate change *concern* on behavioral intention towards climate change adaptation. The effect of concern on intention to adapt to climate change is stronger when abstract construal is activated than when concrete construal is activated.

H5a: The abstraction level of climate change images will moderate the effect of climate change *self-efficacy* on egocentric psychological distance. The effect of self-efficacy on climate change psychological distance is stronger when images are more concrete than when images are more abstract.

H5b: The abstraction level of climate change images will moderate the effect of climate change *self-efficacy* on mitigation behavioral intention. The effect of self-efficacy on climate change mitigation behavioral intention is stronger when images are more concrete than when images are more abstract.

H5c: The abstraction level of climate change images will moderate the effect of climate change *self-efficacy* on behavioral intention towards climate change adaptation. The effect of self-efficacy on intention to adapt to climate change is stronger when images are more concrete than when images are more abstract.

In the section on the effect of construal level, it is also explained that the abstraction process could interact with a variety of human values (e.g., self-transcendence, self-interest) to affect people's decision-making. Values play a prominent role as behavioral guides (Eyal et al., 2009; Knez, 2016), especially in environmental and climate change communication (Corner, Markowitz, & Pidgeon, 2014; Goldsmith et al., 2016). In psychological research, studies have

revealed that abstract construal could make people behave in ways that are more congruent with their core value orientations. In the context of climate change, this study predicts that people who have self-transcendent motives (e.g., biospheric, environmentally focused, or altruistic values) will be more encouraged to perform climate-friendly behaviors than those who do not have such values. When being exposed to abstract (vs. concrete) images, the behavioral gap between people with self-transcendent values and those who do not have such values will be enlarged. That is, images with higher level of abstraction will strengthen the effect of value orientation on people's attitudinal and behavioral responses to climate change. Therefore, it is predicted that:

H6a: The abstraction level of climate change images will moderate the effect of *value* orientation on perceived egocentric distance to climate change. The effect of self-transcendent values on egocentric distance to climate change is stronger when images are more abstract than when they are more concrete.

H6b: The abstraction level of climate change images will moderate the effect of *value* orientation on mitigation behavioral intention. The effect of self-transcendent values on mitigation behavioral intention is stronger when images are more abstract than when they are more concrete.

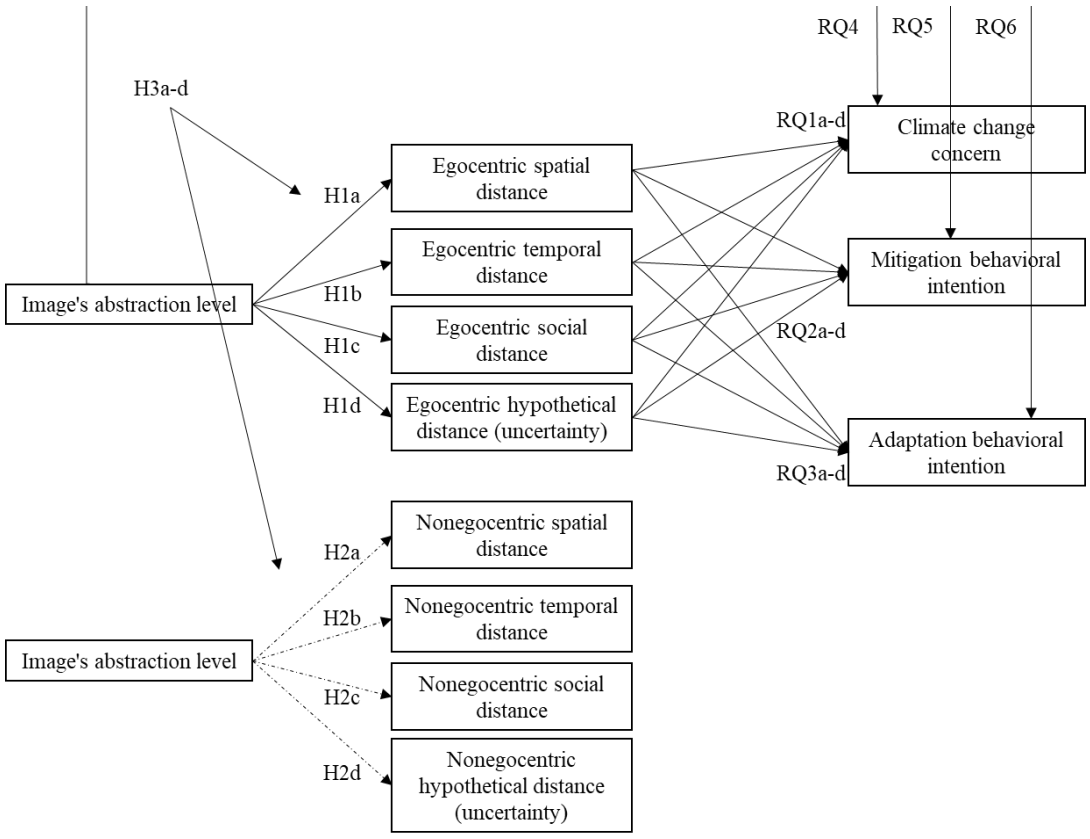
H6c: The abstraction level of climate change images will moderate the effect of *value* orientation on behavioral intention towards climate change adaptation. The effect of self-transcendent values on intention to adapt to climate change is stronger when images are more abstract than when they are more concrete.

Similar to value orientation, self-efficacy and climate change concern, political orientation and other social psychological factors also play an important role in predicting people's diverging beliefs on climate change (Hart & Nisbet, 2012; Hindman, 2009; Malka,

Krosnick, & Langer, 2009; McCright & Dunlap, 2011). Thus, it is possible that like other social psychological factors (e.g. environmental concern, value orientation), the effect of political orientation on people's responses to climate change is moderated by construal level of climate change. The following research questions are proposed:

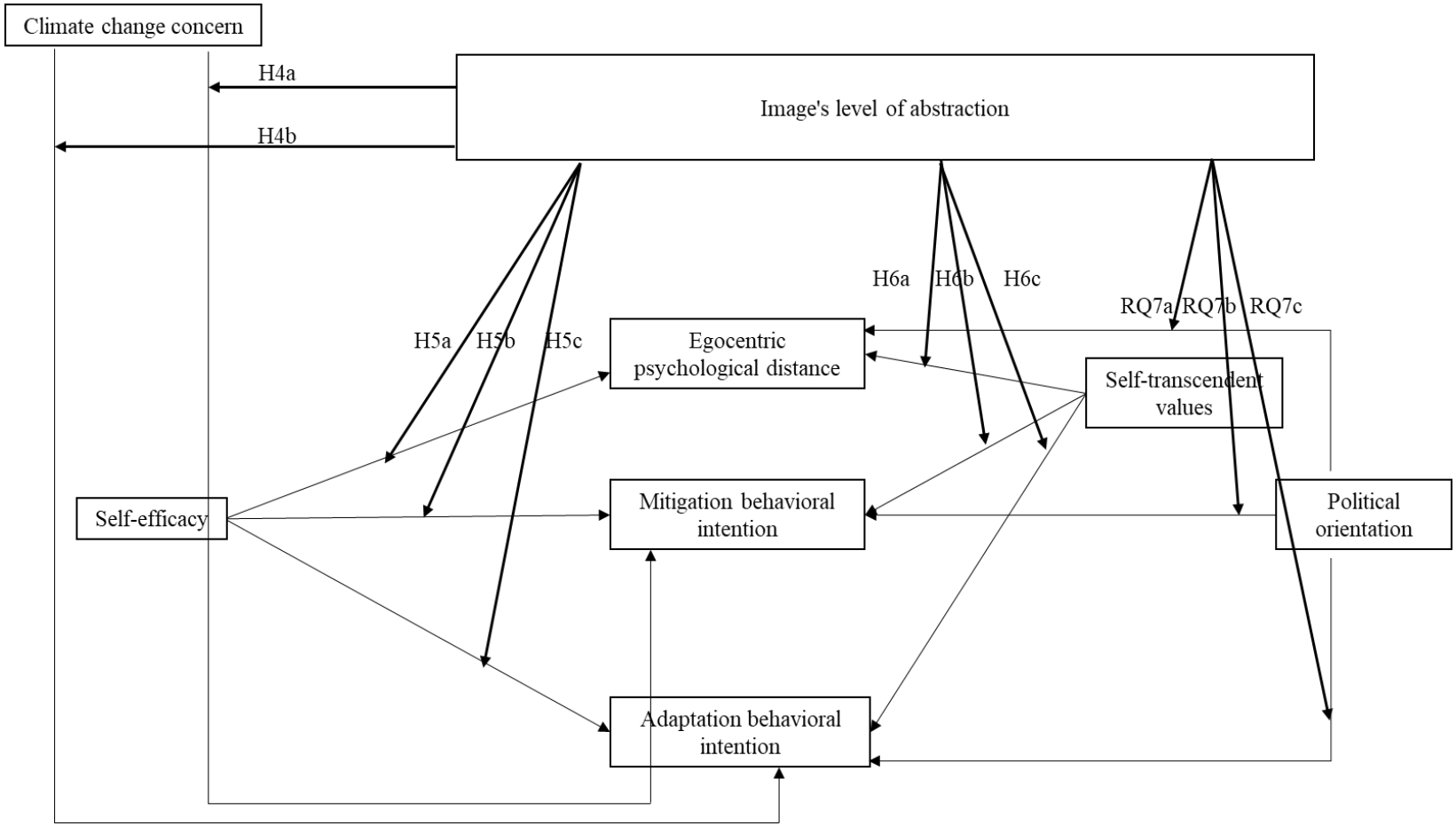
How could abstraction level of climate change images moderate the effect of political orientation on egocentric psychological distance to climate change (**RQ7a**), the effect of political orientation on mitigation behavioral intention (**RQ7b**), and the effect of political orientation on intention toward climate change adaptation (**RQ7c**)?

Figure 1 The proposed model



Note: H2a-d (dashed arrows) predict that an image's level of abstraction would not influence the four nonegocentric psychological distances; H3a-d compare the positive effect of an image's abstraction level on egocentric and on nonegocentric distances.

Figure 2 Conceptual model with the proposed moderation effect of image's level of abstraction



Note: Bold arrows are the hypothesized moderations. The four egocentric psychological distance dimensions (spatial, temporal, social and hypothetical distances) were averaged to form an index of egocentric psychological distance.

CHAPTER 3: METHOD

Climate change visuals and their effects have traditionally been studied using approaches such as content analysis, discourse analysis, thematic analysis, Q-method (with small sample sizes), survey questionnaire, or social semiotics (for an overview, see O'Neill & Smith, 2014). Experimental method had not been adopted until recent years (e.g., Hart & Feldman, 2016). This dissertation builds upon and goes beyond this past research in several ways. First, it uses an online experimental method to examine the effect of visuals. Pretest 1 and Pretest 2 experiments are used to ensure the experimental manipulation is successful, and face-to-face interviews in Pretest 3 are conducted to ask for advice on the main test experiments' questionnaires to make sure they are well-designed. Two main experiments are included to address the hypotheses and the research questions. Second, this study uses large-size diverse national sample for the two main experiments (Experiment 1 and 2). Lastly, the effect of real-world images as well as their accompanying captions are examined, where the images are only minimally modified to make sure they are in the same style and size.

All the experiments are post-test only between-subject designs with two conditions (abstract v.s. concrete). Pretests of individual's existing perceptions of the distance of climate change were not conducted because they may cue the participants to make inferences about the purpose of the experiment and to respond in accordance with (or contrary to) the perceived purpose when answering the same questions in the post-test. These will cause harm to the internal validity. Although no pretest of individual's existing perceptions is designed, the equivalence of groups can be ensured by random group assignment and large sample size. Furthermore, this study does not use no-image control group, because CLT focuses on the contrasts between more abstract and more concrete construals; also, experiments in previous

theoretical and empirical studies of psychological distance of climate change focused on the comparisons between distant and proximal framing conditions (e.g., Jones et al., 2016; Sacchi et al., 2016; Rickard, Yang & Schuldt, 2016) and did not include a control group.

Procedure

Pretest 1 and 2. Pretest 1 and 2 were conducted before the main study. They served as a manipulation check and were used to examine if the abstract and the concrete climate change images selected for this study can successfully activate people's abstract and concrete construals, respectively. Pretest 1 was conducted in April 2017. A total of 18 images of climate change were selected, including nine abstract and nine concrete images. Participants were randomly assigned to either the abstract condition or the concrete condition (described below). In both conditions, on the first webpage, participants were told that they would see nine climate change-related images accompanied by captions. Following the images, participants were given the Behavioral Identification Form (BIF) (Vallacher and Wegner, 1987; Vallacher and Wegner, 1989) which measured their differences in construal level. The BIF has 25 randomized items, each of which presented a behavior (e.g., making a list) along with two alternate descriptions of the behavior, namely, the lower-level identification (concrete; coded as 0; e.g., writing things down) emphasizing the means by which the behavior is performed and a higher-level identification (abstract; coded as 1; e.g., getting organized) emphasizing the end for which the behavior is performed. Participants were asked to select their preferred alternate description for each given behavior. For each participant, all of their 25 responses on the BIF form were coded and then summed to create a score representing their level of construal, with higher scores indicating higher level of construal (more abstract thinking). Pretest 2 was conducted in June 2018, and it

replicated Pretest 1 using a different set of climate change images (n=18). Two rounds (two iterations) of pretest were conducted to check the manipulation because 1) firstly, they were used to verify whether the general criteria for selecting abstract and concrete images of climate change were valid and replicable, that is, whether images selected under these criteria can successfully activate people's different levels of construal in a consistent way; and 2) in each iteration, the magnitude of the difference between the abstract and the concrete conditions (effect size) was measured. This allows for a comparison between the two pretests, which can potentially reveal what set of images produces larger effect than the other. That set of images with higher effect size could potentially be used as stimuli for the two main test experiments (See "Stimuli" section for details).

Pretest 3: Cognitive Interviews. Cognitive interviewing refers to a special type of pretest that focuses on respondents' thought process as they read questions in a survey (Willis, 2004). In this dissertation, fifteen cognitive interviews were conducted before the main study, which fits within the recommended sample size (between 5 and 15) for large-scale national survey panels (Ryan, Gannon-Slater, & Culbertson, 2012; Willis, 2004). A convenience general population sample in San Diego, California, were recruited through face-to-face requests at various coffee shops. Participants were asked to provide feedback on the clarity and length of the survey instruments. In the interviews, the participants were asked 1) to rephrase the question in their own words, or what they thought the question was asking 2) to give a response before seeing the response options, 3) what specific phrases in the questions meant to them, and 4) how difficult/confusing a question was to them. At the end, participants were asked what overall suggestions they had for the survey design, such as the ordering of the questions/sections, length of the instruments, layout, etc. Following the method suggested by Willis (2004), the

interviewing was iterative, with items being updated iteratively according to participants' feedback. Based on past interview feedback, the two main test questionnaires were revised and tested on new rounds of interviews until relatively well-functioning. This cognitive interviewing process helped reduce measurement errors and improved content validity of the items. The two main test experiments were conducted after the interviews were completed and after the survey instruments were finalized.

Experiment 1. The set-up for Experiment 1 is similar to that of Pretest 1 and 2. First, participants were randomly assigned to one of the two conditions (abstract, concrete). Each participant viewed either nine abstract or nine concrete images of climate change. Then, they were directed to fill out a questionnaire that asks their nonegocentric psychological distance of climate change on the four distance dimensions (temporal, spatial, social, and hypothetical dimensions). Specifically, participants were instructed to take the future generation's perspectives to think about climate change and to take the Maldivians' perspectives to estimate how the Maldivians experience or perceive climate change. This nonegocentric perspective-taking is different from egocentric thinking, and it requires a concern for others' welfare. The Maldives is a tropical island nation in the Indian Ocean; it is the lowest-lying country in the world and is very vulnerable to sea level rise associated with climate change. The Maldives is chosen for this study because it has been widely used as a "test case" for climate change impacts, studies of climate change communication and psychological distance of climate change (e.g., Schuldt, Rickard, & Yang, 2018). After the section on nonegocentric distance perceptions, participants were asked about their concern for climate change, behavioral intentions toward climate change mitigation and adaptation. The final part of the survey asked

about participants' demographic characteristics, such as age, gender, education level, race, income, and political orientation. All participants were thanked and debriefed at the end.

In this experiment, participants' value and self-efficacy were not asked, since this experiment is designed to only address H2a – H2d, H3a – H3d, which all focus on nonegocentric psychological distances. The effect of construal level and its relationship with egocentric psychological distance, values, and climate change self-efficacy were assessed in the second experiment.

Experiment 2. In Experiment 2, similarly, participants were randomly assigned to one of the two experimental conditions (abstract, concrete). Each participant viewed either nine abstract or nine concrete images of climate change. After looking at the images, participants were asked to complete a questionnaire. The questionnaire firstly assesses participants' egocentric psychological distance of climate change, then it asks about participants' concern for climate change, behavioral intentions toward climate change mitigation and adaptation, perceived self-efficacy on climate change, value orientations, and lastly, their demographical information including age, gender, education level, race, income, and political orientation (for the measurements of these concepts, see the section "Measurements" below). At the end, participants were thanked and debriefed.

Stimuli

The 18 images used in Pretest 2 were continuously used as stimuli in the two main test experiments (See Appendix F for details). Although the effect size that measures the differences between the two groups was extremely close to that of Pretest 1, images used in Pretest 2 were collected in 2018 and were more up-to-date. Thus, Pretest 2 images were selected and used as

main test stimuli. Among these 18 images, nine have abstract features and the other nine images have concrete features, and they were used for the abstract and the concrete conditions respectively. All the abstract and concrete features have been identified in prior experimental research in psychology (Burgoon, Henderson, & Markman, 2013) as well as visual content analysis research in the field of climate change communication (Duan, Zwickle, & Takahashi, 2017). These images were selected based on the criteria described in the previous research that clarified how level of abstraction of climate change image should be measured (Duan et al., 2017); the selection was also based on the abstract and concrete definitions described in CLT (Trope & Liberman, 2010).

Specifically, for example, in the abstract condition, images are black-and-white non-photographs (e.g., satellite images, cartoons, line graphs), with no humans, and they focus on the causes of climate change and portray climate change more as a constant invariant process (e.g., melting ice, greenhouse gas emissions). In contrast, images in the concrete condition are colorful photographs, and they feature ordinary people in the U.S., containing detailed information about the present situation (e.g., temporal, spatial and identity information). They emphasize certain consequences and incidental aspects of climate change. All the images and captions were only minimally modified to display in roughly similar size and style.

Participants

In Pretest 1, 198 participants from Amazon Mechanical Turk (MTurk) were recruited (for a description of this data source (see Paolacci, Chandler & Ipeirotis, 2010). Similarly, Pretest 2 recruited 192 participants from Mturk. In Pretest 3, fifteen residents of San Diego California, were recruited, and each of them received $10 as compensation. The interviewees included: an

individual who recently immigrated into the U.S. from South Africa, a local musician, a chemical scientist at the University of California-San Diego, a student at San Diego State University, a business owner, etc.

A power analysis for sample size estimation was conducted, with a confidence level = 95% (Z-score = 1.96), standard deviation = .5, confidence interval = 5%, effect size ≈ .20, and power = .80 for a between group comparison, which suggests a sample size of approximately N = 390 for each main test experiment. In order to explore the research topic with a more diverse sample, Experiment 1 and Experiment 2 each recruited 450 participants from Qualtrics' online panel. The recruited number of responses were more than that was estimated, considering that some of the responses may not be of high quality and may be deleted in data analysis. Quotas for gender, age, race/ethnicity, region and political orientation were utilized to ensure a diverse sample that had characteristics similar to census data for the United States. In Experiment 1 (nonegocentric experiment), participants had an average age of 45.77 years (SD = 16.51) and were 51.6% female, 73.3% White, and 12.9% Hispanic or Latino. Median education was "Trade/technical/vocational training," and 32.6% of participants had a bachelor's degree or higher. Median income was $50,000 to less than $75,000. In Experiment 2 (egocentric experiment), participants had an average age of 45.93 years (SD = 16.51) and were 52.9 % female, 73.2% White, and 11.9% Hispanic or Latino. Median education was "Trade/technical/vocational training," and 35.9% of participants had a bachelor's degree or higher. Median income was $50,000 to less than $75,000. There were 1% (n=5) participants that had invalid age responses (beyond reasonable age range), and these responses were replaced by mean values.

Measurements

Egocentric and Nonegocentric Distances of Climate Change. Participants' nonegocentric and egocentric psychological distances of climate change were measured using items adapted from past research (Hart & Nisbet, 2012; Jones et al., 2016; Leiserowitz, Maibach, Roser-Renouf, Feinberg, & Howe, 2013; Liberman & Förster, 2011; Spence et al., 2012). To test H2a – H2d, H3a – H3d and ensure the effects of construal level on nonegocentric and egocentric distances are comparable, this study phrased nonegocentric and egocentric distances in the same format. There were two sets of items of similar format measuring people's egocentric and nonegocentric distances on each distance dimension (See Table 1 for details). In the nonegocentric experiment (Experiment 1), participants were asked to think about climate change from future generation's perspectives and from the Maldivians' perspectives.

Table 1 Measurements of egocentric and nonegocentric psychological distances of climate change

	Egocentric distance	**Nonegocentric distance**
Spatial distance	Worst effects of climate change are felt more by faraway places/countries rather than ***my place***.	Compared to other places in the world, worst effects of climate change are felt more by places/countries near ***the Maldives***.
	I think about ***faraway*** places rather than nearby places more often when thinking of negative effects of climate change.	***The Maldivians (Maldive Islanders)*** think about ***nearby*** places rather than faraway places more often when thinking of negative effects of climate change.
	Many negative effects of climate change are geographically ***close to me***.	Many negative effects of climate change are geographically ***close to the Maldives***.
	[a] I feel the estimated distance between the geographical area(s) that are being negatively affected by climate change and ***my location*** could be:	[a] I feel the estimated distance between the geographical area(s) that are being negatively affected by climate change and ***the Maldives*** could be:

Table 1 (cont'd)

	Mean = 3.73, SD = 1.28, Cronbach's alpha = .73	[e] Mean = 3.47, SD =1.28, Spearman-Brown coefficient = .70
Temporal distance	[b] Imagine that climate change shows negative effects. How much time ***from now*** do you think you will personally see these negative effects?	[b] Imagine that climate change will show its negative effects at a future time. How much time ***after that future time point*** will you personally see these negative effects?
	Climate change is an urgent threat or risk ***for my generation***.	***For future generation***, climate change will be an urgent threat or risk.
	I will be able to feel the negative effects of climate change ***very soon***.	Imagine that you are in the year 2030. You will be able to feel the negative effects of climate change ***very soon in or after 2030.***
	Mean = 2.70, SD = 1.55, Cronbach's alpha = .83	Mean = 2.60, SD =1.51, Cronbach's alpha = .86
Social distance	***I*** can personally feel ***familiar*** with the similar negative experiences reflected in the images.	***The Maldivians (Maldive Islanders)*** can personally feel ***unfamiliar*** with the similar negative experiences reflected in the images.
	The stories in the images show problems similar ***to my own***.	The stories in the images show problems similar ***to the Maldivians (Maldive Islanders)***.
	People generally similar to me can feel/experience the negative impacts of climate change.	***The Maldivians (Maldive Islanders)*** can feel/experience the negative impacts of climate change.
	Climate change could negatively ***affect me*** much more than other people ("Other people" are not family or close friends).	Climate change could negatively ***affect the Maldivians (Maldive Islanders)*** much more than other people.
	I could be socially and personally ***faraway*** to many negative effects of climate change.	***The Maldivians (Maldive Islanders)*** could be socially and personally ***faraway*** to many negative effects of climate change.

Table 1 (cont'd)

	[c] ***My chance*** of feeling the negative effects of climate change is __ than that of other people in the world ("Other people" are not family or close friends).	[c] ***The Maldivians' (Maldive Islanders) chance*** of feeling the negative impacts of climate change is _ than that of other people in the world.
	Mean = 3.73, SD = 1.09, Cronbach's alpha = .77	Mean = 3.34, SD = .95, Cronbach's alpha = .70
Hypothetical distance	The seriousness of the negative effects of climate change ***on me*** could be largely exaggerated.	The seriousness of the negative effects of climate change ***on the Maldivians (Maldive Islanders)*** could be largely exaggerated.
	It is certain that climate change will have a negative impact ***on me***.	It is certain that climate change will have a negative impact ***on the Maldivians (Maldive Islanders).***
	[d] How do you estimate the likelihood of ***yourself*** seeing negative effects of climate change?	[d] How do you estimate the likelihood of ***the Maldivians (Maldive Islanders)*** seeing negative effects of climate change?
	Mean = 3.26, SD = 1.49, Cronbach's alpha = .79	Mean = 3.11, SD = 1.31, Cronbach's alpha = .78

Note: [a] This question was measured on a 6-point Likert scale that ranged from "Extremely close" to "Extremely distant;" [b] This question was measured on a 9-point Likert scale, including options "< 5 years," "5-10 years," "10-15 years," "15-20 years," "20-25 years," "25-30 years," "30-50 years," "50-100 years," and "Hundreds of years from now;" [c] This question was measured on a 7-point Likert scale including options "60% lower than other people," "40% lower than other people," "20% lower than other people," "equal to other people," "20% higher than other people," "40% higher than other people," and "60% higher than other people;" [d] This question was measured on a 6-point Likert scale ranging from "Extremely low probability" to "Extremely high probability." All other items in the table were measured on a 7-point Likert scale ranging from "Strongly disagree" to "Strongly agree." The negatively worded items were reverse coded, and the scales were standardized to 7-point, with higher values indicating greater (egocentric, nonegocentric) psychological distances. Reliability values, the mean and standard deviation values of the four composite scores for each type of psychological distance are indicated in the table. [e] The original four items in the nonegocentric spatial distance index did not reach an acceptable reliability score. Thus, a principle component analysis was conducted and the items with low factor loadings were removed. The first and the third items were retained, and the index was then performed with the Spearman-Brown coefficient, which is more appropriate than is Cronbach's alpha when the scale consists only two items (Eisinga, Grotenhuis, & Pelzer, 2013).

Climate Change Concern. The questions that measure climate change concern were adapted from Spence et al. (2012). Participants were asked "How concerned, if at all, are you about climate change, sometimes referred to as global warming?" "Considering any potential effects of climate change which there might be on you personally, how concerned, if at all, are you about climate change?" and "Considering any potential effects of climate change there might be on society in general, how concerned, are you about climate change?" The Likert-type scale responses ranged from 1 (not at all concerned) to 5 (a great deal concerned). The scores for the 3 items were averaged to form an index of climate change concern (Egocentric experiment: M = 3.48, SD = 1.22, Cronbach's alpha = .93; Nonegocentric experiment: M = 3.48, SD = 1.24, Cronbach's alpha =.94).

Climate Change Mitigation Behavioral Intention. Behavioral intention was divided into two types - mitigation behavioral intention and adaption behavioral intention. For each of them, both generic and specific intentions were measured. Generic mitigating intention was measured by a 4-item Likert-type scale, including "I plan to take some actions to stop climate change," "I personally do not intend to do much to stop climate change," "I will make some efforts to mitigate greenhouse gas emissions," and "I intend to take concrete steps to do something to mitigate greenhouse gas emissions." Specific mitigating intention was adapted from Broomell, Budescu, Por (2015), Brügger et al. (2016), Gifford and Comeau (2011) and O'Connor, Bard, and Fisher, (1999). It was measured by a 8-item Likert-type scale, including items such as "I intend to choose a car that gets good gas mileage (this would reduce the purchase of trucks, vans, and Bronco type vehicles)," "I intend to install more insulation and weatherize homes and apartments," "I intend to use more carpooling and/or drive less using trains and buses more often," "I intend to replace older appliances with more energy efficient

new models (refrigerators, furnaces, dishwashers, and others)," "I intend to use less air conditioning in the summer and less heat in the winter," "I intend to switch off lights when not in use," "I intend to buy local foods when possible," "I intend to eat less meat." The scores for the 12 generic and specific items were averaged to form the index of mitigation intention for a range of scores from 1 (Very unlikely) to 5 (Very likely) (M = 3.59, SD = .83, Cronbach's alpha = .88).

Behavioral Intention Towards Climate Change Adaptation. The items used to measure generic adaptation intention were developed by imitating those used for generic mitigation intention. Generic adaptation intention was measured by a 4-item Likert-type scale, including "I plan to take some actions to adapt to climate change," "I personally do not intend to do much to adapt to climate change," "I will make some efforts to adapt to the negative effects of climate change," and "I intend to take concrete steps to do something to adapt to the negative effects of climate change." Specific adaptation intention was adapted slightly from Brügger et al. (2016). It was measured by a 9-item Likert-type scale, including items such as "I intend to repaint my (future) house in a lighter color (less heat absorption in the summer)," "I intend to buy a flood insurance or other climate-related disaster insurance for my (future) house," "I intend to install a water re-use system at home," "I intend to donate money to preserve species at risk from climate change," "I intend to persuade relatives or friends to move away from flood plains or climate-vulnerable areas," "I intend to fit water saving device in my cistern to save when flushing," "I intend to read more about how to avoid heat stress during heat waves," "I intend to find out how much my (future) house or flat is at risk from climate-related risks," and "I intend to donate money for projects in developing countries that move housing estates away from areas at risk of climate change." The scores for the 13 generic and specific items were averaged to

form the index of adaptation intention, for a range of scores from 1 (Very unlikely) to 5 (Very likely) (M = 3.19, SD = .91, Cronbach's alpha = .92).

Perceived Efficacy. The perceived efficacy items asked participants to indicate their level of agreement with three statements: "I believe my actions have an influence on global warming and climate change," "My actions to reduce the effects of global warming and climate change in my community will encourage others to reduce the effects of global warming through their own actions," and "Human beings are responsible for global warming and climate change." These 3-item Likert-type scale ranged from 1 (Strongly disagree) to 7 (Strongly agree) and was adopted from previous research (Kellstedt, Zahran, & Vedlitz, 2008; Milfont, 2012). The scores for the three items were averaged to form an index of self-efficacy, for a range of scores from 1 to 7 (M = 4.77, SD = 1.48, Cronbach's alpha = .80).

Values. Research shows that the self-transcendent versus self-enhancement dimension of the values in the Schwartz's Value Theory is especially relevant to various types of environmental beliefs and behaviors (De Groot & Steg, 2007; Schwartz, 1992, 1994; Steg, Perlaviciute, van der Werff, & Lurvink, 2014). These values are typically measured with an adapted short version of the Schwartz Value Survey (SVS) (Bouman, Steg, & Kiers, 2018). Following the SVS procedure, participants in this study were presented with a list of values, all of which had a short title (e.g., "unity with nature") and a brief description in a parenthesis (e.g., "fitting into nature"). Participants were asked how important each value is as a guiding principle in their lives on a 9-point bi-polar scale (−1 *opposed to my values* to 0 *not important* to 7 *of supreme importance*). The self-transcendent values include altruistic and biospheric value dimensions. Similarly, there are two types of self-enhancement values: egoistic values (the special consideration of costs and benefits of environmentally significant behavior, (de Groot &

Steg, 2008), and hedonic values ("a concern about improving one's feelings and reducing effort," Steg et al., 2014, p.167). A number of the 8 items were used to measure self-transcendent values: Preventing pollution (protecting natural resources), protecting the environment (preserving nature), respecting the earth (harmony with other species), unity with nature (fitting into nature), equality (equal opportunity for all), social justice (correcting injustice, care for the weak), a world at peace (free of war and conflict), and helpful (working for the welfare of others). The scores for the 8 items were averaged to form an index of self-transcendent values, for a range of scores from -1 to 7 (M = 5.34, SD = 1.30, Cronbach's alpha = .89). Self-enhancement scale was measured by 8 value items, including social power (control over others, dominance), authority (the right to lead or command), influential (having an impact on people and events), wealth (material possessions, money), ambitious (hardworking, aspiring), pleasure (gratification of desires), enjoying life (enjoying food, sex, leisure), self-indulgent (doing pleasant things). The scores for the 8 items were averaged to form an index of self-enhancement value, for a range of scores from -1 to 7 (M = 3.76, SD = 1.28, Cronbach's alpha = .75).

Other Variables. The differences in individuals' responses to environmental issues were also found in previous studies to be related to sociodemographic variables, such as age, gender, education, race, ethnicity, region of residence, political orientation and income (Gifford & Nilsson, 2014). Thus, they were also measured in this study. Age was measured in years. Region was divided into four Census Bureau-designated region categories, which include "Northeast," "Midwest," "South," and "West." (United States Census Bureau, 2018). Higher numbers for education, income and political orientation indicate higher education, income levels and more liberal political opinions.

Data Analysis

Pretest 1 and 2. In Pretests 1 and 2, to compare the construal level of abstract and concrete conditions' participants, responses on construal level questionnaire were exported into SPSS software for descriptive analysis, independent sample t-test and effect size calculation.

Pretest 3: Cognitive Interviews. The data from the interviews were used to identify major problems mentioned by the interviewees (e.g., problems with the study design, problems of the question wordings or question ordering, etc.). The qualitative feedback collected from the interviews was then analyzed, and the identified problems in the questionnaires were fixed prior to the two main test experiments. For example, one statement in the questionnaire "Climate change could negatively affect me," was supposed to measure an individual's social closeness to the risk relative to others. However, when participants were asked how they interpreted the statement, a young man mentioned that climate change could negatively affect both other people and himself, although to a varying degree. Similarly, another young woman thought the question was vague since she believed climate change happened or will happen to everyone. Therefore, the statement was narrowed down and revised to more specifically refer to self-other comparison; it was changed to "Climate change could negatively affect me much more than other people ('Other people' are not family or close friends)."

Experiment 1 and Experiment 2. The two experiments were conducted at the same time to test the first set of hypotheses (H1a-d, H2a-d, H3a-d). The question formats and the scales of the independent and dependent variables were designed to be the same for the two experiments, which can ensure that the equality of coefficients from the two different regression models from the two experiments can be compared. Then the two datasets were combined for data analysis purposes. Multiple regressions were conducted to test the effect of images' abstraction level on

the four nonegocentric distance dimensions and the four egocentric distance dimensions, respectively, while controlling for demographic variables. The regression coefficients in the two regression models were then compared with the Z test formula proposed by Clogg, Petkova, & Haritou (1995) and Paternoster, Brame, Mazerolle, & Piquero (1998). Experiment 2 was conducted to also address the rest of the research questions and hypotheses. Multiple regressions were conducted, regressing climate change concern, mitigation behavioral intention, and adaptation intention against the four egocentric psychological distances, respectively, while controlling for relevant variables. Second, climate change concern, mitigation and adaptation intentions were regressed on images' level of abstraction, respectively. Last, to examine the potential moderating effect of construal level, moderation models were explored using PROCESS macro (Hayes, 2013) (model 1, 5000 bootstrap resampling) with the images' level of abstraction (abstract images vs. concrete images) as moderator; climate change concern, perceived self-efficacy, self-transcendent values, and political orientation as independent variables respectively; and egocentric psychological distance, mitigation intention, adaptation behavioral intention as dependent variable for each model.

CHAPTER 4: RESULTS

Pretests

Pretest 1. To test whether the abstract and concrete images were successful in manipulating respondent's level of construal, Pre-test 1 was conducted using the BIF questionnaire (See Appendix E for stimuli). For most of the items in the BIF test (24 out of 25), the percent of participants who preferred higher level (abstract) descriptions in the abstract condition was higher than that of the participants in the concrete condition (See Appendix G for details). An independent samples t-test showed a statistically significant difference between the two conditions: participants who viewed abstract images were more likely to prefer abstract behavioral descriptions (n=99, M=16.12) in the BIF test than those who viewed concrete images (n=99, M=13.76) (p=.022, Cohen's d = .33), that is, they were activated to have higher level of construal than those in the concrete condition. Thus, the manipulation was successful.

Pretest 2. Pretest 2 replicated Pretest 1 using another set of images. The images were selected following the same criteria (See Appendix F for stimuli). For most of the items in the BIF test (23 out of 25), the percent of participants who preferred higher level (abstract) descriptions in the abstract condition was higher than that of the participants in the concrete condition (See Appendix G for details). An independent samples t-test showed a statistically significant difference between the two conditions: participants who viewed abstract images were more likely to prefer abstract behavioral descriptions (n=93, M=16.53) in the BIF test than those who viewed concrete images (n=99, M=14.35) (p=.024, Cohen's d = .33), that is, they were activated to have higher level of construal than those in the concrete condition. Thus, it was concluded that the manipulation was successful.

Pretest 3: Cognitive Interviews. In Pretest 3, cognitive interviews were conducted to pilot test the survey instrument of the main study. Participants pointed out the following issues: 1) The question "When thinking about my own chances of feeling the negative impacts of climate change, I believe that my chance of feeling the negative effects of climate change is __ of others' chances." was hard to understand, since people who thought they were more likely than others to experience climate change were asked to select percentages higher than 100%. To resolve this issue, "120%" was changed to "chance 20% higher than others," "100%" was changed to "equal to other people," etc. 2). Participants also mentioned the wordings of the nonegocentric distance questions were confusing since they were not very familiar with the country - the Maldives. According to this feedback, a detailed instruction section was added with a map illustrating the location of the country. 3) Two interviewees pointed out that the wording of the statements such as "worst effects of climate change are felt by faraway places" was unclear because climate change has effects on both their local area and faraway places. Based on this feedback, such statements in the two surveys were rephrased to emphasize comparisons between current and future, local and faraway places, self and others, reality and uncertainty (e.g., the statement "worst effects of climate change are felt by faraway places" was changed to "worst effects of climate change are felt by faraway places rather than my place.") After collecting all the important feedback, the wordings, question types and layout were all revised and improved to ensure that surveys were better designed and can be easily understood by a variety of audience.

Egocentric and Nonegocentric Psychological Distances of Climate Change

Two separate experiments were conducted to examine egocentric (Experiment 2) and nonegocentric (Experiment 1) psychological distances of climate change. Hypotheses (H1a-d) stated that participants' egocentric spatial distance (H1a), temporal distance (H1b), social distance (H1c) and hypothetical distance (H1d) of climate change would increase as climate change images' level of abstraction increased, while controlling for all other relevant predictors. To test these hypotheses, four egocentric distance outcome variables were regressed separately against the treatment condition (abstract vs. concrete images), as well as the key demographical variables that were found to associate with environmental perceptions in the past literature (Klineberg et al., 1998).

As Table 2 shows, participants who viewed abstract images thought climate change as spatially (B = .30, p<.001, r^2 = .10), temporally (B = .09, p<.05, r^2 = .01) and socially (B = .10, p<.05, r^2 = .01) more distant to themselves than those in the concrete condition, after controlling for social demographic variables. Therefore, H1a, H1b, and H1c were supported. Whereas, H1d was not supported, as participants in the abstract condition did not significantly differ from those in the concrete condition with regards to their egocentric hypothetical distance (perceived uncertainty) of climate change (p>.05).

Drawing on CLT, H2a-d predicted that images' abstraction level would not affect people's nonegocentric spatial distance (H2a), temporal distance (H2b), social distance (H2c) and hypothetical distance (H2d) of climate change. Four multiple linear regressions were conducted to test for the effect of abstraction level on the four nonegocentric psychological distance outcome variables, respectively, while controlling for other climate change perception-related social demographic variables. Table 2 reports that H2a was not supported, as images'

Table 2 OLS regression models explaining perceived egocentric (N= 448) and nonegocentric (N=442) distances of climate change

Variables	Spatial distance		Temporal distance		Social distance		Hypothetical distance	
	Ego-centric	Nonego-centric	Ego-centric	Nonego-centric	Ego-centric	Nonego-centric	Ego-centric	Non-egocentric
Treatment (abstract = 1)	.30***	-.15**	.09*	.03	.10*	-.08 [a]	.06	-.06
Control variables								
Age	-.15**	.06	.09	.04	-.01	.02	.03	-.04
Male	.06	-.02	.17***	.14**	.14**	.09	.13**	.08
Education	-.09*	-.07	-.01	-.02	-.09	-.09	-.08	-.01
Income	.04	-.01	-.02	.02	-.04	.03	.02	.00
Political orientation	-.24***	-.19***	-.35***	-.39***	-.28***	-.25***	-.38***	-.37***
Race [b]								
White	-.08	-.04	-.03	-.04	-.06	-.05	-.06	.04
Black	-.09	-.07	-.01	-.06	-.09	-.07	-.06	-.03
Hispanic	-.10*	-.10	-.01	-.08	-.09	-.15**	-.03	-.09
Region [c]								
Northeast	-.10	.00	-.05	.00	-.17**	.03	-.05	-.02
South	-.12*	-.00	-.00	.01	-.15*	.06	-.04	.02
West	-.21***	.00	-.08	-.02	-.18**	-.01	-.11*	-.01
Adjusted R^2	.198	.063	.160	.164	.136	.084	.166	.132
F	10.183***	3.472***	8.094***	8.195***	6.875***	4.382***	8.429***	6.609***

*Note: a. marginally significant (p < .10); b. Other is the reference group; c. Midwest is the reference group; Higher values indicate greater psychological distances; Entries are standardized beta coefficients; *p < 0.05, **p < 0.01, ***p < 0.001.*

level of abstraction significantly predicted people's nonegocentric spatial distance (B = -.15, $p<.01$, $r^2 = .03$); people who viewed abstract (vs. concrete) images of climate change perceived less (vs. greater) spatial distance between other people and climate change. In terms of nonegocentric social distance (H2c), it was found the difference between abstract and concrete conditions was marginally significant (B = -.08, $p<.10$, $r^2 = .01$), with perceived nonegocentric social distance in the abstract condition slightly lower than those in the concrete condition. Since images' level of abstraction had no significant effect on either nonegocentric temporal distance, social distance or hypothetical distance (perceived uncertainty), H2b, H2c and H2d were supported.

To gain further understanding of how the concepts of egocentric and nonegocentric psychological distances differ in climate change communication, this study also hypothesized that images' abstraction level had greater positive effect on egocentric distances than nonegocentric distances of climate change in terms of spatial (H3a), temporal (H3b), social (H3c) and hypothetical (perceived uncertainty) (H3d) dimensions. For each distance dimension, the β of abstraction level from the egocentric and the nonegocentric regression models were compared using the Z test formula proposed by Clogg, Petkova, & Haritou (1995) and Paternoster, Brame, Mazerolle, & Piquero (1998). One-tailed test results showed that on spatial ($Z=7.19$, $p<.001$), social ($Z=2.84$, $p<.01$) and hypothetical (perceived uncertainty) ($Z=1.95$, $p<.05$) dimensions, images' abstraction level had a significantly greater positive effect on egocentric distances than on nonegocentric distances (it even had negative effect on nonegocentric spatial distance). However, the effect of images' level of abstraction on egocentric and nonegocentric temporal distances of climate change did not differ significantly ($Z=1.11$, $p>.05$). Therefore, H3a, H3c, H3d were supported, and H3b was not supported.

To address RQ1a, a multiple regression was run to predict climate change concern from egocentric spatial distance, self-efficacy, self-transcendent values, and other social demographic variables. Model 1 in Table 3 statistically significantly predicted climate change concern $F(14, 433) = 40.092$, $p < .001$, adjusted $R2 = .55$. It was found that participants' concern for climate change increased as their egocentric spatial distance to climate change decreased ($B = -.24$, $p < .001$, $r^2 = .19$), when controlling for other relevant variables. Similar multiple regressions were run to address how egocentric temporal (RQ1b), social (RQ1c), and hypothetical (perceived uncertainty) (RQ1d) distances predict climate change concern, respectively, after controlling for relevant variables. Model 2 in Table 3 statistically significantly predicted climate change concern $F(14, 433) = 61.613$, $p < .001$, adjusted $R2 = .66$. It shows that people's concern for climate change increased as their egocentric temporal distance to climate change decreased ($B = -.53$, $p < .001$, $r^2 = .59$). Similarly, Model 3 in Table 3 statistically significantly predicted climate change concern $F(14, 433) = 47.749$, $p < .001$, adjusted $R2 = .59$, showing that people's concern for climate change increased as their egocentric social distance to climate change decreased ($B = -.38$, $p < .001$, $r^2 = .44$). Finally, in Table 3, Model 4 statistically significantly predicted climate change concern $F(14, 433) = 62.482$, $p < .001$, adjusted $R2 = .66$. People's concern for climate change also increased as their egocentric hypothetical distance to climate change (perceived uncertainty of climate change) decreased ($B = -.56$, $p < .001$, $r^2 = .61$), when controlling for other relevant variables.

To address RQ2a-d, hierarchical multiple regressions were conducted to predict climate change mitigation behavioral intention from egocentric psychological distance, self-efficacy, self-transcendent values, climate change concern, and other social demographic variables.

Table 3 OLS regression models explaining climate change concern (N = 448)

	Model 1	Model 2	Model 3	Model 4
Egocentric psychological distances				
Egocentric spatial distance	-.24***			
Egocentric temporal distance		-.53***		
Egocentric social distance			-.38***	
Egocentric hypothetical distance (uncertainty)				-.56***
Perceived self-efficacy	.57***	.33***	.42***	.29***
Self-transcendent values	.10**	.07*	.11**	.07*
Control variables				
Age	-.09*	-.01	-.06	-.04
Male	.02	.07*	.04	.04
Education	-.04	-.01	-.04	-.05
Income	-.01	-.01	-.02	.02
Political orientation	.06	.02	.06	.01
Races [a]				
White	-.02	-.02	-.03	-.04
Black	-.01	.01	-.03	-.02
Hispanic	-.05	-.01	-.05	-.02
Region [b]				
Northeast	.01	.01	-.03	.01
South	-.07	-.02	-.08*	-.03
West	-.04	.00	-.04	-.02
Adjusted R^2	.550	.655	.594	.658
F	40.092***	61.613***	47.749***	62.482***

*Note: [a] Other is the reference group; [b] Midwest is the reference group; Higher values indicate greater psychological distances; Entries are standardized beta coefficients; *p < 0.05, **p < 0.01, ***p < 0.001.*

Results in Table 4 show that when only controlling for social demographic variables, participants who perceived less spatial distance between climate change and themselves tended to have greater intention to engage in climate change mitigation behaviors (B = -.30, p <.001, r^2 = .13). But the negative effect of egocentric spatial distance on mitigation intention became insignificant in Model 2 when climate change concern, self-efficacy and environmental value variables were included (p> .05). Similarly, as shown in Model 3 and Model 4 in Table 4, participants who perceived climate change as temporally closer to themselves had greater climate change

mitigation intention (B = -.57, p <.001, r^2 = .37). But the negative effect of egocentric temporal distance on mitigation intention became insignificant in Model 4 when climate change concern, self-efficacy and environmental value variables were included (p > .05). In Table 4, Model 5 shows that while controlling for demographic variables, egocentric social distance had a significant negative effect on intention to mitigate climate change (B = -.55, p <.001, r^2 = .34), with people feeling greater social distance to climate change having lower mitigation behavior intention. Although this effect attenuated in the following model (Model 6, B = -.16, p <.001), the statistical significance level did not drop after including the environmentalism variables. In terms of hypothetical distance, Model 7 in Table 4 shows that people who perceived greater uncertainty about climate change had significantly lower intention to engage in climate change mitigation behaviors, after controlling for demographic variables (B = -.63, p <.001, r^2 = .43). This negative effect attenuated in the following model (Model 8, B = -.17); the statistical significance level also dropped from p = .001 to p = .01 level when climate change concern, self-efficacy and self-transcendent environmental value were included.

To address RQ3a-d, similar hierarchical multiple regressions were conducted to predict people's intention to adapt to negative effects of climate change from egocentric psychological distance, self-efficacy, self-transcendent value, climate change concern, and other social demographic variables (See Table 5 for details).

Table 4 Hierarchical regression explaining climate change mitigation behavior intention (N = 448)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Block 1: Control variables								
Age	-.08	-.01	.02	-.00	-.04	-.01	-.01	-.01
Male	-.12**	-.03	-.04	-.03	-.06	-.02	-.06	-.03
Education	.04	.05	.06	.05	.02	.04	.02	.04
Income	.01	-.05	-.01	-.05	-.02	-.05	.02	-.04
Political orientation	.19***	-.03	.07	-.03	.11**	-.03	.03	-.04
Races [a]								
White	-.04	-.01	-.03	-.01	-.05	-.02	-.06	-.02
Black	-.06	-.06	-.04	-.06	-.09	-.07	-.08	-.07
Hispanic	.03	-.01	.05	.00	.01	-.01	.04	.00
Region [b]								
Northeast	-.04	-.03	-.03	-.03	-.10*	-.05	-.04	-.03
South	-.06	-.06	-.02	-.05	-.09	-.08	-.03	-.06
West	.06	.03	.08	.04	.03	.02	.06	.03
Egocentric spatial distance	-.30***	-.05						
Egocentric temporal distance			-.57***	-.08				
Egocentric social distance					-.55***	-.16***		
Egocentric hypothetical distance (uncertainty)							-.63***	-.17**
Block 2: Environmentalism								
Climate change concern		.24***		.21***		.18***		.16**
Perceived self-efficacy		.49***		.48***		.45***		.45***
Self-transcendent values		.14***		.14***		.15***		.14***
Adjusted R^2	.183	.592	.374	.592	.364	.602	.431	.600
F	9.332***	44.154***	23.257***	44.297***	22.273***	46.103***	29.197***	45.755***

*Note: [a] Other is the reference group; [b] Midwest is the reference group; Higher values indicate greater psychological distances; Entries are standardized beta coefficients; *p < 0.05, **p < 0.01, ***p < 0.001; Egocentric psychological distances were included under the control variable block to avoid overcomplicating the hierarchical regression models.*

Table 5 Hierarchical regression explaining climate change adaptation behavior intention (N = 448)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Block 1: Control variables								
Age	-.13**	-.05	-.03	-.04	-.08*	-.06	-.06	-.04
Male	-.10*	-.02	-.02	-.02	-.04	-.01	-.04	-.02
Education	-.00	.01	.02	.01	-.03	-.01	-.02	.01
Income	.05	-.01	.03	-.01	.02	-.01	.05	-.01
Political orientation	.13**	-.08*	.01	-.08*	.04	-.09*	-.01	-.08*
Races [a]								
White	-.05	-.03	-.05	-.03	-.07	-.04	-.07	-.03
Black	-.01	-.01	.01	-.01	-.04	-.03	-.03	-.01
Hispanic	.07	.04	.09*	.05	.05	.03	.08	.05
Region [b]								
Northeast	.01	.02	.02	.02	-.06	-.01	.02	.02
South	-.01	-.01	.03	-.00	-.06	-.03	.01	-.00
West	.04	.02	.07	.03	.00	-.00	.05	.03
Egocentric spatial distance	-.30***	-.03						
Egocentric temporal distance			-.55***	-.03				
Egocentric social distance					-.60***	-.23***		
Egocentric hypothetical distance (uncertainty)							-.57***	-.02
Block 2: Environmentalism								
Climate change concern		.35***		.34***		.25***		.35***
Perceived self-efficacy		.40***		.40***		.35***		.40***
Self-transcendent values		.10*		.10**		.10**		.10**
Adjusted R^2	.153	.537	.331	.536	.383	.563	.344	.536
F	7.734***	35.528***	19.465***	35.465***	24.151***	39.379***	20.569***	35.436***

*Note: [a] Other is the reference group; [b] Midwest is the reference group; Higher values indicate greater psychological distances; Entries are standardized beta coefficients; *p < 0.05, **p < 0.01, ***p < 0.001; Egocentric psychological distances were included under the control variable block to avoid overcomplicating the hierarchical regression models.*

Results showed that people who perceived greater egocentric distances to climate change tended to have lower intention to adapt to climate change (Egocentric spatial distance, B = -.30, p <.001, r^2 = .11; Egocentric temporal distance, B = -.55, p <.001, r^2 = .33; Egocentric social distance, B = -.60, p <.001, r^2 = .38; Egocentric hypothetical distance B = -.57, p <.001, r^2 = .34), when only social demographic variables were controlled. After including climate change related environmentalism variables, the effect from egocentric social distance attenuated but the statistical significance level did not change (B = -.23, p <.001), and the effect from egocentric spatial, temporal and hypothetical (uncertainty) distances on adaptation intention attenuated and became insignificant.

Construal Level, Climate Change Concern and Behavioral Intentions

RQ4-6 asked how level of abstraction of climate change images relates to people's concern (RQ4) about the issue, mitigation behavioral intention (RQ5), as well as their intention to adapt to negative effects of climate change (RQ6). First, multiple regression was conducted in which climate change concern was regressed against images' abstraction level, self-efficacy, self-transcendent value, and other social demographic variables. Results showed that images level of abstraction did not have a significant impact on people's climate change concern (p >.05). Similar multiple regression models were run with mitigation behavioral intention and adaptation behavioral intention as dependent variables, separately. Results consistently showed that images' level of abstraction did not have an impact on people's intention to mitigate or adapt to climate change (p >.05). According to the zero-order correlations for study variables, the correlations between abstraction level and climate change concern, abstraction level and mitigation intention, abstraction level and adaptation intention were not significant (p >.05).

The Moderating Role of Construal Level in the Relationships

It was hypothesized that construal level of climate change images could moderate the effect of climate change concern on climate change mitigation behavioral intention (H4a) and the effect of concern on climate change adaptation behavioral intention (H4b). To test these hypotheses, a moderation model was explored using PROCESS macro (Hayes, 2013) (model 1, 5000 bootstrap resampling) with climate change concern as independent variable; the images' level of abstraction (abstract images vs. concrete images) as moderator; and mitigation behavioral intention as dependent variable. Contrary to Hypothesis 4a, the model did not reveal a significant interaction effect between climate change concern and images' abstraction level on mitigation behavioral intention β= -.08, SE = .05, t(444)=-1.64, p=.101. Increased climate change concern predicted mitigation behavioral intention among participants who viewed abstract images and those who viewed concrete images in equivalent ways. Therefore, H4a was not supported. To address H4b, a similar moderation model was explored following the same procedure, using adaptation behavioral intention as dependent variable. Results showed that the interaction effect between climate change concern and images' abstraction level on adaptation behavioral intention was also not significant β= -.08, SE = .05, t(444)=-1.50, p=.136. Thus, H4b was not supported.

To test H5a, H5b and H5c, three moderation models were explored using PROCESS macro (Hayes, 2013) (model 1, 5000 bootstrap resampling) with climate change self-efficacy as independent variable; the images' level of abstraction (abstract images vs. concrete images) as moderator; and egocentric psychological distance (H5a), mitigation intention (H5b), adaptation behavioral intention (H5c) as dependent variable respectively for each model. Scores of the four

egocentric psychological distances were averaged to form a composite index to measure egocentric psychological distance of climate change. The first moderation model for H5a showed that while there was significant main effect of self-efficacy on egocentric psychological distance (β= -.54, SE = .04, t(444)= -15.24, p<.001), the self-efficacy × images' abstraction level interaction did not have a significant effect on egocentric psychological distance (β= .00, p =.927). Therefore, H5a was not supported.

In the second model for H5b, the results showed that self-efficacy was also highly related to climate change mitigation behavioral intention (β = .44, SE = .02, t (444) = 18.10, p < .001, CI = LL: .40, UL: .49), with more self-efficacious people being more likely to take climate change mitigation actions. Images' level of abstraction did not have a significant effect on mitigation behavioral intention (β = .05, SE=.05, t(444)= .88, p=.382). The self-efficacy × images' abstraction level interaction was significant (β= -.08, SE=.04, t(444)= -2.11, p <.05, CI = LL: -.15, UL: -.01, ΔR^2 = .00). When individuals were exposed to concrete climate change images and were activated by concrete construals, self-efficacy significantly affected the intention toward climate change mitigation (β = .44, SE=.02, t(444) = 18.10, p< .001, CI = LL: .40, UL: .49). By contrast, when individuals' abstract construals were activated by abstract images, self-efficacy had a weaker impact on their intention to mitigate climate change (β =.37, SE=.03, t(444)=13.52, p< .001, CI = LL: .31, UL: .42) (See Figure 3). Therefore, H5b was supported.

In the third model for H5c, similar patterns were found - the moderation model showed that images abstraction level moderated the effect of self-efficacy on adaptation behavioral intention, and the self-efficacy × images' abstraction level interaction was significant (β= -.09, SE=.04, t(444)= -2.00, p <.05, CI = LL: -.17, UL: -.00, ΔR^2 = .00). When individuals were exposed to concrete climate change images, self-efficacy significantly affected the intention

toward climate change adaptation (β = .46, SE=.03, t(444) = 15.96, p< .001, CI = LL: .40, UL: .52). By contrast, when individuals' were exposed to abstract images, self-efficacy had a weaker impact on their intention to adapt to climate change (β =.37, SE=.03, t(444)=11.74, p< .001, CI = LL: .31, UL: .44) (See Figure 4). Therefore, H5c was supported.

To test H6a, H6b and H6c, three moderation models were explored using PROCESS macro (Hayes, 2013) (model 1, 5000 bootstrap resampling) with self-transcendent values as independent variable; the images' level of abstraction (abstract images vs. concrete images) as moderator; and egocentric psychological distance perception (H6a), mitigation intention (H6b) and adaptation behavioral intention (H6c) as dependent variable, respectively. The first moderation model for H6a showed that there was a significant relationship on the perceived egocentric distance to climate change from the interaction between self-transcendent values and images' level of abstraction (β = .18, SE= .08, t(444)= 2.30, p < .05, CI = LL: .03, UL: .32, ΔR2 = .01).

Figure 3 Mitigation behavioral intention by Self-efficacy × Images' abstraction level

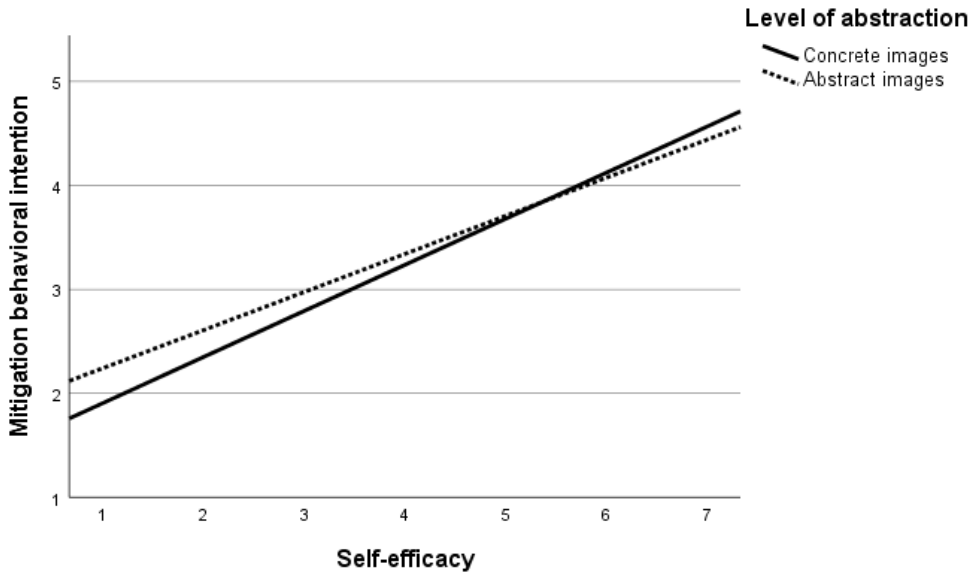
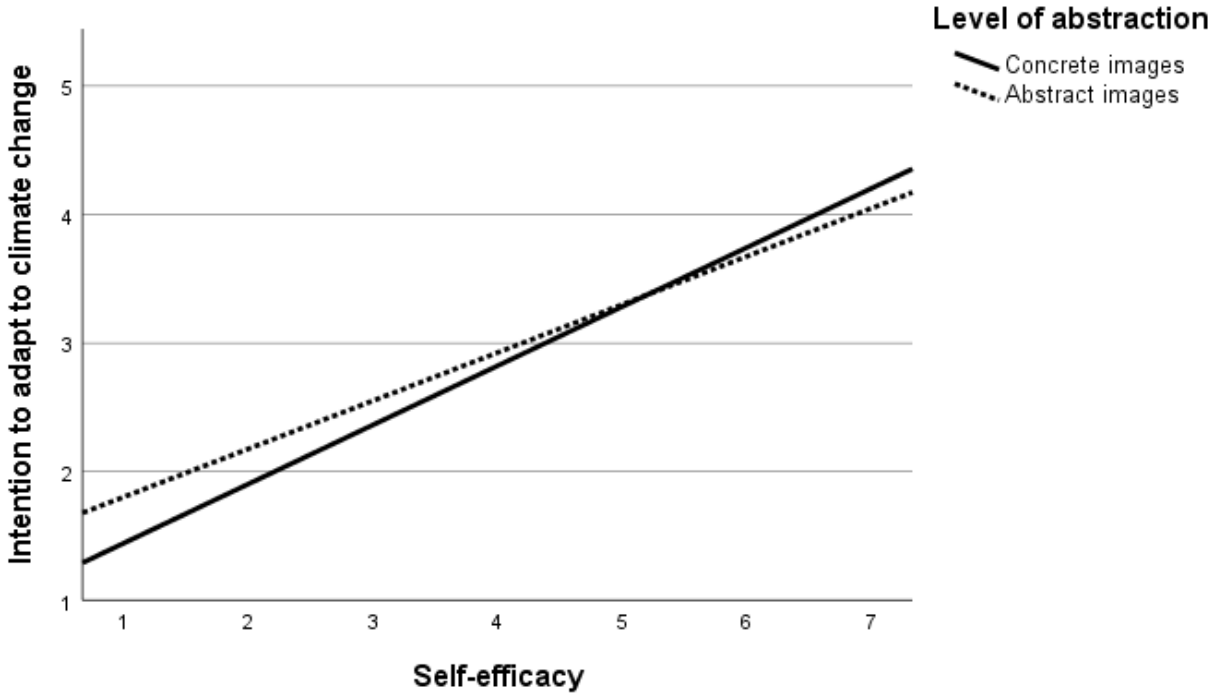


Figure 4 Behavioral intention towards adaptation by Self-efficacy × Images' abstraction level



When being exposed to concrete images, self-transcendent values had a significant negative impact on people's perceived egocentric distance to climate change (β = -.44, SE =.06, t(444) = -7.77, p<.001, CI = LL: -.55, UL: -.33); people with higher self-transcendent values perceived less distance to the risk. Whereas when participants were in the abstract condition, there was a weaker impact of self-transcendent values on egocentric psychological distance (β = -.26, SE = .05, t(444)= -5.08, p<.001, CI = LL: -.36, UL: -.16) (See Figure 5). Thus, the interaction term was significant in an opposite direction and H6a was not supported.

In terms of mitigation behavioral intention, there was a significant two-way interaction between image's level of abstraction condition and self-transcendent values (β = -.19, SE=.05, t(444)= -3.48, p<.001, CI= LL: -.29, UL: -.08, ΔR^2 = .02). When participants were in concrete condition and activated by concrete construals, self-transcendent values significantly affected their intention to mitigate climate change (β = .39, SE = .04, t(444) = 9.84, p< .001, CI = LL: .31,

UL: .47). When participants were in the abstract condition, the effect of self-transcendent values on mitigation behavioral intention was weaker (β = .20, SE = .04, t(444)= 5.59, p< .001, CI = LL: .13, UL: .27) (See Figure 6). Thus, the interaction term was significant in an opposite direction and H6b was not supported.

Likewise, the images' level of abstraction × self-transcendent values interaction had a significant effect on intention to adapt to climate change (β = -.19, SE= .06, t(444)= -3.18, p< .001, CI=LL: -.31, UL: -.07, ΔR^2 = .02). When participants viewed concrete images of climate change, the self-transcendent values had a significant positive effect on their intention to adapt to climate change (β = .38, SE =.04, t(444)=8.55, p< .001, CI = LL: 30, UL: .47). On the contrary, when participants viewed abstract images, the self-transcendent values had a weaker positive effect on their intention to adapt to climate change (β = .19, SE = .04, t(444) = 4.62, p< .001, CI = LL: .11,

Figure 5 Interaction between images' abstraction level and self-transcendent values on egocentric psychological distance of climate change

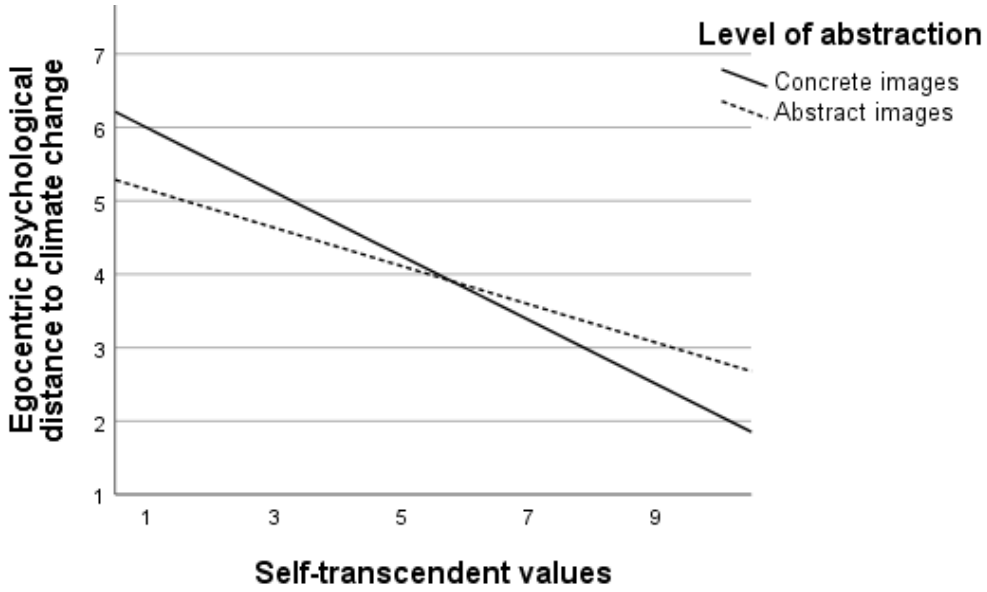
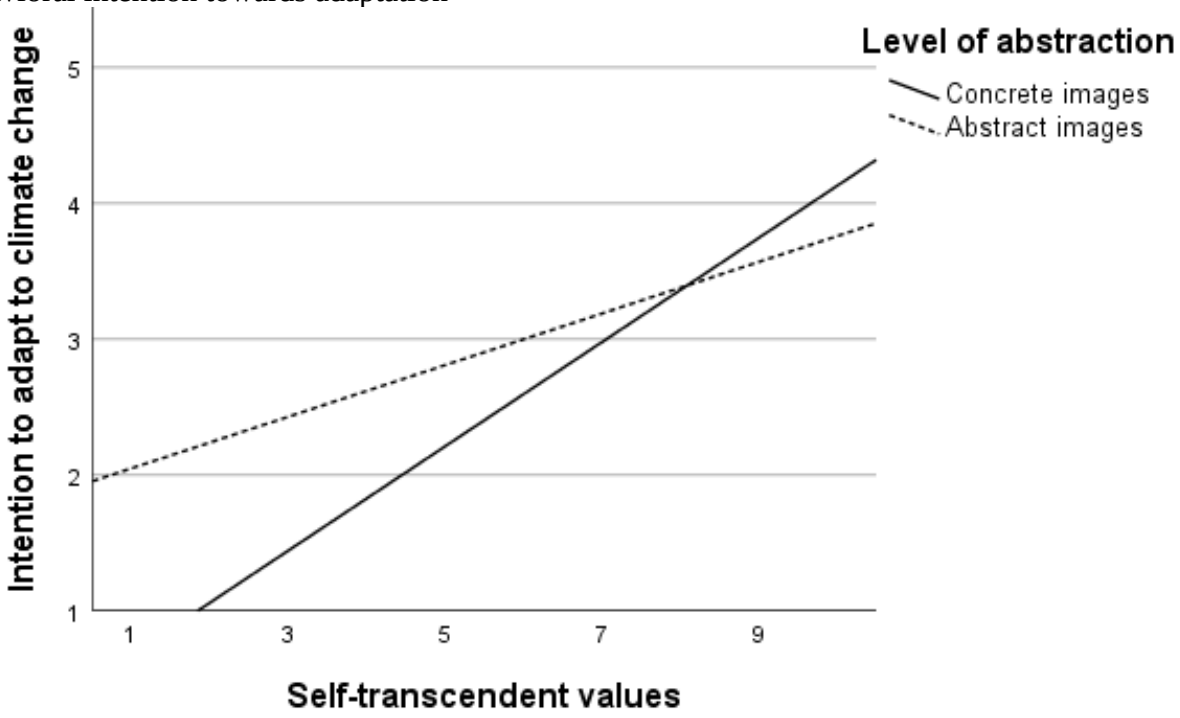


Figure 6 Interaction between images' abstraction level and self-transcendent values on mitigation behavioral intention

Figure 7 Interaction between images' abstraction level and self-transcendent values on behavioral intention towards adaptation



UL: .27) (See Figure 7). The interaction term was significant in an opposite direction. H6c was not supported.

The last set of research questions asked how construal level could potentially moderate the effect of political orientation on egocentric psychological distance to climate change (RQ7a), the effect of political orientation on mitigation behavioral intention (RQ7b), and the relationship between political orientation and intention toward climate change adaptation (RQ7c). Like the previous procedures, three moderation models were explored using PROCESS macro (Hayes, 2013) (model 1, 5000 bootstrap resampling) with political orientation as independent variable; the images' level of abstraction (abstract images vs. concrete images) as moderator; and egocentric psychological distance (RQ7a), mitigation intention (RQ7b), adaptation behavioral intention (RQ7c) as dependent variable respectively for each model.

In terms of RQ7a, results showed that there was a significant relationship on the egocentric psychological distance to climate change from the interaction between political orientation and images' level of abstraction ($\beta = .11$, SE = .05, $t(444) = 2.5$, $p < .05$, CI = LL: .02, UL: .20, $\Delta R^2 = .01$). For participants in the concrete condition, political orientation had a significant effect on their egocentric psychological distance to climate change ($\beta = -.27$, SE = .03, $t(444) = -8.12$, $p < .001$, CI = LL: -.33, UL: -.20). On the contrary, among participants who viewed abstract images, political orientation had a weaker effect on their egocentric psychological distance ($\beta = -.15$, SE = .03, $t(444) = -4.93$, $p < .001$, CI = LL: -.22, UL: -.09) (See Figure 8).

RQ7b asked about the possible moderating effect of images' level of abstraction on the relationship between political orientation and mitigation behavioral intention. Results showed that the images' level of abstraction × political orientation interaction had a marginally

significant effect on intention to mitigate climate change (β = -.06, SE = .04, t(444) = -1.68, p = .093, ΔR^2 = .01). In the concrete condition, political orientation had a significant effect on people's mitigation behavioral intention (β = .14, SE = .03, t(444) = 5.53, p< .001). On the contrary, the effect of political orientation on mitigation behavioral intention among participants in the abstract condition was slightly weaker (β = .08, SE = .02, t(444) = 3.38, p < .01) (See Figure 9).

To address RQ7c, a similar moderation model was explored following the same procedure, using adaptation behavioral intention as dependent variable. Results showed that the interaction effect between political orientation and images' abstraction level on adaptation behavioral intention was not significant *β*= -.05, SE = .04, *t*(444)= -1.17, *p*=.243.

Figure 8 Marginal means for egocentric psychological distance of climate change across level of abstraction conditions and political orientation groups (p < .05)

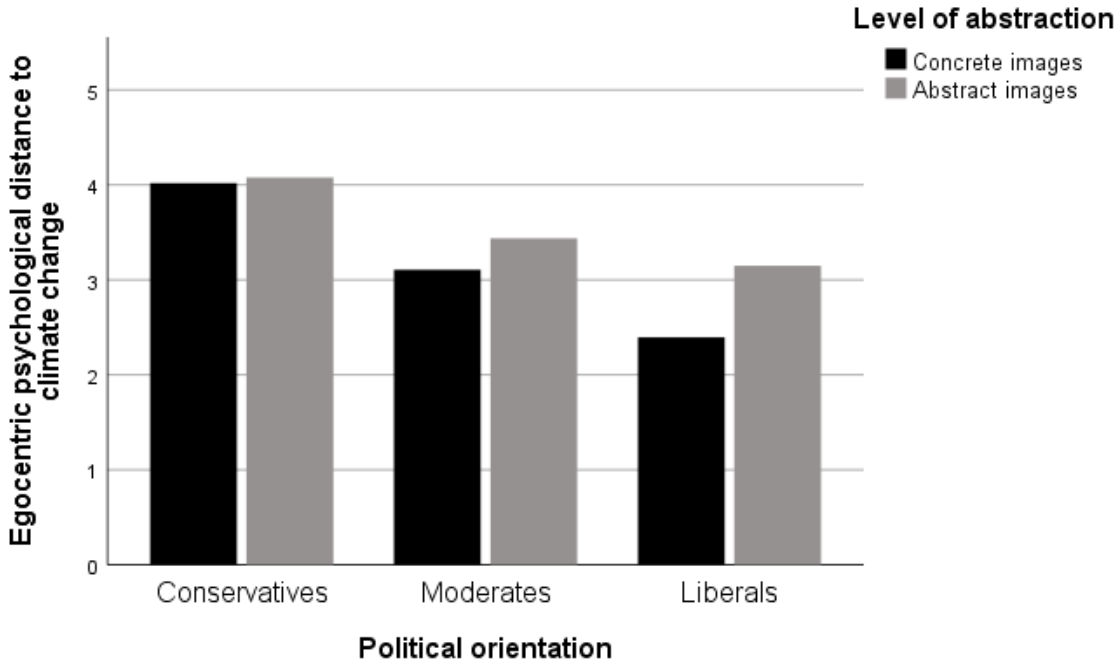
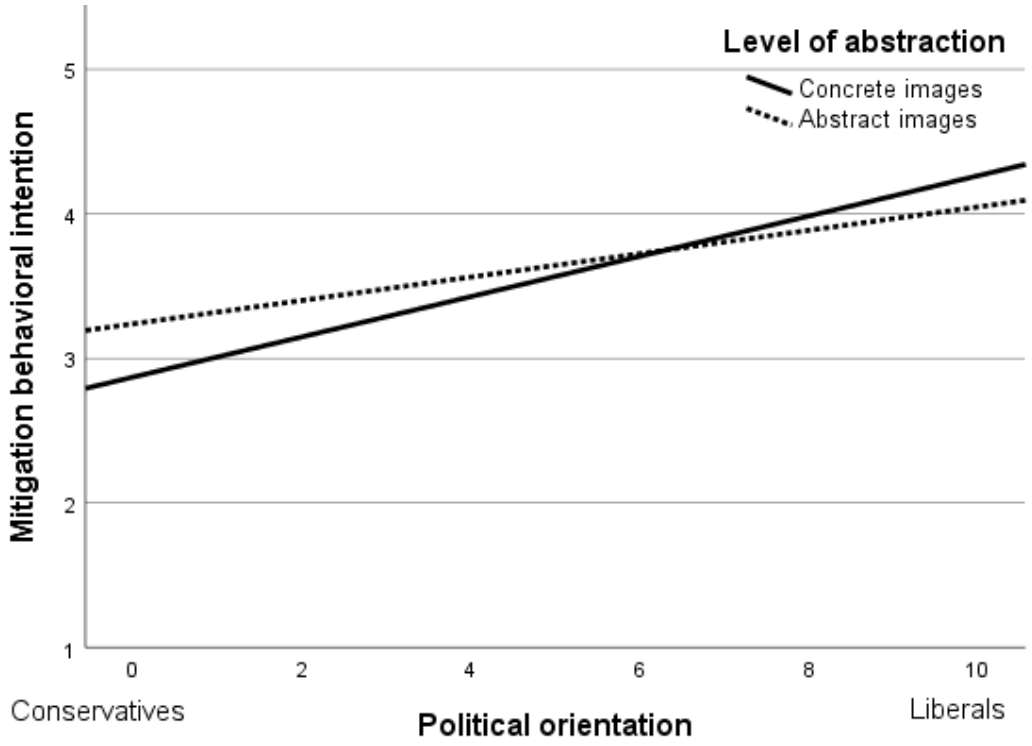


Figure 9 Climate change mitigation behavioral intention across level of abstraction conditions and political orientation (marginally significant, p =.09)



CHAPTER 5: DISCUSSION AND CONCLUSION

Summary of Findings

There has been growing interest focusing on behavioral or attitudinal consequences of manipulating the psychological distance of climate change (e.g., Rickard et al., 2016; Sacchi et al., 2016; Singh et al., 2017; Schuldt et al., 2018; Spence & Pidgeon, 2010). Until now, however, scholars have not yet examined 1) how the two theoretically-suggested sub-dimensions of psychological distance (egocentric vs. nonegocentric distances) differ in the context of climate change communication; 2) how people's egocentric psychological distance of climate change can be influenced by their construal level – the level of abstraction at which they construe the issue (McDonald et al., 2015); 3) how construal level of climate change may moderate the relationship between sociopolitical factors (e.g., self-efficacy, self-transcendent values, political orientation) and climate change related pro-environmental attitudes; and more importantly, 4) how the potential effect of abstract versus concrete construals might apply to climate change visual perception.

Addressing these issues, this dissertation firstly examined the role of abstraction in the communication of climate change through the visuals. The study found that climate change visuals with abstract and concrete features successfully activated people's abstract and concrete construals, respectively. Abstract images (vs. concrete images) encouraged more abstract thinking, leading people to perceive greater spatial, temporal and social distance between climate change and themselves, though they did not lead people to perceive higher uncertainty. Regarding nonegocentric psychological distance perceptions, as the study predicted, images' abstraction level did not have a significant effect on people's perceived temporal, social and hypothetical (uncertainty) distances between climate change and other people. However, the

abstraction level had a significant negative effect on people's perceived nonegocentric spatial distance – abstract images (vs. concrete images) encouraged people to think that other places are more vulnerable to climate change. Overall, indeed, construal level had a greater positive effect on egocentric distance perceptions than on nonegocentric psychological distance perceptions (with the exception of temporal distance dimension).

The next part of the study explored the relationships between egocentric psychological distances and climate change-related critical outcomes such as concern and behavioral intention. It was found that egocentric psychological distance perceptions - the perceptions of spatial, temporal, social distances and uncertainty of climate change - all negatively affected people's concern for the issue, with greater egocentric distance perceptions leading to less concern for the issue. In terms of mitigation and adaptation behavioral intentions, the study revealed that all the four psychological distances (spatial, temporal, social and hypothetical distances) significantly affected people's intention to act, after controlling for key social demographic variables. But after controlling for environmentalism factors such as climate change concern, environmental values (e.g., self-transcendent values), many of these negative effects from psychological distances attenuated and became insignificant. In the models that explain mitigation behavioral intention, only the negative effects of social distance and uncertainty (hypothetical distance) remained significant after controlling for environmentalism factors. Likewise, in the models that explain intention toward climate adaptation, only the negative effect of social distance remained significant after controlling for environmentalism factors.

The last part of the study examined how the level of abstraction of climate change images affected people's attitudinal and behavioral responses to climate change. It was found that although images with abstract and concrete features encouraged more abstract and more concrete

thinking among people, respectively, they did not directly lead to different levels of concern or behavioral intention related to climate change. Instead, images' level of abstraction moderated the relationships between some key sociopolitical factors (e.g., self-efficacy, self-transcendent values, political orientation) and climate change related pro-environmental attitudes. Specifically, it was found that construal level of climate change significantly moderated the effect of self-efficacy on behavioral (mitigation, adaptation) intention, with concrete construals encouraging more concern about self-efficacy. Similarly, when people were activated by concrete construals, self-transcendent (biospheric, altruistic) values could have a greater positive effect on climate change related pro-environmental attitudes, and political orientation could have a greater effect on people's responses to climate change. This emphasizes that abstraction could be an important moderator of the relationship between sociopolitical factors and pro-environmental attitudes in the communication of climate change.

The Effect of Construal Level on Egocentric Psychological Distance of Climate Change

Today, one significant barrier to effective communication of climate change is that the risk has been widely perceived as psychologically distant (Brügger, et al., 2015; Spence, et al., 2011); how to alter this "distant" perception to bring the issue closer to home remains a fundamental societal challenge. This study built upon CLT to explore how the popular perception of climate change as a distant issue could be formed under the influences of different abstract and concrete visual communication strategies.

First, as hypothesized, the study revealed that abstract images (vs. concrete images) led people to perceive greater spatial, temporal and social distances between climate change and themselves, but they did not encourage higher level of uncertainty toward climate change. In

terms of spatial distance, the finding is in close accord with the environmental communication literature on local versus global message framing (Evans et al., 2014; Scannell & Gifford, 2013), which explained that local frames of climate change (e.g., local weather forecasts, Bloodhart et al., 2015) can encourage people's worry and concern about the issue. The result is also consistent with previous psychological literature (Fujita et al., 2006; Liberman et al., 2007) which suggested the perceived spatial distance between self and the objects would be greater when the object was described in abstract terms than when the object was described in concrete terms. Egocentric temporal and social distance perceptions were also positively affected by images' abstraction level, which accords with the previous findings that concrete (vs. abstract) aspects of an event tended to lead people to expect the event to occur in the nearer future (Liberman et al.,2007). It also confirms a previous finding by Bar-Anan Liberman and Trope (2006) that people who used abstract (vs. concrete) descriptions to talk about a target event could feel more socially distant from that event.

Visual communication scholars and advocates could follow this line of research to explore how to make climate change a psychologically *local* issue by including more concrete features in the visuals, such as colors, incidental aspects, human elements, and detailed information. Given that Americans nowadays tend not to view climate change as an urgent priority issue (Pew Research Center, 2018), it is also important to introduce images with concrete features to help increase people's perceived temporal proximity to the issue. Considering that concrete information is more available in memory than abstract information (Johnson & Kisielius, 1985), concrete visual communication strategy may also enhance the persuasive effectiveness by making the temporally proximal perception of climate change last longer in people's minds. Today, taking perspective of other human victims of environmental issues

(reducing the social distance between self and others) could greatly encourage people's engagement with the issues (e.g., pro-environmental intentions) (Pahl & Bauer, 2013), and this study provides initial evidence that concrete visualization strategies may reduce people's social distance to climate change, which will likely encourage their engagement with the issue.

This study also found that abstract versus concrete images did not affect people's perceived egocentric hypothetical distance of climate change - perceived level of uncertainty of the issue. One possible explanation is that the perceived uncertainty of the issue is the most complex psychological distance dimension (Bar-Anan & Liberman, 2006) and could possibly depend more upon the individual-level characteristics, such as individuals' level of climate skepticism. For example, the belief of whether climate change is certainly occurring may be a core value that is resistant to the visuals' priming effect. Thus, although previous psychological research suggested that imagining an event occurring with more concrete thinking may increase the estimated likelihood of the event (Bar-Anan & Liberman, 2006), the mechanism might not readily apply to climate change communication context.

Differentiating Egocentric and Nonegocentric Psychological Distances in Climate Change Communication

It is worth noting that the study generally supported applying the egocentric-nonegocentric distinction in construal level theory to strategic climate change communication. Results provided initial evidence that egocentric distance perception (e.g., distance from self and own experience, such as whether climate change is happening far from 'my own location') and nonegocentric distance perception (distance from others or others' experience, such as whether

climate change is happening far from 'other geographical locations') are different in the context of climate change, especially on spatial, social and hypothetical distance dimensions.

On the one hand, consistent with previous psychological studies (Liberman & Förster, 2011), construal level only positively affected people's egocentric thinking of the spatial, temporal and social distances of climate change but not the nonegocentric thinking. This confirms the previous findings that people are more sensitive to egocentric estimates (Holyoak & Mah, 1982), which are the more habitual reference points (Liberman & Förster, 2009). It also shows that people can potentially shift their reference points when thinking about climate change, even though they might lack specific knowledge about the other locations/groups (e.g., the Maldives). Considering that climate change is an issue requiring global collective action and mutual understanding among peoples in different countries, future research should continue to investigate the role of nonegocentric perspective-taking in climate change communication, especially how learning about and sensing the others' proximity to climate change may affect people's own risk perceptions, pro-environmental attitudes and behaviors.

On the other hand, climate change images' level of abstraction was found to affect nonegocentric spatial distance in a negative way. More abstract (vs. concrete) images encouraged people to perceive less spatial distance between climate change and other people. This negative effect suggests that spatial distance is different from the other three types of distance when discussing nonegocentric thinking. When targeting compassionate people who are very altruistic and outward-focused, abstract (vs. concrete) visual information may be more effective in encouraging their concern for the issue.

To sum up, it is important for future studies to note the egocentric-nonegocentric distinction in climate change communication. First, this theoretical aspect of psychological

distance in CLT clarifies egocentric psychological distance is directly and positively affected by people's global-versus-local thinking style (construal level), and people's sensing of others' experience of climate change might be based on their knowledge rather than the construal-level mindsets. Second, a growing number of recent studies have examined whether reduced psychological distance encourages greater intention to act, but the egocentric-nonegocentric distinction has not been addressed among this recent literature. This lack of clarity related to the conceptualization and operationalization of psychological distance might explain why there have been mixed findings regarding the role psychological distance plays in promoting climate change related pro-environmental behaviors (Brügger et al., 2016; Schuldt et al., 2018). For example, existing measurements of psychological distance of climate change include: "to what degree do you believe 'climate change is happening right now?" and "to what degree do you believe we must tackle the issue right now?" (e.g., Spence et al., 2012; Jones et al., 2016). These statements are not anchored on all the egocentric references points, namely, self and the experienced reality. While responding to these attitudinal statements, participants may conflate egocentric and nonegocentric psychological distances; they may shift reference point(s) and mentally assume things from other people's perspectives or thinking in a generic and objective way, which deviate from the subjective nature of the concept of psychological distance in CLT (Trope & Liberman, 2010).

The Effect of Psychological Distance

As aforementioned, psychological distance is a subjective experience varying individually by a host of complex factors (e.g., personal experience, political orientation) (Trope & Liberman, 2010). There are both accuracy and conflation problems when trying to

experimentally test the distal versus proximal framing effects in climate change communication (McDonald et al., 2015; Zwickle, 2014), since people's distant and proximal perceptions may not be easily affected by framing. This is likely why existing experimental studies' centering on priming psychologically proximal frames was not effective in promoting climate change engagement (For review, see Schuldt et al., 2018).

Therefore, instead of examining the effect of the manipulated distal versus proximal frames, this study focused specifically on people's existing distance perceptions of climate change. Results consistently showed that greater egocentric spatial, temporal, social and hypothetical (uncertainty) distances of climate change led to less concern for the issue. This generally supports the previous literature on the relationships among various psychological distances and climate change concern (Jones et al., 2016; Spence, Poortinga, & Pidgeon, 2012). In extending the previous literature, this research also controlled for other relevant variables when examining the effect of psychological distances on people's responses to climate change. Results showed that psychological distances all negatively affected mitigation and adaptation behavioral intentions. But after controlling for environmentalism factors such as climate change concern, environmental values (e.g. self-transcendent values), many of the negative effects on behavioral intention from psychological distances attenuated and became insignificant. Consistent with previous findings (e.g., Brügger et al., 2015), the results showed that climate change related pro-environmental behavioral intentions were more strongly associated with environmentalism (e.g., climate change concern, self-transcendent values, self-efficacy about climate change) than with psychological distance perceptions. It is likely that people's decision-making processes are multi-faceted, and the behaviors people take to mitigate their own greenhouse emissions or to adapt to their experienced negative impacts of climate change are

influenced by many, and more powerful, forces, such as environmental values and climate change self-efficacy. This also re-explains why there has been growing evidence that reduced psychological distance may not directly lead to increased level of climate change engagement.

The Moderating Role of Construal Level in Climate Change Communication

Images with abstract and concrete features were found to encourage abstract and concrete construals, respectively. But construal-level mindsets did not directly affect people's responses to climate change. This challenges previous research in exemplification theory and visual persuasion which claimed that when communicating the hurricane risk, people who viewed indexical images (vs. iconic images) perceived greater risks (Rickard et al., 2018) and farmers with concrete construals would be more likely to act concretely to safeguard their self-interests, such as adopting self-protective climate adaptation practices (Haden et al., 2012). The finding that construal-level mindsets did not directly affect people's attitudinal and behavioral responses to climate change is consistent with the CLT assumption mentioned by McDonald et al., (2015), which claimed abstract and concrete construals of climate change may either promote or prevent climate change actions depending on a number of *other* factors.

This study found that construal level of climate change activated by images can be an important moderator of the relationship between sociopolitical factors (e.g., self-efficacy, self-transcendent values, political orientation) and responses to climate change. Specifically, confirming previous studies' assumptions, results showed that when people were activated by concrete construals, they would be more concerned about immediate feasibility issues - whether they had the ability to perform a behavior (Bandura, 1982; O'Connor & Keil, 2017). In this context, the impact of self-efficacy on behavioral intention could be greater. This conclusion

suggests that for self-efficacious people (e.g., people who believe their actions can positively affect climate change), concrete (vs. abstract) construals may be more effective in encouraging their pro-environmental behavioral intention. In the communication process, emphasizing individual efficacy for climate change using concrete lens will likely be an innovative and effective way of promoting public engagement with climate change.

This study revealed that concrete construals can also strengthen the positive effect of self-transcendent (biospheric, altruistic) values on pro-environmental attitudes and behavioral intentions. This challenges the notion suggested by prior psychological studies (Eyal, Liberman, & Trope, 2008) that abstract construal fosters the role of stable and decontextualized values. It is likely that in climate change communication, abstract construals lead to a generalized thinking of the risk and reduces the overall sensitivity of the issue (Maglio, Trope, & Liberman, 2013). This lack of sensitivity might attenuate the positive influence of environmental values on climate change behavioral intentions. It is also likely that when participants' mindsets were abstract, their existing attitudes and behavioral intention toward climate change were more stable and might be less affected by their values or other social political factors.

This study also showed that political orientation significantly affected people's responses to climate change, and this effect was strengthened when people had concrete construals (vs. abstract construals). Specifically, concrete images of climate change encouraged liberals' mitigation behavioral intention and significantly reduced their psychological distance to climate change. But concrete images discouraged the mitigation intention (marginal influence; $p = .09$) among the conservatives and did not reduce their perceived distance to the risk (sig. at $p=.05$ level). The finding is consistent with past work (e.g., Hart & Nisbet, 2012) which showed that different frames on climate change (high versus low social distance) may backfire for

Republicans. This finding expands the current literature by incorporating construal-level perspective and further clarifies how climate change interventions affect people differently.

Limitations and Future Research

This study is a first step toward a deeper understanding of the role of abstraction in influencing climate change related pro-environmental attitudes and behavioral intention. The study demonstrated 1) how abstract versus concrete visuals could be used strategically to reduce the public's perceived distance to the risk of climate change; 2) the distinction between egocentric and nonegocentric distance perceptions in the context of climate change, and its implications for future research on psychological distance of climate change. Additionally, this study showed under what circumstances psychological distance can affect people's climate change behavioral intention, the relative effects between psychological distance and other environmentalism factors such as concern, self-efficacy. Most importantly, this study found that common messaging practices such as concrete framing and localized communication might backfire for the conservatives (Cook & Lewandowsky, 2016; Dixon, Hmielowski, & Ma, 2017; Hart & Nisbet, 2012; Zhou, 2016). When targeting conservatives, less self-efficacious people, and people who are low in self-transcendent values, abstract messaging strategies might be more effective in encouraging their environmental attitudes and behavioral intentions.

This study is not without limitations. First, people's construal level of climate change images did not affect their perceived uncertainty of the issue, and this is likely because the uncertainty aspects were not explicitly reflected in the image stimuli. Future research could replicate the findings with more diverse image stimuli that can reflect a wider range of abstract, uncertain or generic features of climate change.

Second, this study measured behavioral intention rather than actual behaviors. Although behavioral intentions are important antecedents to actual actions, they are not proxy to actual behaviors. Participants in this study may have reported inaccurate environmental-friendly intentions due to social desirability. Future research should try to find ways to gauge actual behaviors and to study how one's construal level relates to his or her actual behaviors on climate change mitigation and adaptation.

Last, this study presents an initial attempt to differentiate egocentric and nonegocentric thinking in climate change communication. The measurements of nonegocentric distances used the Maldives as a case study and were adapted from those egocentric distance measurements in order to make the two types of distance be comparable. Future studies could include more items to refine the measurements of nonegocentric distance to contribute to the integration of CLT and climate change communication. Future study could also extend the current findings to explore how considering others' experience of or proximity to climate change might affect one's own attitudes and behaviors toward the issue.

There are both challenges and opportunities in future visual communication research that can stem from this dissertation. On the one hand, research from construal-level perspective is needed to look beyond visual themes or emotions to classify visuals by their level of abstraction, as abstract and concrete visuals may elicit different perceptions over an issue. This is especially true when studying visual communication of climate change, a risk that often involves abstract scientific information. On the other hand, abstract and concrete visualizing strategies should be treated with caution since the magnitude of the abstract-concrete distinction may differ across all the (abstract, concrete) feature aspects. It is unclear which specific abstract or concrete features are more effective or powerful than others in influencing people's perceptions. In the future, a

more detailed and nuanced comparison can be made within the abstract or the concrete images to better capture the complexity with regard to image's level of abstraction and its effect.

Future research could also build from this dissertation by continuing to replicate the findings with other sample beyond the U.S. to increase the research ecological validity and to take culture into account. A growing body of literature has documented that people's pro-environmental attitudes and behaviors are culture-bound. For example, it was argued that individualistic cultures in the Western world may encourage analytic thinking and members of collectivistic cultures may be more interested in holistic thinking, and the differences apply to environmental perceptions (Miyamoto, Nisbett, & Masuda, 2006; Sacchi et al., 2016). Future research could explore how construal-level cognitive process can be integrated with cultural aspects to influence people from different cultural groups.

In terms of practical contribution, the findings revealed abstract and concrete visual information of climate change could not only activate people's abstract and concrete mindsets respectively, but also differentially influence their perceptions of spatial, temporal and social distances to the risk. In light of this, visual communication practitioners could make climate change more local, temporally urgent and socially relevant to a broader audience by designing and disseminating images with concrete features, such as colorful photographs that focus on ordinary people, incidental aspects, and those that include sufficient detailed information. Second, the effect of social distance on people's responses to climate change was found to be strong, even when compared to other environmentalism factors. Thus, reducing people's perceived social distance to climate change victims could be a visual communication strategy that is effective in encouraging climate change friendly attitudes and behavior intentions. Third, although abstract and concrete construals did not directly influence people's decision-making,

they can be combined with other messaging strategies to make an impact. For example, environmental advocacy campaigns and communicators could emphasize individual efficacy on climate change using concrete visuals so that they can encourage people to take more mitigation and adaptation actions. Last, for climate change visual communicators, activists and designers, it is worth noting that images with more abstract features (e.g. data intensive infographics, charts, cartoons, etc.) could be more effective in engaging the conservatives and those who are low in self-transcendent values with the issue of climate change.

APPENDICES

APPENDIX A: Consent Form

Please read the following form carefully before you start with the questionnaire.

You are invited to participate in a research study conducted by a team of researchers at Michigan State University. When you are invited to participate in research, you have the right to be informed about the study procedures so that you can decide whether you want to participate. This form may contain words that you do not know. Please ask the researcher to explain any words or information that you do not understand.

Your participation in this study is voluntary. You may choose not to participate at all, or you may refuse to participate in certain procedures or answer certain questions or discontinue your participation at any time without consequence.

[a] **Description:** You are being asked to participate in a research study of climate change images. First, you will be asked to answer some demographic questions, including gender, age, race/ethnicity, etc. Second, you will be asked to read through nine images related to climate change as well as their accompanying captions. Then, you will be asked how the images affect your ideas about climate change. Last, there will be six additional demographic questions. The study will take approximately 20 minutes to complete.

Risks: Your participation in this study is not expected to cause you any risks greater than those encountered in everyday life. Your answers will not harm you in any way. If you feel uncomfortable at any point, you can withdraw from the study. If you feel uncomfortable after you've started the experiment, you have the right to withdraw from the study without any consequences.

Confidentiality: Your identity, participation, and any information you provide will be anonymous. Your information will not be shared with anyone and will only be used for the purpose of the research. MSU IRB will have access to the data as well as the researcher. The data will be kept for at least three years after the project closes.

Questions, Concerns, and Complaints: If you have concerns or questions about this study, such as scientific issues, how to do any part of it, or to report an injury, please contact the researchers: primary contact Ran Duan (duanran3@msu.edu, 517-575-5110, 404 Wilson Rd., Room 305, Communication Arts and Sciences Building, Michigan State University, East Lansing, MI 48824), or researcher Bruno Takahashi (btakahas@msu.edu, 517-432-2454, 404 Wilson Rd., Room 348, Communication Arts and Sciences Building, Michigan State University, East Lansing, MI 48824).

If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 4000 Collins Rd, Suite 136, Lansing, MI 48910.

Consent: I have read this consent form and my questions have been answered. I hereby give my voluntary consent to participate in this study:

- Yes, by selecting this option I hereby give my voluntary consent to participate in this study.
- I do not wish to participate in this study.

[NOTE: [a] This Description section was used in the consent form of Experiment 2. The description of Experiment 1 is as follows: "You are being asked to participate in a research study of climate change images. First, you will be asked to answer some demographic questions, including gender, age, race/ethnicity, etc. Second, you will be asked to read through nine images related to climate change as well as their accompanying captions. Then, you will be asked a few questions about climate change. Last, there will be six additional demographic questions. The study will take approximately 13 minutes to complete." The consent forms of Pretest 1 and 2 have the same Description section - "You will need to read through nine climate change related images as well as their accompanying captions. You will need to complete a questionnaire after viewing the images. The whole study will take you approximately 8-10 minutes."]

APPENDIX B: Questionnaire for Pretest 1 and 2

[NOTE: 1. After viewing image stimuli, participants were instructed to complete the questionnaire below. 2. In the 25-item questionnaire, “a” refers to more abstract description, while “b” refers to more concrete description.]

Any behavior can be described in many ways. For example, one person might describe a behavior as "writing a paper," while another person might describe the same behavior as "pushing keys on the keyboard." Yet another person might describe it as "expressing thoughts." This form focuses on your personal preferences for how a number of different behaviors should be described. Below you will find several behaviors listed. After each behavior will be two different ways in which the behavior might be identified.

For example:
Attending class

a. sitting in a chair
b. looking at a teacher

Your task is to choose the identification, a or b, that best describes the behavior for you. Simply place a checkmark next to the option you prefer. Be sure to respond to every item. Please mark only one alternative for each pair. Remember, mark the description that you personally believe is more appropriate for each pair.

1. Making a list
a. Getting organized
b. Writing things down

2. Reading
a. Gaining knowledge
b. Following lines of print

3. Joining the Army
a. Helping the Nation's defense
b. Signing up

4. Washing clothes
a. Removing odors from clothes
b. Putting clothes into the machine

5. Picking an apple
a. Getting something to eat
b. Pulling an apple off a branch

6. Chopping down a tree
a. Getting firewood

b. Wielding an axe

7. Measuring a room for carpeting
a. Getting ready to remodel
b. Using a yardstick

8. Cleaning the house
a. Showing one's cleanliness
b. Vacuuming the floor

9. Painting a room
a. Making the room look fresh
b. Applying brush strokes

10. Paying the rent
a. Maintaining a place to live
b. Writing a check

11. Caring for houseplants
a. Making the room look nice
b. Watering plants

12. Locking a door
a. Securing the house
b. Putting a key in the lock

13. Voting
a. Influencing the election
b. Marking a ballot

14. Climbing a tree
a. Getting a good view
b. Holding on to branches

15. Filling out a personality test
a. Revealing what you're like
b. Answering questions

16. Toothbrushing
a. Preventing tooth decay
b. Moving a brush around in one's mouth

17. Taking a test
a. Showing one's knowledge
b. Answering questions

18. Greeting someone
a. Showing friendliness
b. Saying hello

19. Resisting temptation
a. Showing moral courage
b. Saying "no"

20. Eating
a. Getting nutrition
b. Chewing and swallowing

21. Growing a garden
a. Getting fresh vegetables
b. Planting seeds

22. Traveling by car
a. Seeing countryside
b. Following a map

23. Having a cavity filled
a. Protecting your teeth
b. Going to the dentist

24. Talking to a child
a. Teaching a child something
b. Using simple words

25. Pushing a doorbell
a. Seeing if someone's home
b. Moving a finger

[End of Survey] Thank you for your participation in our study! Your participation is greatly appreciated.

Useful Contact Information:
If you have any questions regarding this study, please contact Dr. Bruno Takahashi by email: btakahas@msu.edu. If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 4000 Collins Rd, Suite 136, Lansing, MI 48910.

PLEASE CLICK THE ">>" BUTTON TO REGISTER YOUR RESPONSES AND RECEIVE YOUR PAYMENT.

APPENDIX C: Experiment 1 Questionnaire

Part 1: Demographic

[NOTE: This section was used for pre-screening purpose. People under 18 or those who were not in the U.S. were screened out. Quotas for gender, age, race/ethnicity, region and political orientation were utilized to ensure a diverse sample that had characteristics similar to census data for the United States.]

1. What is your biological gender?
   - Male
   - Female

2. What is your age?
   - 17 or under
   - 18-34
   - 35-54
   - 55 or older

Skip To: End of Block If What is your age? = 17 or under

3. Which of the following do you most closely identify with?
   - White/Caucasian
   - Black/African American
   - Hispanic/Latino
   - Other (Asian, Islander, Native American, etc.)

4. What is your party identification?
   - Democrat
   - Independent
   - Republican

5. What region are you currently residing in?

   - **Northeast** (New England, Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, Mid-Atlantic, New Jersey, New York, and Pennsylvania)
   - **Midwest** (Illinois, Indiana, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota)
   - **South** (Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, District of Columbia, West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, and Texas)
   - **West** (Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming, Alaska, California, Hawaii, Oregon, and Washington)

Part 2: Stimuli

Please view each climate change image (and its accompanying caption) for at least 15 seconds.

[NOTE: In this section, participants were randomly assigned to either the abstract or the concrete group. They viewed either nine abstract or nine concrete images of climate change as well as the images' accompanying captions. The images were presented in a random order.]

Part 3: Nonegocentric temporal distance (e.g., taking future generations' perspectives)

1. After viewing the images, now please imagine that climate change will show its negative effects at a future time. How much time after that future time point will you personally see these negative effects?

    - o < 5 years
    - o 5-10 years
    - o 10-15 years
    - o 15-20 years
    - o 20-25 years
    - o 25-30 years
    - o 30-50 years
    - o 50-100 years
    - o Hundreds of years from that future timepoint

2. For future generation, climate change will be an urgent threat or risk.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

3. Imagine that you are in the year 2030. You will be able to feel the negative effects of climate change very soon in or after 2030.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

Part 4: Climate change and the Maldives (taking other people's perspectives)

[NOTE: This section has 15 questions; they were presented in a random order. #14 and #15 were attention-check questions, and response that failed these questions were deleted for data analysis.]

PLEASE READ BEFORE YOU CONTINUE:

In this section, we want to understand how you think about the levels of climate change effects on other people, especially other nations. The following questions will ask you to take the Maldivians' perspectives to assess or estimate their experience or perception of climate change. The Maldives is a tropical island nation in the Indian Ocean.

The information you just learned from the climate change images and captions might not be very useful in terms of answering the questions about the Maldives. Please be aware that these questions might be but are not necessarily related to the images. Questions and images were administered together for efficiency reasons.

Please carefully answer the questions and try NOT to give identical responses (e.g. neither agree nor disagree) throughout the survey.

I understand that

- I am supposed to take the Maldivians' perspectives to answer the following questions.
- The following questions might be but are not necessarily related to the images.

>> next page

Q. Please scroll down to answer the questions. Feel free to scroll up in case you want to look for information from the images. Note: The Maldives, a tropical island nation in the Indian Ocean.

[NOTE: Image stimuli were presented *here*.]

Based on your estimates, please state the extent to which you agree or disagree with the statement:

1. Compared to other places in the world, worst effects of climate change are felt more by places/countries near the Maldives.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

2. The Maldivians (Maldive Islanders) think about nearby places rather than faraway places more often when thinking of negative effects of climate change.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

3. Many negative effects of climate change are geographically close to the Maldives.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

4. The estimated distance between the geographical area(s) that are being negatively affected by climate change and the Maldives could be:

Extremely close	Very close	Somewhat close	Somewhat distant	Very distant	Extremely distant

5. The Maldivians (Maldive Islanders) can personally feel unfamiliar with the similar negative experiences reflected in the images.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

6. The stories in the images show problems similar to the Maldivians (Maldive Islanders).

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

7. The Maldivians (Maldive Islanders) can feel/experience the negative impacts of climate change.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

8. Climate change could negatively affect the Maldivians (Maldive Islanders) much more than other people.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

9. The Maldivians (Maldive Islanders) could be socially and personally faraway to many negative effects of climate change.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

10. I feel...
The Maldivians' (Maldive Islanders) chance of feeling the negative impacts of climate change is ____ than that of other people in the world.

- o 60% lower than other people
- o 40% lower than other people
- o 20% lower than other people
- o Equal to other people
- o 20% higher than other people
- o 40% higher than other people
- o 60% higher than other people

11. The seriousness of the negative effects of climate change on the Maldivians (Maldive Islanders) could be largely exaggerated.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

12. It is certain that climate change will have a negative impact on the Maldivians (Maldive Islanders).

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

13. How do you estimate the likelihood of the Maldivians (Maldive Islanders) seeing negative effects of climate change?

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

14. If you currently live in the U.S., please select somewhat disagree

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

15. In order to show you are now paying attention, please select somewhat agree

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

Part 5: Climate change concern and behavioral intentions

>> next page

[NOTE: The questions appeared in a random order.]

Now please carefully answer the following section of questions.

1. How concerned, if at all, are you about climate change, sometimes referred to as 'global warming?'
   - None at all concerned
   - A little concerned
   - A moderate amount concerned
   - A lot concerned
   - A great deal concerned

2. Considering any potential effects of climate change which there might be on you personally, how concerned, if at all, are you about climate change?
   - None at all concerned
   - A little concerned
   - A moderate amount concerned
   - A lot concerned
   - A great deal concerned

3. Considering any potential effects of climate change there might be on society in general, how concerned are you about climate change?
   - None at all concerned
   - A little concerned
   - A moderate amount concerned
   - A lot concerned
   - A great deal concerned

Now please carefully consider how likely are you to take each action in the future to address climate change.

[NOTE: The questions appeared in a random order. Answer options included: Very unlikely, Somewhat unlikely, Neither likely nor unlikely, Somewhat likely, Very likely]

1. I plan to take some actions to stop climate change.
2. I plan to take some actions to adapt to climate change.
3. I personally DO NOT intend to do much to stop climate change.
4. I personally DO NOT intend to do much to adapt to climate change.
5. I will make some efforts to mitigate greenhouse gas emissions.
6. I will make some efforts to adapt to the negative effects of climate change.

7. I intend to take concrete steps to do something to mitigate greenhouse gas emissions.

8. I intend to take concrete steps to do something to adapt to the negative effects of climate change.

>> next page

Now please carefully consider how likely are you to take each action in the future to address climate change.

[NOTE: The questions appeared in a random order. Answer options included: Very unlikely, Somewhat unlikely, Neither likely nor unlikely, Somewhat likely, Very likely]

1. I intend to choose a car that gets good gas mileage (this would reduce the purchase of trucks, vans, and Bronco type vehicles)
2. I intend to install more insulation and weatherize homes and apartments
3. I intend to use more carpooling and/or drive less using trains and buses more often
4. I intend to replace older appliances with more energy efficient new models (refrigerators, furnaces, dishwashers, and others)
5. I intend to use less air conditioning in the summer and less heat in the winter
6. I intend to switch off lights when not in use
7. I intend to buy local foods when possible
8. I intend to eat less meat
9. I intend to repaint my (future) house in a lighter color (less heat absorption in the summer)
10. I intend to buy a flood insurance or other climate-related disaster insurance for my (future) house
11. I intend to install a water re-use system at home
12. I intend to donate money to preserve species at risk from climate change
13. I intend to persuade relatives or friends to move away from flood plains or climate-vulnerable areas
14. I intend to fit water saving device in my cistern to save when flushing
15. I intend to read more about how to avoid heat stress during heat waves
16. I intend to find out how much my (future) house or flat is at risk from climate-related risks
17. I intend to donate money for projects in developing countries that move housing estates away from areas at risk of climate change

>> next page

Part 6: Demographic questions

Please carefully fill out the detailed demographic questions below.

1. What is your age in years?

_____

2. What is your political orientation?

Extremely conservative							Extremely liberal

3. What is the highest level of education you have completed?
   - o No schooling completed
   - o Nursery school to 8th grade
   - o Some high school, no diploma
   - o High school graduate, diploma or the equivalent (for example: GED)
   - o Some college credit, no degree
   - o Trade/technical/vocational training
   - o Associate's degree
   - o Bachelor's degree
   - o Master's degree
   - o Doctorate degree

4. What is your total monthly household (family) income?
   - o Master's degree
   - o Doctorate degree
   - o Less than $10,000
   - o $10,000 to $50,000
   - o More than $50,000 and less than $75,000
   - o $75,000 to $100,000
   - o More than $100,000 and less than $150,000
   - o $150,000 to $200,000
   - o More than $200,000

5. Do you consider yourself Latino or Hispanic?
   - o Yes
   - o No

6. Which of the following describes your race?
   - o White
   - o Black/African American
   - o Asian
   - o American Indian or Alaska Native
   - o Native Hawaiian or Pacific Islander
   - o Other

Part 7: Debriefing
Thank you for your participation in our study! Your participation is greatly appreciated.

Useful Contact Information: If you have any questions regarding this study, please contact Ran Duan (primary contact) by email: duanran3@msu.edu, or Dr. Bruno Takahashi by email: btakahas@msu.edu. If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 4000 Collins Rd, Suite 136, Lansing, MI 48910.

APPENDIX D: Experiment 2 Questionnaire

Part 1: Demographic

[NOTE: This section was used for pre-screening purpose. People under 18 or those who were not in the U.S. were screened out. Quotas for gender, age, race/ethnicity, region and political orientation were utilized to ensure a diverse sample that had characteristics similar to census data for the United States.]

1. What is your biological gender?
   - Male
   - Female

2. What is your age?
   - 17 or under
   - 18-34
   - 35-54
   - 55 or older

Skip To: End of Block If What is your age? = 17 or under

3. Which of the following do you most closely identify with?
   - White/Caucasian
   - Black/African American
   - Hispanic/Latino
   - Other (Asian, Islander, Native American, etc.)

4. What is your party identification?
   - Democrat
   - Independent
   - Republican

5. What region are you currently residing in?

   - **Northeast** (New England, Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, Mid-Atlantic, New Jersey, New York, and Pennsylvania)
   - **Midwest** (Illinois, Indiana, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota)
   - **South** (Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, District of Columbia, West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, and Texas)
   - **West** (Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming, Alaska, California, Hawaii, Oregon, and Washington)

Part 2: Stimuli

Please view each climate change image (and its accompanying caption) for at least 15 seconds.

[NOTE: In this section, participants were randomly assigned to either the abstract or the concrete group. They viewed either nine abstract or nine concrete images of climate change as well as the images' accompanying captions. The images were presented in a random order.]

Part 3: Egocentric temporal distance

4. After viewing the images, imagine that climate change shows negative effects. How much time from now do you think you will personally see these negative effects?

    - o < 5 years
    - o 5-10 years
    - o 10-15 years
    - o 15-20 years
    - o 20-25 years
    - o 25-30 years
    - o 30-50 years
    - o 50-100 years
    - o Hundreds of years from that future timepoint

5. Climate change is an urgent threat or risk for my generation.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

6. I will be able to feel the negative effects of climate change very soon.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

Part 4: Egocentric psychological distance of climate change

[NOTE: This section has 15 questions; they were presented in a random order. #14 and #15 were attention-check questions, and response that failed these questions were deleted for data analysis.]

PLEASE READ BEFORE YOU CONTINUE:

In this section, we want to understand how you think about climate change affecting you personally.

The information you just learned from the climate change images and captions might be very useful in terms of answering the questions about your opinions!

Please carefully answer the questions and try NOT to give identical responses (e.g., neither agree nor disagree) throughout the survey.

>> next page

Q. Please scroll down to answer the questions. Feel free to scroll up in case you want to look for information from the images.

[NOTE: Image stimuli were presented *here*.]

Based on the images and their accompanying captions, now please state the extent to which you agree or disagree with the statements below:

1. Worst effects of climate change are felt more by faraway places/countries rather than my place.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

2. I think about faraway places rather than nearby places more often when thinking of negative effects of climate change.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

11. Many negative effects of climate change are geographically close to the me.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

12. After viewing the images, I feel the estimated distance between the geographical area(s) that are being negatively affected by climate change and my location could be:

Extremely close	Very close	Somewhat close	Somewhat distant	Very distant	Extremely distant

13. I can personally feel familiar with the similar negative experiences reflected in the images.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

14. The stories in the images show problems similar to my own.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

15. People generally similar to me can feel/experience the negative impacts of climate change.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

16. After viewing the images, I feel climate change could negatively affect me much more than other people ("Other people" are not family or close friends).

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

17. I could be socially and personally faraway to many negative effects of climate change.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

18. After viewing the images, I feel...
My chance of feeling the negative effects of climate change is____ than that of other people in the world ("Other people" are not family or close friends).

- o 60% lower than other people
- o 40% lower than other people
- o 20% lower than other people
- o Equal to other people

- 20% higher than other people
- 40% higher than other people
- 60% higher than other people

16. The seriousness of the negative effects of climate change on me could be largely exaggerated.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

17. It is certain that climate change will have a negative impact on me.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

18. How do you estimate the likelihood of yourself seeing negative effects of climate change?

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

19. If you currently live in the U.S., please select somewhat disagree

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

20. In order to show you are now paying attention, please select somewhat agree

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

Part 5: Climate change concern and behavioral intentions

>> next page

[NOTE: The questions appeared in a random order.]

Now please carefully answer the following section of questions.

4. How concerned, if at all, are you about climate change, sometimes referred to as 'global warming?'
   - o None at all concerned
   - o A little concerned
   - o A moderate amount concerned
   - o A lot concerned
   - o A great deal concerned

5. Considering any potential effects of climate change which there might be on you personally, how concerned, if at all, are you about climate change?
   - o None at all concerned
   - o A little concerned
   - o A moderate amount concerned
   - o A lot concerned
   - o A great deal concerned

6. Considering any potential effects of climate change there might be on society in general, how concerned are you about climate change?
   - o None at all concerned
   - o A little concerned
   - o A moderate amount concerned
   - o A lot concerned
   - o A great deal concerned

Now please carefully consider how likely are you to take each action in the future to address climate change.

[NOTE: The questions appeared in a random order. Answer options included: Very unlikely, Somewhat unlikely, Neither likely nor unlikely, Somewhat likely, Very likely]

9. I plan to take some actions to stop climate change.
10. I plan to take some actions to adapt to climate change.
11. I personally DO NOT intend to do much to stop climate change.
12. I personally DO NOT intend to do much to adapt to climate change.
13. I will make some efforts to mitigate greenhouse gas emissions.
14. I will make some efforts to adapt to the negative effects of climate change.

15. I intend to take concrete steps to do something to mitigate greenhouse gas emissions.

16. I intend to take concrete steps to do something to adapt to the negative effects of climate change.

>> next page

Now please carefully consider how likely are you to take each action in the future to address climate change.

[NOTE: The questions appeared in a random order. Answer options included: Very unlikely, Somewhat unlikely, Neither likely nor unlikely, Somewhat likely, Very likely]

18. I intend to choose a car that gets good gas mileage (this would reduce the purchase of trucks, vans, and Bronco type vehicles)
19. I intend to install more insulation and weatherize homes and apartments
20. I intend to use more carpooling and/or drive less using trains and buses more often
21. I intend to replace older appliances with more energy efficient new models (refrigerators, furnaces, dishwashers, and others)
22. I intend to use less air conditioning in the summer and less heat in the winter
23. I intend to switch off lights when not in use
24. I intend to buy local foods when possible
25. I intend to eat less meat
26. I intend to repaint my (future) house in a lighter color (less heat absorption in the summer)
27. I intend to buy a flood insurance or other climate-related disaster insurance for my (future) house
28. I intend to install a water re-use system at home
29. I intend to donate money to preserve species at risk from climate change
30. I intend to persuade relatives or friends to move away from flood plains or climate-vulnerable areas
31. I intend to fit water saving device in my cistern to save when flushing
32. I intend to read more about how to avoid heat stress during heat waves
33. I intend to find out how much my (future) house or flat is at risk from climate-related risks
34. I intend to donate money for projects in developing countries that move housing estates away from areas at risk of climate change

>> next page

Part 6: Self-efficacy

[NOTE: The questions appeared in a random order.]

1. I believe my actions have an influence on global warming and climate change

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

2. My actions to reduce the effects of global warming and climate change in my community will encourage others to reduce the effects of global warming through their own actions

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

3. Human beings are responsible for global warming and climate change

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

Part 7: Value

In this section, please rate the importance of these 16 values as guiding principles in your life. Please vary your responses to ensure enough variation between answers and to rate only few values as extremely important.

1. Social power, control over others, dominance

Opposed to my values	○	○	○	○	○	○	○	○	○	of supreme importance

2. Authority, the right to lead or command

Opposed to my values	○	○	○	○	○	○	○	○	○	of supreme importance

3. Influential, having an impact on people and events

Opposed to my values	○	○	○	○	○	○	○	○	○	of supreme importance

4. Wealth, material possessions, money

Opposed to my values	○	○	○	○	○	○	○	○	○	of supreme importance

5. Ambitious, hardworking, aspiring

Opposed to my values	○	○	○	○	○	○	○	○	○	of supreme importance

6. Pleasure, gratification of desires

Opposed to my values	○	○	○	○	○	○	○	○	○	of supreme importance

7. Enjoying life, enjoying food, sex, leisure, etc.

Opposed to my values	○	○	○	○	○	○	○	○	○	of supreme importance

8. Self-indulgent, doing pleasant things

Opposed to my values	○	○	○	○	○	○	○	○	○	of supreme importance

9. Preventing pollution, protecting natural resources

Opposed to my values	○	○	○	○	○	○	○	○	○	of supreme importance

10. Protecting the environment, preserving nature

Opposed to my values	○	○	○	○	○	○	○	○	○	of supreme importance

11. Respecting the earth, harmony with other species

Opposed to my values	○ ○ ○ ○ ○ ○ ○ ○ ○	of supreme importance

12. Unity with nature, fitting into nature

Opposed to my values	○ ○ ○ ○ ○ ○ ○ ○ ○	of supreme importance

13. Equality, equal opportunity for all

Opposed to my values	○ ○ ○ ○ ○ ○ ○ ○ ○	of supreme importance

14. Social justice, correcting injustice, care for the weak

Opposed to my values	○ ○ ○ ○ ○ ○ ○ ○ ○	of supreme importance

15. A world of peace, free of war and conflict

Opposed to my values	○ ○ ○ ○ ○ ○ ○ ○ ○	of supreme importance

16. Helpful, working for the welfare of others

Opposed to my values	○	○	○	○	○	○	○	○	○	of supreme importance

Part 8: Demographic questions

Please carefully fill out the detailed demographic questions below.

4. What is your age in years?

_____

5. What is your political orientation?

Extremely conservative							Extremely liberal

6. What is the highest level of education you have completed?
   - o No schooling completed
   - o Nursery school to 8th grade
   - o Some high school, no diploma
   - o High school graduate, diploma or the equivalent (for example: GED)
   - o Some college credit, no degree
   - o Trade/technical/vocational training
   - o Associate's degree
   - o Bachelor's degree
   - o Master's degree
   - o Doctorate degree

4. What is your total monthly household (family) income?
   - o Master's degree
   - o Doctorate degree
   - o Less than $10,000
   - o $10,000 to $50,000
   - o More than $50,000 and less than $75,000
   - o $75,000 to $100,000
   - o More than $100,000 and less than $150,000
   - o $150,000 to $200,000
   - o More than $200,000

5. Do you consider yourself Latino or Hispanic?
   - o Yes
   - o No

6. Which of the following describes your race?
   - o White
   - o Black/African American
   - o Asian
   - o American Indian or Alaska Native
   - o Native Hawaiian or Pacific Islander
   - o Other

Part 9: Debriefing

Thank you for your participation in our study! Your participation is greatly appreciated.

Useful Contact Information: If you have any questions regarding this study, please contact Ran Duan (primary contact) by email: duanran3@msu.edu, or Dr. Bruno Takahashi by email: btakahas@msu.edu. If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 4000 Collins Rd, Suite 136, Lansing, MI 48910.

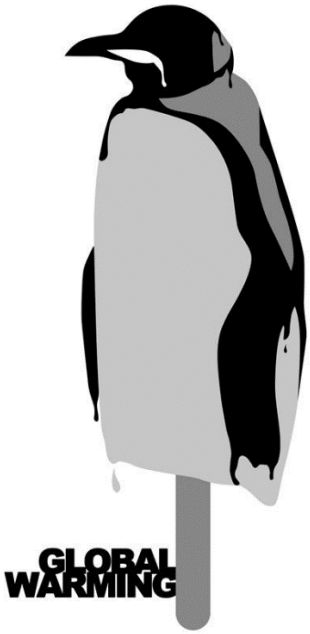
APPENDIX E: Stimuli of Pretest 1

Abstract images

Figure 10 Pretest 1 abstract image 1

(Travis et al., 2016).

Figure 11 Pretest 1 abstract image 2

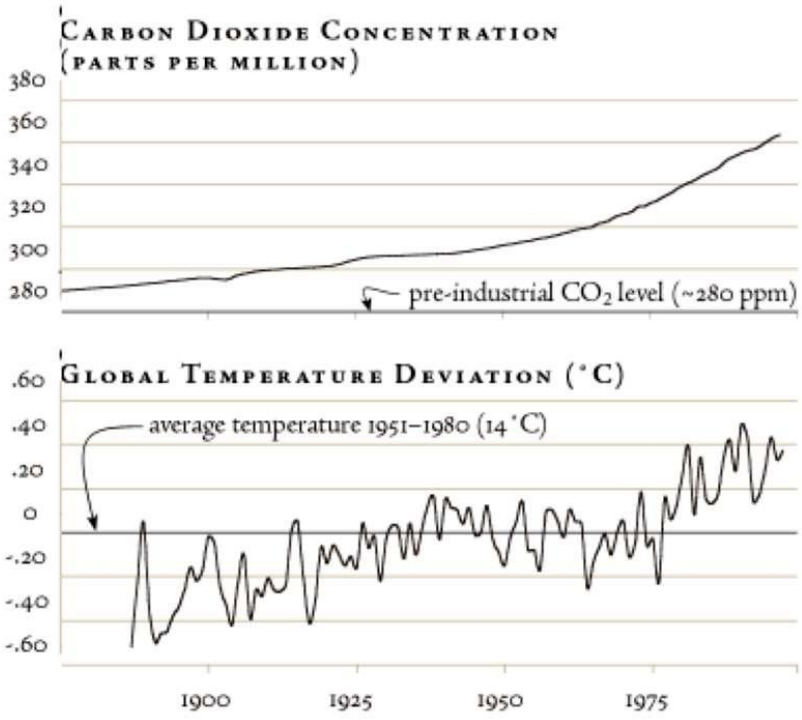


(Starling, 2014).

Figure 12 Pretest 1 abstract image 3

The global effects of greenhouse gases ("dummies.com," n.d.).

Figure 13 Pretest 1 abstract image 4

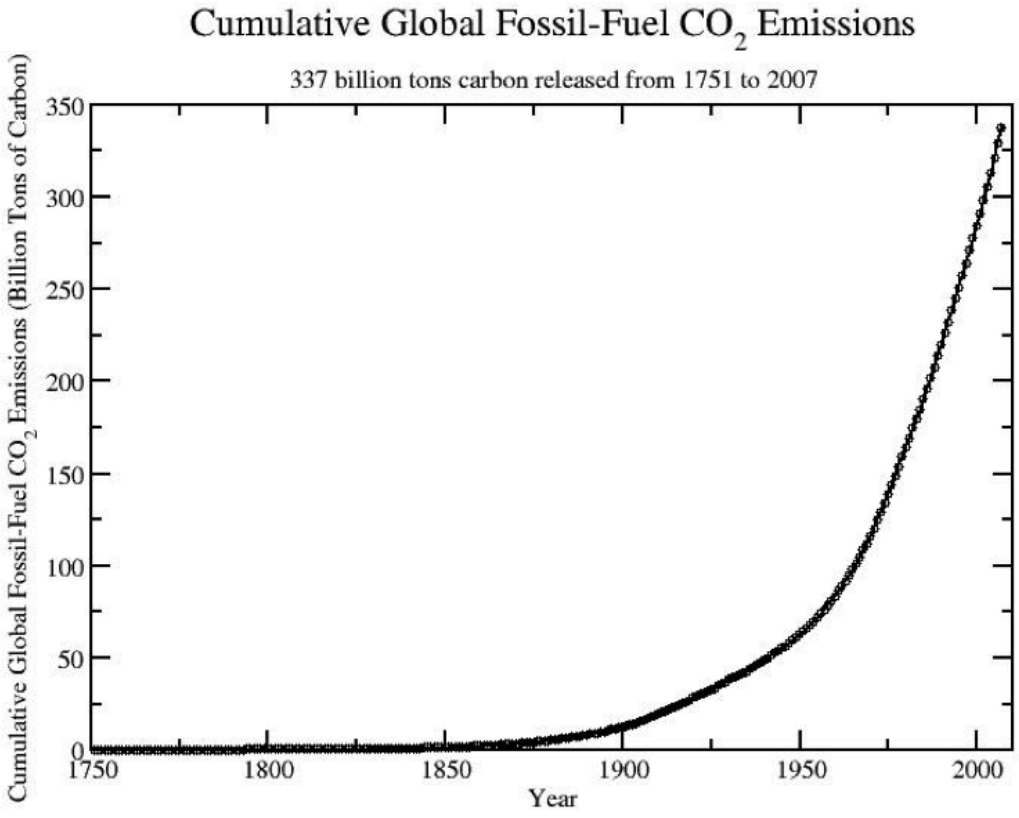


As Arrhenius predicted, both carbon dioxide levels and temperatures increased from 1900–1999. However, carbon dioxide in the atmosphere has increased much more quickly than he expected, but the Earth hasn't warmed as much as he thought it would (Simmon, n.d.).

Figure 14 Pretest 1 abstract image 5

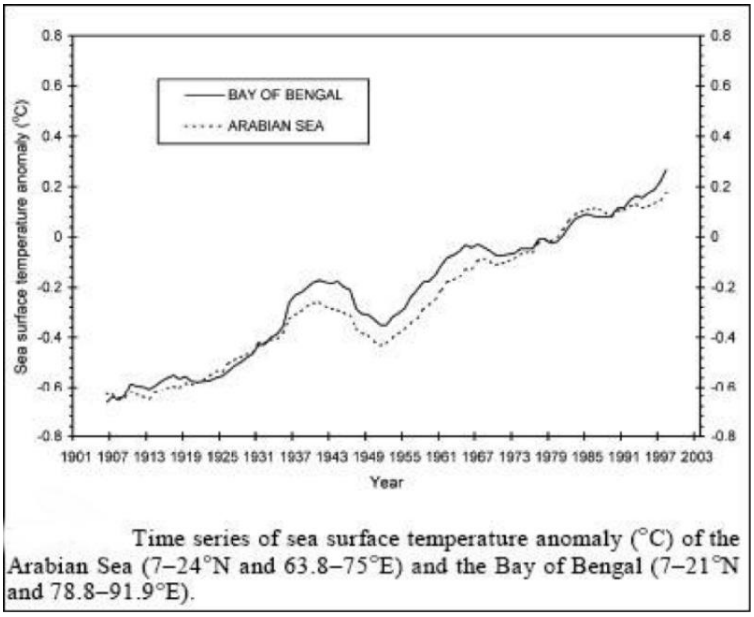
(Toles, 2016).

Figure 15 Pretest 1 abstract image 6



(Boden, Marland, & Andres, 2010).

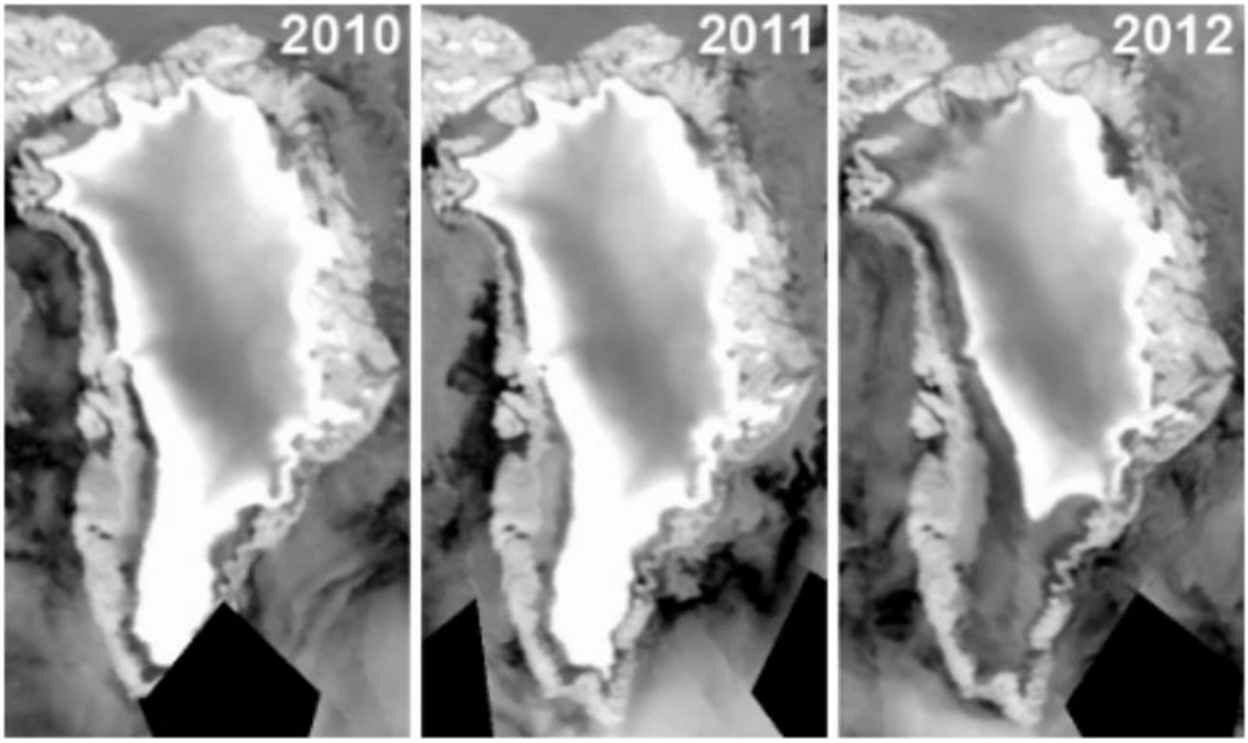
Figure 16 Pretest 1 abstract image 7



Time series of sea surface temperature anomaly (°C) of the Arabian Sea (7–24°N and 63.8–75°E) and the Bay of Bengal (7–21°N and 78.8–91.9°E).

(Global Warming Science, 2009).

Figure 17 Pretest 1 abstract image 8



Satellite images of the ice field behind Jakobshavn Glacier in southwest Greenland (Arctic sea ice blog., 2012).

Figure 18 Pretest 1 abstract image 9

(Pixabay.com, n.d.).

Concrete images

Figure 19 Pretest 1 concrete image 1

Storm surge on a Louisiana highway shows the current effects of rising sea levels (National Oceanic and Atmospheric Administration, 2018).

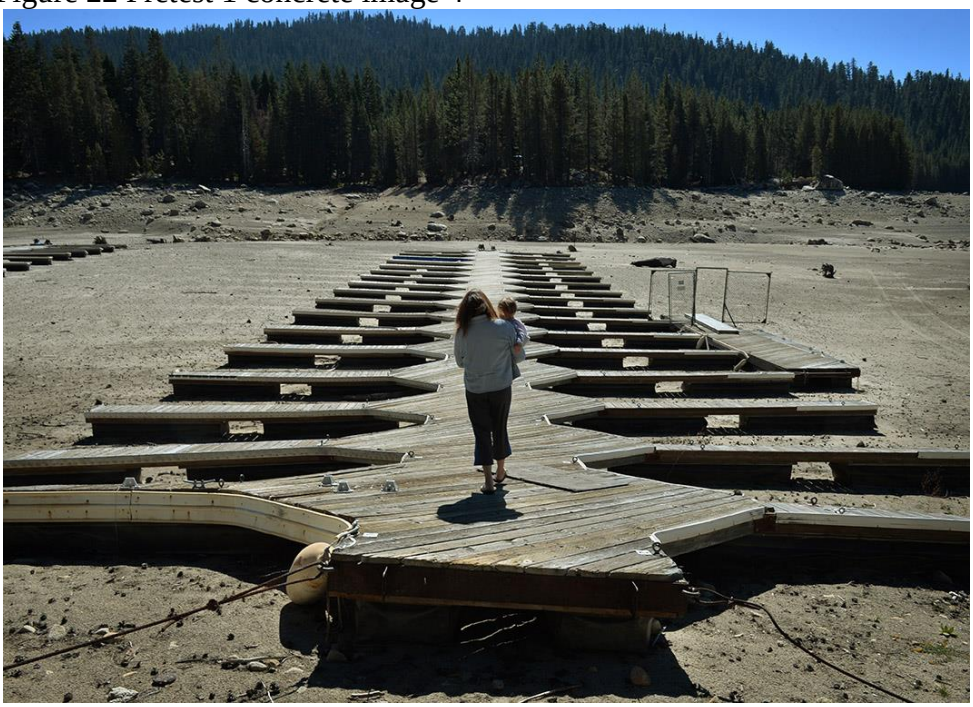
Figure 20 Pretest 1 concrete image 2

Daniela Stefano, left, Carol McCarty, center, and Nicole Stefano stand on the remnants of a sand dune behind their Surf City, New Jersy, homes on July 9. A study finds, such dunes were built to protect coastlines against surges of catastrophic storms such as Superstorm Sandy (Koch, 2013).

Figure 21 Pretest 1 concrete image 3

Rising temperatures are not just a concern for the future. Dangerously hot weather is already occurring more frequently in the Midwest than it did 60 years ago ("Union of Concerned Scientists," n.d.).

Figure 22 Pretest 1 concrete image 4



Marina owner Mitzi Richards carries her granddaughter as they walk on their boat dock at the dried up lake bed of Huntington Lake which is at only 30 percent capacity as a severe drought continues to affect California on Sept. 23, 2014 (Ralston, 2016).

Figure 23 Pretest 1 concrete image 5

Duluth, MN, USA — Water flows down a damaged street in Duluth, Minn. on Wednesday, June 20, 2012 (King, 2013).

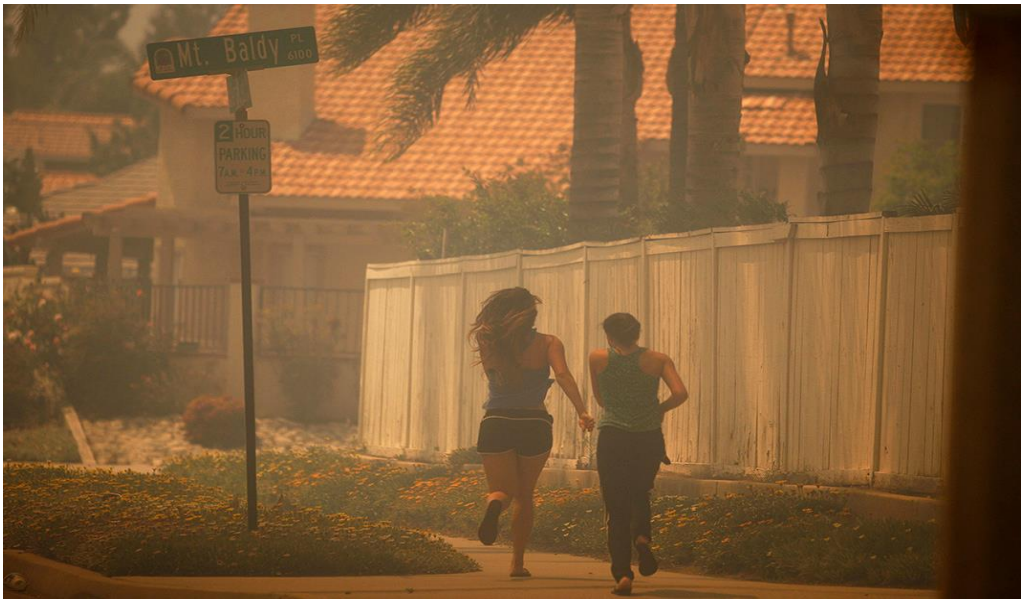
Figure 24 Pretest 1 concrete image 6

A new study links climate change and the collapse of New England's cod population (Associated press, 2015).

Figure 25 Pretest 1 concrete image 7

A woman looks at a roller coaster sitting in the ocean after Hurricane Sandy, in Seaside Heights, New Jersey, in this file photo taken November 28, 2012. The number of people who could be displaced in U.S. coastal regions due to rising sea levels this century as a result of climate change is much higher than previously thought, with more than 13 million Americans at risk with a 6-foot (1.8 meters) rise, scientists say (Burton, 2016).

Figure 26 Pretest 1 concrete image 8



Residents run as a wildfire driven by fierce Santa Ana winds closes in on them in Rancho Cucamonga, California, Apr. 30, 2014 (McNew, n.d.).

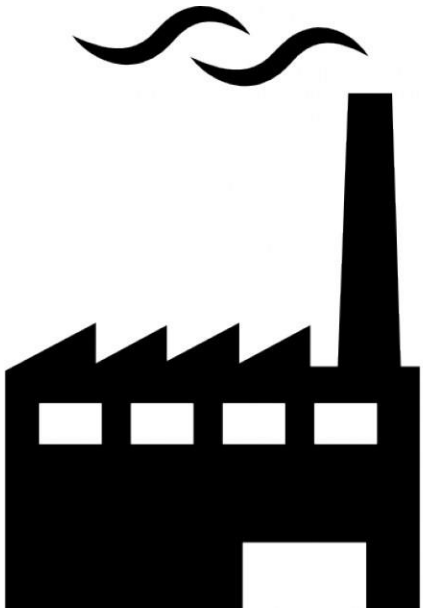
Figure 27 Pretest 1 concrete image 9

Climate Change – As sea levels rise and weather events become more extreme, coastal flooding and erosion will increase across the Chesapeake Bay (“chesapeakebay.net,” n.d.).

APPENDIX F: Stimuli of Pretest 2, Experiment 1 and 2

Abstract Images

Figure 28 Pretest 2 abstract image 1

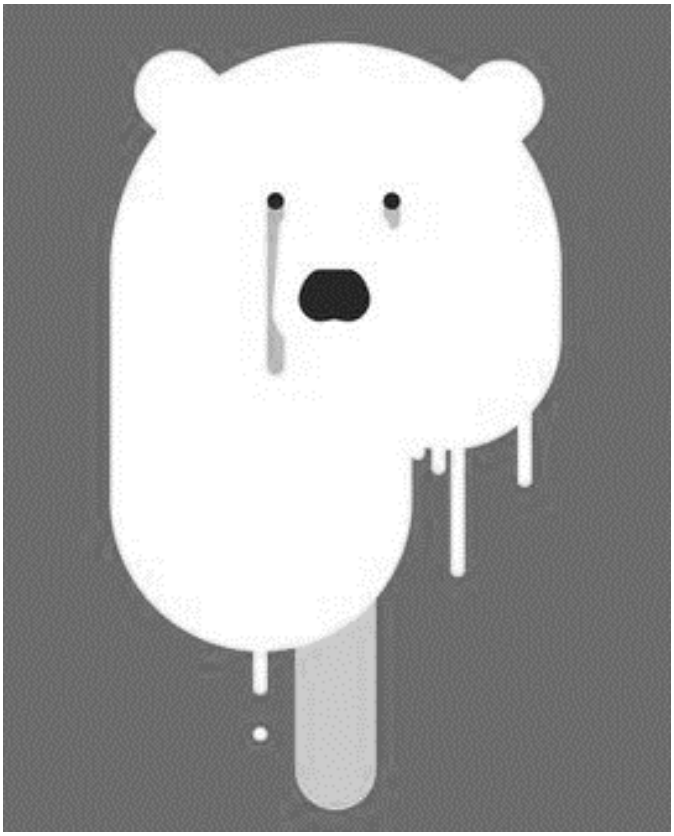


(Zahler, 2016).

Figure 29 Pretest 2 abstract image 2

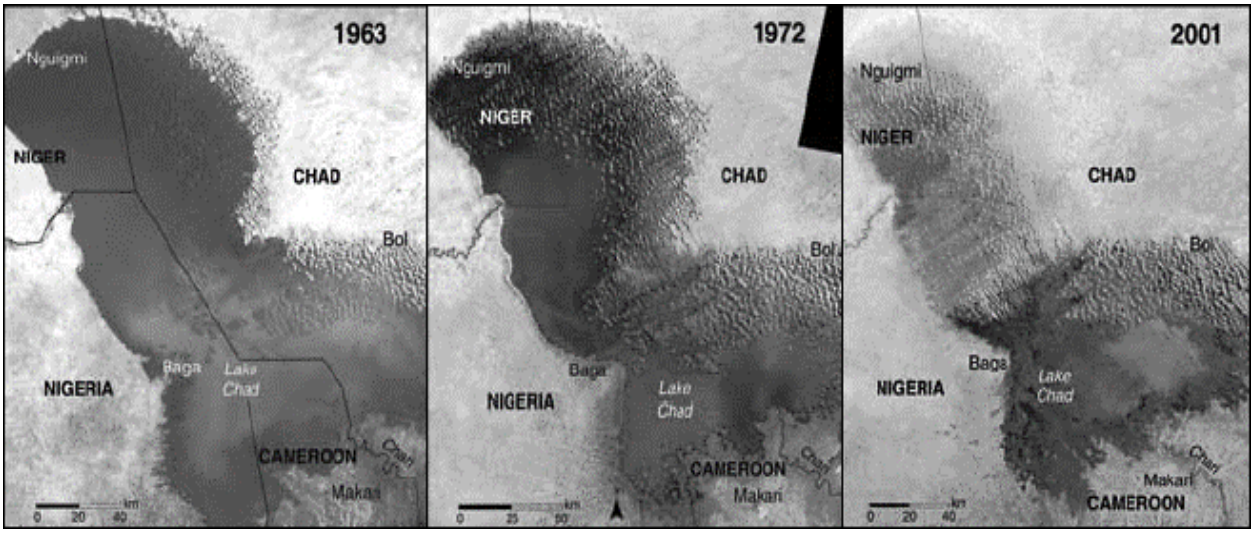
(Bagota, n.d.).

Figure 30 Pretest 2 abstract image 3



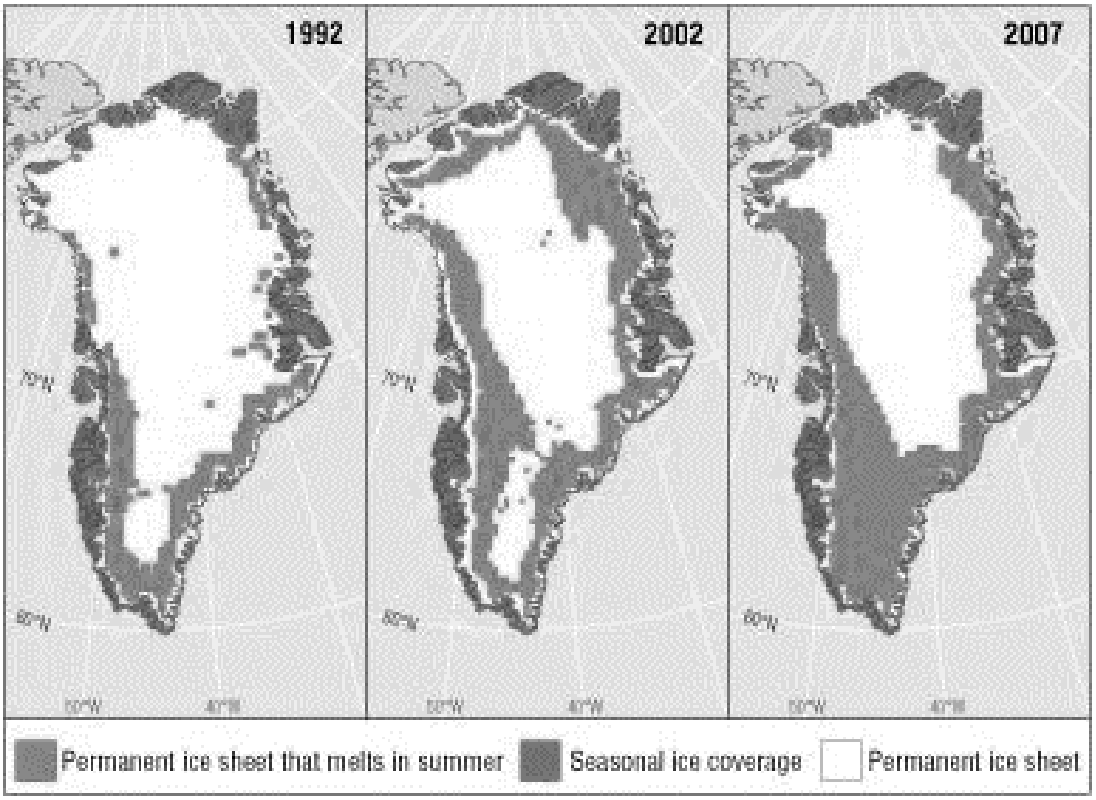
runsickcattle.com (n.d.).

Figure 31 Pretest 2 abstract image 4



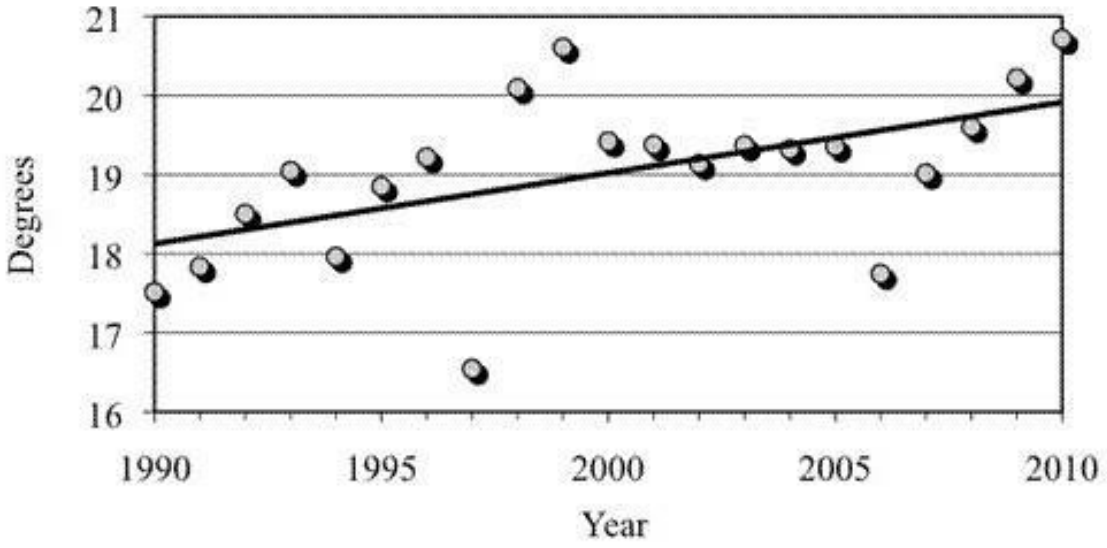
A continued decline in Lake Chad surface area (Osman-Elasha, n.d.).

Figure 32 Pretest 2 abstract image 5



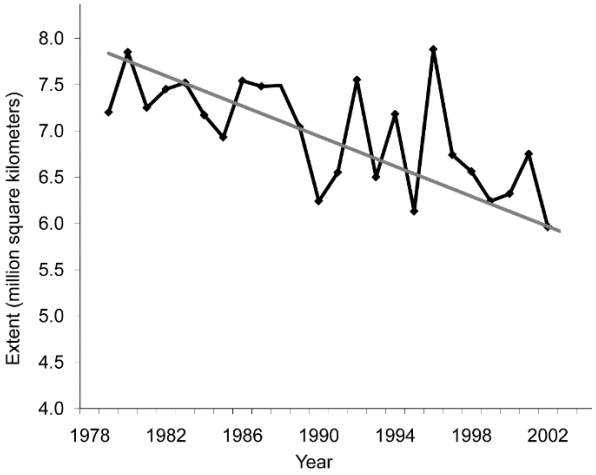
Greenland Ice Sheet (Meaww, 2018).

Figure 33 Pretest 2 abstract image 6



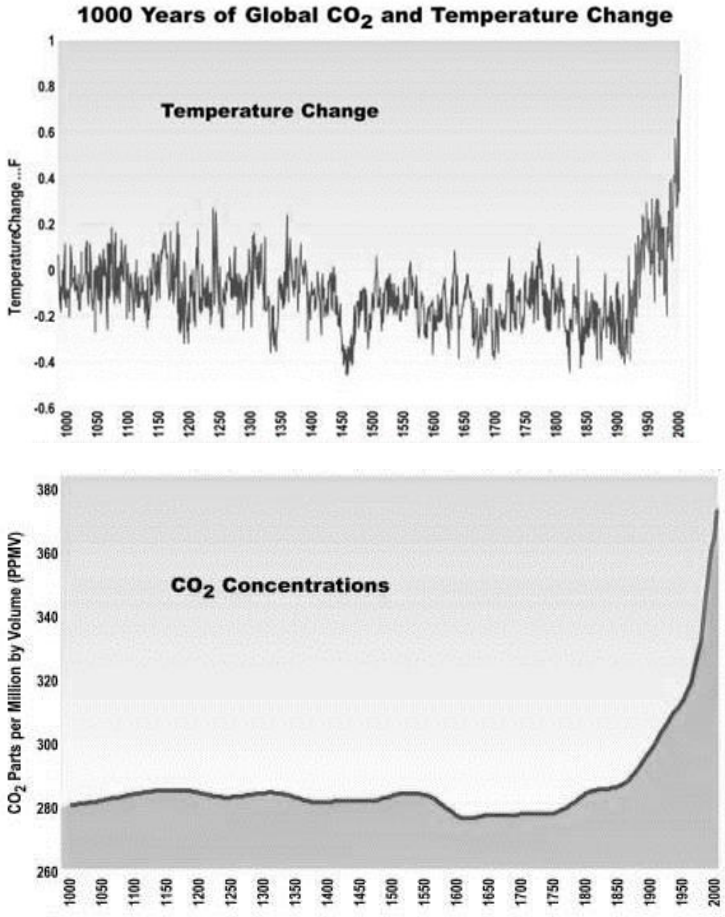
Annual average temperatures, Kathmandu, Nepal (Bhandari, 2015).

Figure 34 Pretest 2 abstract image 7



Average monthly Arctic sea ice extent, September 1979 to 2002 (National Snow and Ice Data Center, 2009).

Figure 35 Pretest 2 abstract image 8



(Environmental Decision Making, Science, and Technology, n.d.).

Figure 36 Pretest 2 abstract image 9

(Allen, n.d.).

[NOTE: Concrete images]

Figure 37 Pretest 2 concrete image 1

Two separate studies find that climate change boosted the storm's rainfall by at least 15 percent. Boat rescue traffic on the flooded Jimmy Johnson Road in Port Arthur, Texas, on August 30, 2017 (Yam, 2017).

Figure 38 Pretest 2 concrete image 2

Climate change fuels wildfires in California. Paul Miller prepares to evacuate his home as a wildfire burns along a hillside near homes in Santa Paula, California, Dec 6, 2017 (Chiu, 2017).

Figure 39 Pretest 2 concrete image 3

Warming Climate Leads to Poor Air Quality. The fact that air pollution worsens as temperatures rise should concern residents of Detroit—poor air quality already puts large numbers of people at risk from respiratory illnesses such as asthma, chronic bronchitis, and emphysema. July 19, 2017 (Union of Concerned Scientists, 2017).

Figure 40 Pretest 2 concrete image 4

Kelly McClenthen returns to her flooded home with boyfriend Daniel Harrison in the aftermath of Hurricane Irma in Bonita Springs, Florida. September 19, 2017 (Herbert, 2017).

Figure 41 Pretest 2 concrete image 5

Residents gather by a bridge to look at cars left crumpled in one of the tributaries of the Patapsco River that burst its banks as it channeled through historic Main Street in Ellicott City, Maryland, May 28, 2018. The destructive flooding left the former mill town heartbroken as it had bounded back from another destructive storm less than two years ago. hotter planet and a wetter atmosphere is making weather events more extreme and thus more deadly more often (McFadden, 2018).

Figure 42 Pretest 2 concrete image 6

Herb Nieves and his dog Max, a red nose pitbull, cool out in the Columbus Circle fountain during a heat wave on July 12, 2017, in New York City. A new study suggests that the parts of the U.S., especially the Northeast, will likely see the effects of climate change sooner than other parts of the world (Talaie, 2017).

Figure 43 Pretest 2 concrete image 7

People cross North Avenue at Damen Avenue in Chicago in late September 2017, on a day when high temperatures reached into the 90s. Climate change threatens Midwest infrastructure, report says (James, 2017).

Figure 44 Pretest 2 concrete image 8

There is a connection between a melting Arctic and frigid temperatures on the East Coast. Clearing snow in Norfolk, Massachusetts as a major winter storm hit. Jan 4 2018 (Campbell, 2018).

Figure 45 Pretest 2 concrete image 9

Residents watch the Thomas fire burn from Prospect Street in Ventura, California. Climate change makes fires more likely, for a variety of reasons. Dec 5, 2017 (Baker, 2017).

APPENDIX G: Results of Pretest 1 and 2

Table 6 Preference for abstract behavior description as a function of images' abstraction level (Pretest 1)

Behavioral Identification Form items	Treatment (%[a])	
	Abstract images	Concrete images
1.Making a list Getting organized*vs. Writing things down	70.7	60.2
2.Reading Following lines of print vs. Gaining knowledge*	77.8	66.7
3. Joining the Army Helping the Nation's defense*vs. Signing up	65.7	46.2
4. Washing clothes Removing odors from clothes* vs. Putting clothes into the machine	60.6	49.5
5. Picking an apple Getting something to eat* vs. Pulling an apple off a branch	63.6	53.7
6. Chopping down a tree Wielding an axe vs. Getting firewood*	62.6	44.1
7. Measuring a room for carpeting Getting ready to remodel* vs. Using a yard stick	74.7	63.4
8. Cleaning the house Showing one's cleanliness* vs. Vacuuming the floor	59.6	50.5
9. Painting a room Applying brush strokes vs. Making the room look fresh*	70.7	58.1
10. Paying the rent Maintaining a place to live* vs. Writing a check	68.7	66.7
11. Caring for houseplants Watering plants vs. Making the room look nice*	43.4	35.5
12. Locking a door Putting a key in the lock vs. Securing the house*	68.7	76.3
13. Voting Influencing the election* vs. Marking a ballot	65.7	53.8
14. Climbing a tree Getting a good view* vs. Holding on to branches	51.5	46.2
15. Filling out a personality test Answering questions vs. Revealing what you're like*	60.6	50.5
16. Toothbrushing Preventing tooth decay* Moving a brush around in one's mouth	76.8	62.4
17. Taking a test Answering questions vs. Showing one's knowledge*	63.6	49.5
18. Greeting someone Saying hello vs. Showing friendliness*	52.5	43.0
19. Resisting temptation Saying "no" vs. Showing moral courage*	50.5	39.8

Table 6 (cont'd)

20. Eating Getting nutrition*vs. Chewing and swallowing	71.7	61.3
21. Growing a garden Planting seeds vs. Getting fresh vegetables*	58.6	46.2
22. Traveling by car Following a map vs. Seeing countryside*	67.7	63.4
23. Having a cavity filled Protecting your teeth* vs. Going to the dentist	52.5	48.4
24. Talking to a child Teaching a child something* vs. Using simple words	71.7	63.4
25. Pushing a doorbell Moving a finger vs. Seeing if someone's home*	81.8	78.5

*Note: * Higher level descriptions; a. Percent of participants who preferred higher level descriptions in the conditions.*

Table 7 Preference for abstract behavior description as a function of images' abstraction level (Pretest 2)

Behavioral Identification Form items	Treatment (%[a])	
	Abstract images	Concrete images
1.Making a list Getting organized*vs. Writing things down	69.9	61.6
2.Reading Following lines of print vs. Gaining knowledge*	81.7	77.8
3. Joining the Army Helping the Nation's defense*vs. Signing up	68.8	62.6
4. Washing clothes Removing odors from clothes* vs. Putting clothes into the machine	62.4	49.5
5. Picking an apple Getting something to eat* vs. Pulling an apple off a branch	54.8	48.5
6. Chopping down a tree Wielding an axe vs. Getting firewood*	64.5	45.5
7. Measuring a room for carpeting Getting ready to remodel* vs. Using a yard stick	68.8	64.6
8. Cleaning the house Showing one's cleanliness* vs. Vacuuming the floor	58.1	48.5
9. Painting a room Applying brush strokes vs. Making the room look fresh*	73.1	64.6
10. Paying the rent Maintaining a place to live* vs. Writing a check	77.4	68.7
11. Caring for houseplants Watering plants vs. Making the room look nice*	32.3	25.3
12. Locking a door Putting a key in the lock vs. Securing the house*	83.9	73.7
13. Voting Influencing the election* vs. Marking a ballot	68.8	57.6
14. Climbing a tree Getting a good view* vs. Holding on to branches	47.3	40.4
15. Filling out a personality test Answering questions vs. Revealing what you're like*	72.0	59.6
16. Toothbrushing Preventing tooth decay* Moving a brush around in one's mouth	75.3	69.7
17. Taking a test Answering questions vs. Showing one's knowledge*	62.4	48.5
18. Greeting someone Saying hello vs. Showing friendliness*	58.1	45.5
19. Resisting temptation Saying "no" vs. Showing moral courage*	55.9	47.5
20. Eating Getting nutrition*vs. Chewing and swallowing	69.9	56.6

Table 7 (cont'd)

21. Growing a garden Planting seeds vs. Getting fresh vegetables*	60.2	60.6
22. Traveling by car Following a map vs. Seeing countryside*	75.3	76.8
23. Having a cavity filled Protecting your teeth* vs. Going to the dentist	51.6	49.5
24. Talking to a child Teaching a child something* vs. Using simple words	67.7	53.5
25. Pushing a doorbell Moving a finger vs. Seeing if someone's home*	92.5	78.8

*Note: * Higher level descriptions; a. Percent of participants who preferred higher level descriptions in the conditions.*

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