THESIS

EXPLORING HUMANS' REACTIONS TO DEGRADED NATURAL ENVIRONMENTS THROUGH PHOTOGRAPHIC STIMULI

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ABSTRACT

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The discrepancy between the imminent threat of climate change and the public lack of meaningful response to that threat has been a puzzling phenomenon. One of the approaches proposed to answer the question about human behaviors regarding climate change is Terror Management Theory (TMT). TMT posits that human share a universal fear of death, such that once exposed, people will engage in some defense mechanisms to ward off those fears. One of those mechanisms involves reassuring oneself of possible symbolic or literal immortality by adhering to shared beliefs within a group, or cultural worldviews. Natural environments can be a source of existential threat to humans as they are inherently associated with both life and death. Therefore, confrontation with nature can provoke anxiety about death, which in turn motivates people to distance themselves from nature. This current project explored the effects of viewing images of different types of environments on people's thoughts of death and worldview defense behavior through four experimental studies. In the first and fourth study, participants viewed and wrote about one of three sets of seven randomly assigned images of the environment (i.e., intact nature, degraded nature, nature with visible human constructions). Participants' thoughts about mortality were assessed via a word completion task. In the second and third study, participants also viewed and wrote about seven images according to their conditions. Next, participants were told that they were going to read two brief essays written by foreign students about the United States. Half of the participants read a pro-American essay and the other half read an anti-

American one. In prior studies, participants' reactions to the author of the essay were indicative of whether or not they engage in worldview defense. While data from the first study provided support for degraded nature increasing thoughts of death, the three subsequent studies presented mixed results. Future research on existential anxieties and their effects on people's response to threats might help further explore humans' climate change responses.

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CHAPTER 1 – INTRODUCTION

The Climate Science Special Report, a report from the United States Global Change Research Program that assessed the science of climate change with a focus on the United States, opened with this executive summary: "…This assessment concludes, based on extensive evidence, that it is extremely likely that human activities, especially emissions of greenhouse gases, are the dominant cause of the observed warming since the mid-20th century…In addition to warming, many other aspects of global climate are changing, primarily in response to human activities. Thousands of studies conducted by researchers around the world have documented changes in surface, atmospheric, and oceanic temperatures; melting glaciers; diminishing snow cover; shrinking sea ice; rising sea levels; ocean acidification; and increasing atmospheric water vapor." (Wuebbles et al., 2017, p. 1). Despite such alarming descriptions of the environment's current state and concerning reports of how climate change has been impacting multiple aspects of human existence (Jay et al., 2018), responses to climate change seem to remain at a standstill. Actions responding to climate change ranging from the governmental (Reckien et al., 2014) to individual levels (Semenza et al., 2008), although attempted, remain insufficient and thus unimpactful.

Such a discrepancy between the sobriety of a life-or-death issue and the public reaction calls into question people's attitude towards nature. One explanation for people's disinterest in the well-being of natural environments is the decreasing frequency of nature experiences in the public. Children are spending less time experiencing natural environments than previous generations did (Soga & Gaston, 2016). Lack of experience with nature is linked to loss of health and well-being benefits, little awareness of the benefit nature can bring, and decreased

motivation to engage with and protect natural environments (Soga & Gaston, 2016). The disconnect between humans and nature perhaps not only prompts people to be more distant towards nature but also prevents people from perceiving the danger to nature as something imminent to their own well-being.

Commenting on the issue of global warming and climate change, Dyson (2005, p.119) compared the sequence of human reactions regarding climate change to that in response to HIV/AIDS, "In short: (i) scientific understanding advances rapidly, but (ii) avoidance, denial, and recrimination characterize the overall societal response, therefore (iii) there is relatively little behavioral change, until (iv) evidence of damage becomes plain." Such implication that only direct experience with adverse outcomes leads to behavioral change presents us with the question of why there seems to be little connection between what we know, what we value, and what we do, which prompts us to wonder whether or not humans respond rationally to climate change (Dickinson, 2009).

Indeed, there is substantial evidence showing that humans do not act rationally when it comes to shifting fundamental belief systems, values, and attitudes – elements that have been studied to be critical to meaningful and durable climate action (Wolfe & Tubi, 2018). Among the alternative approaches proposed to study seemingly irrational human behaviors regarding climate change was Terror Management Theory (Dickinson, 2009; Wolfe & Tubi, 2018).

Terror Management Theory

Terror Management Theory (TMT) was developed based on the works of Ernest Becker whose main goal was to come up with a coherent explanation of human behavior (Solomon et al., 1991). Although humans share a basic evolutionary heritage with all other creatures, what differentiates humans from other species is our self-awareness (Solomon et al., 1991). While

knowing that we are alive can provide us with a sense of self that enables us to better function, being aware of our own ultimate death and the fact that we cannot control how or when it will happen, can be a source of paralyzing terror (Solomon et al., 2004). To guard ourselves against reminders of our mortality and vulnerability, humans try to reassure ourselves of possible symbolic or literal immortality by adhering to cultural worldviews. Defined as "humanly constructed beliefs about reality shared by individuals in a group," cultural worldviews reduce the terror associated with death by providing their members with a sense that they are valuable parts of a meaningful universe (Solomon et al., 2004, p.19). Thus, effective methods of managing fear of death include: "faith in a meaningful conception of reality (the cultural worldview)" and "belief that one is meeting the standards of value prescribed by that worldview (self-esteem)" (Solomon et al., 2004, p.22). Because of our instinct for self-preservation and the protection these constructs offer, humans are motivated to believe in their respective cultural worldview and behave according to the values prescribed within them.

Empirical support for TMT came from evidence for three main hypotheses derived from the theory: the anxiety-buffer hypothesis, the death-thought accessibility hypothesis, and the mortality salience hypothesis (Pyszczynski et al., 2015). The anxiety-buffer hypothesis emphasizes the role of psychological structures, especially self-esteem (either dispositional or enhanced), in reducing anxiety about death. Studies demonstrated that both manipulated and dispositionally high levels of self-esteem not only reduced death anxiety but also mitigated defensive reactions to reminders of death. The death-thought accessibility hypothesis deals primarily with the effect of anxiety-buffering on thoughts about death. Specifically, threats to any component of a person's anxiety-buffer, such as worldviews and self-esteem, make implicit death-related thoughts become more cognitively accessible. In turn, defending one's worldview

or bolstering one's self-esteem decreases accessibility to thoughts of death. Finally, the mortality salience hypothesis focuses on the effect of reminders of death on human psyche and behavior. According to this hypothesis, reminding people of death should increase their need for the protection provided by their anxiety-buffer, such as worldview and self-esteem, thus increasing their commitment to or striving for those anxiety-buffers.

Among the three hypotheses, the mortality salience hypothesis has been the most often tested implication of TMT and thus has been used in several studies across fields, including studies about human environmental behaviors. Thus, the scope of this project will focus primarily on the mortality salience hypothesis. The mortality salience hypothesis states that: If cultural worldviews and self-esteem serve to alleviate anxiety associated with the awareness of death, reminding people of their own mortality should produce defenses to enhance those constructs (Solomon et al., 2004). Defense mechanisms are activated differently depending on whether thoughts of death are conscious or unconscious yet highly accessible. Conscious thoughts of death trigger proximal defenses – attempts to remove those thoughts by suppressing them or pushing the problem of death into the future. Unconscious thoughts of death, on the other hand, activate distal defenses – strategies to deal with the unconscious knowledge of death's inevitability rooted in the hope of symbolic or literal immortality. Such "immortality" can be achieved by adhering to shared beliefs within a group, or cultural worldviews. Whereas proximal defense is rational and threat focused, distal defense is experiential and not directly related to the problem of death (Pyszczynski et al., 1999). Most of the works on the mortality salience hypothesis have focused the distal defense mechanism.

In a meta-analysis conducted 20 years after the conception of TMT, results show that of 277 possible effect sizes (from 277 experiments in 164 journal articles) 221 (80%) were both

positive and statistically significant in favor of the mortality salience hypothesis (Burke et al., 2010). The overall effect size for all the hypothesized mortality salience manipulations was r = .35, suggesting that the mortality salience hypothesis of TMT is robust and produces moderate to large effects across a wide variety of mortality salience manipulations and dependent variables (Burke et al., 2010). This analysis provides support for the mortality salience hypothesis that increasing death-thought accessibility does indeed have effects on constructs of cultural worldviews and self-esteem. Furthermore, this empirical evidence extends the mortality salience hypothesis by proposing that reminding humans of their mortality may influence not only cognitive aspects, but also various human behaviors.

One of the areas that has been studied using mortality salience hypothesis is the human reaction to our own physical bodies and creatureliness - the quality or state of being like an animal. Supportive of the mortality salience hypothesis, one could expect that humans would avoid reminders of our physicality and creatureliness when death-related anxiety arises, since they cause people to think about their mortality (Goldenberg & Roberts, 2004). Indeed, results from several experiments support the premise that humans' detachment from our own physical and animal nature stems from existential concerns. In a study, Goldenberg and colleagues found that writing about one's own death led to a higher disgust sensitivity to body products and animals (Goldenberg et al., 2001). In another study, participants had to read two essays: one distinguished humans from animals and one depicted the similarity between humans and other animals. The participants who wrote about death preferred the former to the latter essay (Goldenberg et al., 2001). Preference for the essay depicting the uniqueness of humans as compared with other animals was also higher in the mortality salience condition compared to the control condition. These findings provide empirical support that people tend to distance

themselves from their physical and animal nature because of the existential concerns they can bring about.

Similar to humans' physical and animal nature, natural environments can be a source of existential threat to humans as it is inherently associated with both life and death (Koole & Van den Berg, 2005). Confrontation with nature can remind humans that we are a part of the same universe as all other living things and hence will have to face ultimate death. Based on TMT, the existential terrors stemming from death-thoughts in turn motivate people to distance themselves from the gruesome reality of nature.

Terror Management Theory and nature

The broader literature on human contact with nature illustrates the substantial impact that natural environments have on human well-being. Contact with natural environments, whether through simulation or direct exposure (e.g., viewing a slideshow of nature scenes, taking a walk in the forest), gives humans many psychological benefits (e.g., Berman et al., 2008; Berto, 2005; Kjellgren & Buhrkall, 2010). The benefits include, but are not limited to, stress reduction and cognitive restoration (e.g., Berman et al., 2008; Berto, 2005; Largo-Wight et al., 2011). In contrast, contact with degraded natural environments (e.g., drought, light pollution) is associated with several negative outcomes, such as increased levels of anxiety and depression (e.g., Doherty & Clayton, 2011; Speldewinde et al., 2009).

While contact with natural environments can have positive and restorative effects on human functioning compared to contact with cultivated environments (Maller et al., 2006; Mcsweeney et al., 2015), there is evidence for the notion that natural environments are more closely associated with thoughts about death than are cultivated environments. In one such study, a group of Dutch undergraduates were asked to indicate in which kind of environment they

thought most about various topics (Koole & Van den Berg, 2005). Specifically, participants were presented with eight different topics: relation problems, politics, family, money matters, death, art, studies, and freedom. For each topic, participants were asked to indicate whether they thought most about these topics when they were visiting wilderness, cultivated nature, or the city. In this study, wild nature was described as nature that has been hardly influenced by humans (i.e. a rain forest or primeval swamp), cultivated nature was described as nature that has been strongly influenced by humans (i.e. meadows or grain fields), and city was described as an environment in which nature played almost no role (i.e. highways or industrial areas). Results showed that participants reported thinking about death significantly more when they were in a wild natural environment compared to cultivated nature and the city (Koole & Van den Berg, 2005).

While the study mentioned above suggested a link between exposure to natural environments and thoughts of death, it is unclear what the direction of this association would be. Another study about natural environments and thoughts of death using the Stroop paradigm addressed this issue (Koole, 2003). The Stroop effect is a demonstration of cognitive interference and is evidenced by a delay in reaction time during tasks where participants must process competing information simultaneously (Stroop, 1935). In the most basic version of the Stroop task, results show that participants took the longest time to name the ink colors of the words printed when the color of the print and the word are different (e.g. where the word “red”" was printed in blue it was to be called “blue,” where it was printed in green it was to be called “green,” where the word “brown” was printed in red it was to be called “red.”) (Stroop, 1935). Although there have been several theories proposed to explain the Stroop effect, all essentially converge on the notion that reading is a simpler and more automatic task than stating colors, and

that a conflict between the two will increase the time needed for processing. Specifically, when one is asked to process two different sources of information (ink color of a word and the word), the individual's cognitive load is increased, and their brains have to work harder to resolve the different sources. Performing these tasks ultimately slows down responses, and the task takes longer. Thus, errors and delay in reaction times within Stroop tasks indicate processing of several sources of information with the competing source of information being strong enough to interfere with the task at hand (e.g. reading the ink color of the words). In Koole's study (2003) study, participants were first presented with either photographs of natural landscapes or photos of cultivated landscapes. Then, participants were asked to name the color of red and blue words that appeared on the computer screen. Participants who were primed with photos of natural landscapes showed a slower reaction time to death related words compared to words from other categories whereas participants who were primed with photos of cultivated landscapes demonstrated no such effect (Koole, 2003). According to the Stroop effect, the automatic action of reading a word happens before one tries to recognize what the color is, making the reaction time in identifying ink color of words with meaning other than the color printed longer. Thus, a difference in reaction times of identifying ink colors across different word categories suggests some level of cognitive interference that is above and beyond the normally observed interference between ink color and word meaning. Specifically, if one does not have thoughts of death, one may ignore the meaning of the word and move on to recognize the word's color. However, if one has thoughts of death, one may notice the meaning of the death-related word, and therefore require more time processing the word meaning before identifying its color. Therefore, slow reaction time to death-related words can be associated with having death-thoughts. The finding

suggests that exposure to nature, even only through photographs, can trigger thoughts about death.

Terror Management Theory and environmental-related behaviors

Not only do natural environments seem to be associated with death, but also reminding people of death could affect people's attitude and behaviors towards natural environments. Several studies using the mortality salience hypothesis have provided support for this notion.

Mortality salience can impact people's preference for the environment. Participants who were primed with a death condition reacted more positively to descriptors of cultivated landscapes and less positively to wilderness landscapes compared to participants who were primed with a neutral condition (Koole & Van den Berg, 2005).

In one study, after writing either about death or dental pain, participants completed a questionnaire about global environmental attitudes as well as anthropocentric and bio-centric pro-environmental motivation. Bio-centric motivation emphasizes the intrinsic value of nature and the importance of protecting elements of the natural environment regardless of their utility for humans. In contrast, anthropocentric motivation champions environmental action for the sake of humans and humanity, focusing on aspects of the environment that serve the supply and survival of humans. While reminders of death decreased people's bio-centric motivation to protect the environment, no such effect is found with anthropocentric motivation. Since anthropocentric motivation concerns human well-being, which is a part of one's cultural worldview, this result is consistent with mortality salience hypothesis: death-thoughts cause people to protect their cultural worldview in order to assuage anxieties towards death. Similarly, reminders of death decreased people's concern for nature (bio-centric concern) but not concern for themselves (Fritsche & Hafner, 2012).

Mortality salience can also influence people's views on wealth and prosperity and, in turn, impact their decisions regarding nature. Writing about death, compared to writing about a neutral topic, led people to have higher financial expectations for themselves in 15 years (Kasser & Sheldon, 2000). Not only did participants expect their overall worth to be higher but they also predicted spending higher amounts on pleasurable items such as clothing and entertainment. Moreover, participants who wrote about death became greedier and consumed more resources in a forest management game. In the game, participants were instructed to imagine that they owned a company that had to bid against three other companies to harvest timber in a national forest. They were told both the benefits and the problems associated with making either large or small bids, and still made large bids despite being reminded that the forest might disappear if they did so. This result supports that mortality salience can negatively affect human decisions towards nature (Kasser & Sheldon, 2000).

The current study

Early studies on TMT showed that, once reminded of death, people generally avoided being associated with their physical bodies and creatureliness, indicating that people tend to distance themselves from entities that could further exacerbate anxiety about death. Similar to humans' physical and animal nature, natural environments can bring up a sense of existential threat to humans as it is inherently associated with both life and death (Koole & Van den Berg, 2005). Indeed, people reported thinking about death significantly more when they were in a wild natural environment compared to cultivated nature and the city (Koole & Van den Berg, 2005). People who saw photos of natural landscapes also thought about death more compared to people who saw photos of cultivated landscapes, as demonstrated by slower reaction times to death-related words in a Stroop task (Koole, 2003). Furthermore, reminding people of death could

affect people's attitude and behaviors towards natural environments, such that after being primed with a death condition people would prefer cultivated landscapes to wilderness landscapes (Koole & Van den Berg, 2005), decrease their bio-centric motivation to protect the environment (Fritsche & Hafner, 2012), and become greedier and consume more resources in a forest-management game (Kasser & Sheldon, 2000).

First among the hypotheses proposed to examine the role of terror management theory in understanding people's responses to global climate change was that thinking about climate change increases death-thought accessibility (Dickinson, 2009). While information about climate change can serve as mortality reminders (Wolfe & Tubi, 2018), no known study has measured the extent to which information about climate change leads people to think about death or the potential effect of such thoughts. Similarly, there is evidence showing that people think more about death when they are in natural environments, however, there is no known published study demonstrating the potential consequences caused by damages to natural environments as a death reminder. Moreover, most studies about humans' attitudes and behaviors towards nature using TMT have employed the mortality salience hypothesis in which participants were either primed to think of death or of a neutral stimulus (i.e. dental pain). In doing so, those studies assumed that the stimuli/situations presented (e.g. natural landscapes, harvesting timber in a national forest) did not communicate any message that could cause death anxiety. Thus, it is essential to determine whether or not exposure to natural environments, especially those that have been damaged by humans, evoke anxiety about death and the extent of such effect, if it exists, on people's attitudes and behaviors. This current project attempts to answer those questions through four experimental studies using images as stimuli for exposure to different types of environments. It should be noted that although images of harmed natural environments are often

linked to climate change, they do not convey "climate change" without more information and context. Due to the study's goal to test degraded natural environments as a death reminder, this project focused on the impact of degraded nature, instead of climate change, on humans' psyche.

The stimuli were sorted into three categories: intact natural environment, degraded natural environment, and built environment. In separating the natural environments into two sub-types, the goal of the current study was to use the degraded natural environment condition to represent damage done to the natural environments and contrast such condition to the general "wilderness" (Koole & Van den Berg, 2005). As previous research has shown that people think about death more when they are in a wild natural environment compared to cultivated nature and the city (Koole & Van den Berg, 2005), the current study planned to use the built environment (or cultivated nature) as a control condition and compare (if present) the effect of reminding people of death-thoughts between intact nature and degraded nature.

Regarding the dependent variables, accessibility to death-thought was measured by the word completion task (e.g. Arndt et al., 1997). The higher the number of death-related words filled out, the more death-thoughts were present. Worldview defense was measured by people's reaction toward a fictional author of an essay that expressed unfavorable views about the United States (e.g. Greenberg et al., 1990). Participants were told that they were going to read two brief essays written by foreign students about the United States. Half of the participants read the pro-American essay and the other half read the anti-American one. Participants then filled out a survey to measure their attitude toward the author with higher scores mean higher regard while lower scores mean lower affinity.

There were four studies testing six hypotheses

Study 1:

Hypothesis 1: Participants who look at images of degraded natural environments will fill out more death-related words than participants who look at images of intact natural environments or participants who look at images of built environments.

Study 2:

Hypothesis 2: There is an interaction effect between types of environments and types of essay such that participants who look at images of degraded natural environments will give lower scores to anti-American essays and higher scores to pro-American essays while participants who look at images of intact natural environments will not differentiate in their responses to the pro- or anti-American essay.

Study 3:

Hypothesis 3a: There is an interaction effect between types of environments and types of essays such that participants who look at images of degraded natural environments will give lower scores to anti-American essays and higher scores to pro-American essays while participants who look at images of intact natural environments will not differentiate in their responses to pro- or anti-American essays.

Hypothesis 3b: Self-esteem is a moderator of worldview defense such that people with low self-esteem when exposed to degraded nature will give lower scores to anti-American essays and higher scores to pro-American essays while people with high self-esteem when exposed to degraded nature will not differentiate in their responses to either pro or anti-American essay.

Study 4:

Hypothesis 4a: Participants who look at images of degraded natural environments will fill out more death-related words than participants who look at images of intact natural environments or participants who look at images of built environments.

Hypothesis 4b: Participants with low self-esteem who look at images of degraded natural environments will fill out more death-related words than participants with high self-esteem who look at images of degraded natural environments.

CHAPTER 2 – METHODS AND RESULTS

Study 1

The purpose of Study 1 was to assess whether or not exposure to stimuli representing climate change (degraded natural environments) increases people's thoughts of death. Several instruments measuring certain aspects of personality were also used to examine potential moderation models.

Methods

Stimuli. Images of built environments, intact nature, and degraded nature were found on Google Images and sorted into matched groups. The final stimulus pool contained 21 images with 7 images for each condition. The images were matched into groups based on the scene depicted (e.g., vegetation, desert, beach, lake). For example, the vegetation group included three images each with a forest scene: an image of a healthy forest for the intact nature condition, deforestation for the degraded nature condition, and a park for the built environment condition. None of the images included humans or animals. Ratings from ten research assistants showed high perceived quality of the pictures and no significant differences among pictures in each sorted group regarding overall quality. The stimuli can be found in the appendix.

Participants. A power analysis was conducted to estimate the sample size for this study. Based on the effect sizes found in a study assessing death-thought accessibility after exposure to terrorism news versus animal abuse news (Das et al., 2009), our power analysis utilized the design of a one-tailed bivariate normal model, a medium effect size and 90% power, resulting in an estimated sample size of 207. Based on potential attrition and incomplete responding, the goal was to recruit approximately 230 people for Study 1.

Participants were 232 college students from Introductory Psychology classes at a large public university in the Rocky Mountain region completing the study for course credits. The sample consisted of 181 women, 49 men, and two non-binary individuals, with ages ranging from 18 to 43 years old (M = 19.71, SD = 2.73). The sample comprised 69.4% White, 6% Black, 11.2% Hispanic, 6.5% Asian, and 6.9% other ethnicities.

Procedures. Once they accessed the study via Qualtrics, participants completed the consent form and were randomly assigned to either intact or degraded nature or built-environment condition. In all three conditions, participants were asked to write about the images they were shown with the following prompts: "Imagine yourself being in the picture. Describe what you would be experiencing in as much detail as possible. What does it feel like to be there? What do you want to do?" Then, participants completed a filler questionnaire, a word completion task, and some measures of personality traits. Lastly, participants completed a demographics questionnaire and were debriefed.

Measures. The ***Positive and Negative Affect Schedule*** (PANAS) was used to measure general negative and positive affective states. The PANAS has high reliability and validity (both scales have $\alpha > 0.83$; Watson, Clark, & Tellegen, 1988). Participants were asked to complete the 20-item PANAS to indicate how they are feeling as they are imagining themselves in the environment. Half of the emotions are negative (e.g., distressed, upset, irritable), while the other half are positive (e.g., interested, excited, inspired). Thus, the scale yielded two subscales: positive and negative emotions. Participants rated the extent to which they experience each emotion on a 5-point Likert Scale, ranging from 1-"very slightly" to 5-"extremely." Because the effect of mortality salience on distal defense is observed after a delay, filler tasks are often used

between death-reminders and outcome measures. A meta-analysis of mortality salience research showed that the most common delay task was the PANAS (Burke et al., 2010)

The ***Word Completion Task*** was used to measure Study 1's dependent variable – level of accessibility to thoughts of death. It has been used in several studies to assess the cognitive accessibility of death-relevant thoughts (Hayes et al., 2010). The task used in this study featured 25-word fragments, 8 of which could be completed with a neutral or death-related word (e.g., COFF_ _ can be COFFEE or COFFIN). The possible death related words are buried, corpse, dead, murder, grave, killed, skull, and coffin. Participants was instructed to complete the words as fast as possible. The number of death related words completed by each participant indicated his or her level of accessibility to thought of death.

Right-Wing Authoritarianism Scale. One of the personality traits of interest in this project is authoritarianism. Originally studied under the umbrella of prejudice and fascism, the authoritarian personality is a pattern of traits or behaviors that exhibit high regard for authority, rigidity, conventionality, and contempt for those who are deemed worse off (Adorno et al., 1950). It has been suggested that when reminded of death, people who are high in authoritarianism are more susceptible to the mortality salience hypothesis: among those who wrote about death, participants who were high in authoritarianism reacted more negatively to individuals who expressed different worldviews compared to participants who were low in authoritarianism (Greenberg et al., 1990). In another study about the impact of threat on cognitive strategies, researchers found that once exposed to a reminder of death, participants with high authoritarianism were more interested in an article with one way arguments and less interested in an article with a balanced, two-sided view – a pattern those with high authoritarianism did not exhibit when in a dental pain reminder condition (Lavine et al., 2005).

Thus, the current project wanted to test whether or not authoritarianism affects people's death-thought accessibility.

The Right-Wing Authoritarianism Scale (RWA) was used to measure participants' authoritarian personality. The RWA has high reliability and has been used in many studies (α = .90; Altemeyer, 2006). An improved version of the California F-scale (Adorno et al., 1950), the RWA scale contains 22 statements and asks participants to rate the extent to which they agree with each statement on a 9-point Likert Scale.

Neuroticism Scale. Another personality trait of interest is neuroticism. One of the five main personality traits, neuroticism refers to individual differences in how one possesses and reacts to negative affect (Costa & McCrae, 1987). Individuals high in neuroticism are more likely to think about death and mortality (Abdel-Khalek, 1998) and express higher levels of fear of death (Loo, 1984) compared to individuals low in neuroticism. Indeed, people high in neuroticism are more likely to have strong reactions when exposed to a reminder of death and are more likely to think about death when presented with stimuli representing human creatureliness (Goldenberg et al., 1999). Therefore, the current study wanted to examine whether or not neuroticism has an impact on how participants reacted to different types of environment and how it impacts thoughts of death.

The Neuroticism Scale is a subtest from the Revised Eysenck Personality Questionnaire (EPQ-R) (Eysenck et al., 1985). The scale consists of 12 items and asks participants to respond "yes" or "no" to each statement.

Brief Nature Relatedness Scale. Nature relatedness refers to individual levels of connectedness with the natural world (NIbset et al., 2008) and is positively related with pro-environmental behaviors, environmental identity, and environmental self-identity (e.g., Balundė

et al., 2019; Mackay & Schmitt, 2019; Whitburn et al., 2019). Such qualities have been shown to influence people's behaviors towards the environment after exposure to reminder of death (Fritsche & Hafner, 2012). Thus, the current study wanted to explore whether or not nature relatedness moderates the impact of mortality salience on people's behaviors after being exposed to different kinds of environments.

The brief Nature Relatedness Scale (NR-6) was used to assess participants' connection with nature. The scale has high reliability and has been found to be predictive of happiness, environmental concern, and nature contact ($\alpha > 0.84$; Nisbet & Zelenski, 2013). The scale comprises 6 items and asks participants to rate the extent to which they agree with each statement on a 5-point Likert Scale.

Descriptive information about participants was gathered at the end of the study. This demographic form includes items related to age, gender, race, ethnicity, religion and education level. Participants were also asked about the quality of the images as a manipulation check.

Results

A one-way between subjects ANOVA was conducted to compare the effect of different types of environment on thoughts of death in built environment, intact nature, and degraded nature conditions (See Table 1 for descriptive statistics and *F* values for all analyses). There was a significant effect of types of environment on the number of death related words completed for the three conditions, $F(2, 229) = 7.72$, $p < .005$. Post hoc comparisons using the Scheffe test indicated that the mean score of accessibility to thought of death for intact nature condition ($M = 2.44$, $SD = 1.12$) was significantly lower than the degraded nature condition ($M = 3.18$, $SD = 1.13$). However, the built environment condition ($M = 2.82$, $SD = 1.29$) did not significantly differ from the intact or degraded nature conditions.

A series of regressions was carried out to test for potential moderation effects of authoritarianism, neuroticism, and nature relatedness (See Table 2 for all analyses). Types of environments were first dummy coded. After centering authoritarianism and computing the interaction terms of each dummy code and authoritarianism, the two dummy codes, authoritarianism, and the interaction were entered into a simultaneous regression model. The same procedure was done for both neuroticism and nature relatedness. Out of the three analyses, only the multiple regression model done with nature-relatedness showed significant result. Even though nature-relatedness was not associated with changes in thoughts of death, the interaction between built condition versus degraded condition and nature-relatedness was significant (b = -.46, SE_b = .21, β = -.22, $p < .05$). Decomposition of the interaction revealed that people high in nature-relatedness scored higher in the word completion task after seeing pictures of degraded natural environments than after seeing pictures of built environments. On the other hand, people low in nature-relatedness scored slightly higher in the word completion task after seeing pictures of built environments than after seeing pictures of degraded natural environments. In other words, nature-relatedness influences how people respond to exposure to degraded nature such that those high in nature-relatedness indicated higher effect of mortality salience when viewing degraded nature versus the built environment, whereas those low in nature-relatedness did not differ much in how they respond to degraded nature and built environment. Results provided support for hypothesis 1: Participants who looked at images of degraded natural environments filled out more death-related words than participants who looked at images of intact natural environments or participants who looked at images of built environments.

To test for potential relationship between affect and awareness of death, one-way MANOVAs were performed on the PANAS positive and negative affect scales. Results showed

that types of environment had a statistically significant effect on both positive affect, F (2,229) = 5.497, p<.01, and negative affect, F(2,229) = 17.946, p<.001. However, none of the correlations between affect and number of death related words completed were significant. See Table 3 for all correlation coefficients and p values.

Study 2

As results from Study 1 provided support for the hypothesis that exposure to degraded natural environments increases people's thoughts of death, the purpose of Study 2 was to assess the potential effect of such thoughts of death on people's attitude towards those with different worldviews. Several instruments measuring certain aspects of personality were also used to examine potential moderation models.

Methods

Participants. A power analysis was conducted to estimate the sample size for this study. Similar to Study 1, power analysis utilized the design of a one-tailed bivariate normal model, a medium effect size and 90% power, resulting in an estimated sample size of 206. Based on potential attrition and incomplete responding, the goal is to recruit approximately 240 people for Study 2.

Participants were 241 college students from Introductory Psychology classes at a large public university in the Rocky Mountain region completing the study for course credits. The sample consisted of 172 women, 65 men, one non-binary individual, and three individuals who did not want to disclose their gender, with ages ranging from 18 to 37 years old (M = 19.70, SD = 2.27). The sample comprised 67.6% White, 3.7% Black, 11.6% Hispanic, 6.6% Asian, and 10.5% other ethnicities.

Procedures. Because results from Study 1 showed that there was no significant difference in awareness of death between participants in the built environments condition and participants in the other two conditions, we decided to remove the built environments condition from Study 2. Thus, after signing the informed consent, participants were randomly assigned to see images of either intact nature or degraded nature and wrote about them. Then, participants completed the PANAS.

Next, participants were told that they were going to read a brief essay written by foreign students about the United States. The essays were the same as those used in several previous mortality salience studies (e.g., Greenberg et al., 1992). Half of the participants read the pro-American essay and the other half read the anti-American one. Participants then completed a questionnaire assessing their reactions to the essay and the author. Participants' response to the essay was an indication of whether or not participants engage in worldview defense. Hypothetically, death-related anxiety – provoked by exposure to degraded nature – would prompt people to defend their worldview (i.e., positive attitude toward the pro-American essay and negative attitude toward the anti-American essay) in order to alleviate the terror brought by existential threats. Finally, participants completed the personality measures, the demographics form and were debriefed.

Measures. Measures from Study 1 were utilized in Study 2. Additionally, following the essays participants answered questions measuring participants' attitude towards the essay and the author. The questions were: "How much do you think you would like this person?" "How intelligent do you believe this person to be?" "How knowledgeable do you believe this person to be?" "Is this person's opinion well-informed?" "How much do you agree with this person's opinion?" and "From your perspective, how true do you think this person's opinion is of the topic

they discussed?" (Goldenberg et al., 2001). Participants were asked to respond to each item on a 9-point Likert scale, with 1 reflecting the most negative evaluation and 9 the most positive evaluation. A measure of the reactions towards the essay author was then created by computing the mean response to the six questions. The measure demonstrated high internal reliability when used in a previous study on people's reactions towards their creatureliness ($\alpha = 0.86$; Goldenberg et al., 2001).

Results

A 2 (types of environments) × 2 (types of essays) factorial ANOVA was conducted to test for the effect of types of environments and types of essay on participant's attitude towards the author of the essay (See Table 4 for descriptive statistics and *F* values for all analyses). There was a significant main effect of type of essay on participants' attitude towards the authors such that participants reported lower affinity towards the author after reading the anti-American essay ($M = 5.44$, $SD = 1.92$) than after reading the pro-American essay ($M = 6.34$, $SD = 1.51$), $F(1,237) = 15.80$, $p < .001$, $\eta_p^2 = .06$. In contrast, results showed no significant main effects of types of environments on participants' attitude towards authors or interaction effect of types of environments and types of essays. Thus, results did not provide support for hypothesis 2.

Two-way MANOVAs were performed on the PANAS positive and negative affect scales. Results showed that while there was no significant interaction effect on affect, types of environment had a statistically significant effect on both positive affect, F (1,237) = 7.477, $p<.01$, $\eta_p^2 = .031$, and negative affect, $F(1,237) = 49.749$, $p<.001$, $\eta_p^2 = .173$. Correlation analysis between affect and essay reaction within each condition revealed a positive relationship between positive affect and essay reaction for participants who looked at intact nature images and read pro-American essays. A positive relationship was also observed between negative affect

and essay reaction in participants who looked at intact nature images and read anti-American essays. See Table 5 for correlation coefficients and p values.

Study 3

Results from Study 2 did not provide support for the hypothesis that there is an interaction effect between types of environments and types of essays such that participants who look at images of degraded natural environments will give lower scores to anti-American essays and higher scores to pro-American essays while participants who look at images of intact natural environments will not differentiate in their responses to either pro or anti-American essay. Furthermore, there is no significant main effect of types of environments on participants' attitude towards authors. While results from Study 1 suggested that exposure to degraded nature should increase participants' accessibility to death-thoughts, results from Study 2 indicated that thoughts of death prompted by looking at degraded nature do not influence participants' attitudes towards those with a different worldview. This pattern does not fit with the mortality salience hypothesis which states that thoughts of death should lead people to engage in defending either their worldview or self-esteem to guard against death anxiety. The discrepancy between results from Study 2 and the mortality salience hypothesis could be due to either the kind of death-thoughts created by exposure to degraded nature or some protective factors that help alleviate the need to engage in defense mechanisms even when thoughts of death are highly accessible. Therefore, Study 3 attempted to test for one such protective factor – self-esteem – based on the anxiety-buffer hypothesis of TMT. The anxiety-buffer hypothesis suggests that self-esteem could reduce death anxiety and mitigate defensive reactions to reminders of death. Thus, the purpose of Study 3 was to again assess the effect of thoughts of death on people's attitude towards those with different worldviews while focusing on self-esteem as a potential moderator in guarding against

anxiety about death. Several instruments measuring certain aspects of personality were also used to examine potential moderation models.

Methods

Participants. Participants were 320 college students from Introductory Psychology classes at a large public university in the Rocky Mountain region completing the study for course credits. The sample consisted of 178 women, 138 men, two non-binary individuals, and two individuals who did not want to disclose their gender, with ages ranging from 18 to 39 years old (M = 19.75, SD = 2.22). The sample comprised 76.3% White, 4.1% Black, 10.3% Hispanic, 4.1% Asian, and 5.2% other ethnicities.

Procedures. Procedures from Study 2 were utilized in Study 3

Measures. Measures from Study 2 were utilized in Study 3. Additionally, participants were asked to complete a measure of self-esteem as part of the personality measure portion.

The ***Rosenberg Self-Esteem Scale*** *(*RSE) (Rosenberg, 1965) has been used in several studies about TMT to assess for self-esteem (e.g. Goldenberg et al., 1999; Harmon-Jones et al., 1997). The scale has high reliability range with α within the range of .77 to .88 (e.g. Rosenberg, 1986). The RSE consists of 10 items and asks participants to rate the extent to which they agree with each statement on a 4-point Likert Scale.

Results

A 2 (types of environments) × 2 (types of essays) factorial ANOVAs was conducted to test for the effect of types of environment and types of essay on participant's attitude towards the author of the essay (See Table 6 for descriptive statistics and F values for all analyses). There was a significant main effect of type of essay on participant's attitude towards the authors such that participants reported lower affinity towards the author after reading the anti-American essay

(M = 5.18, SD = 1.69) than after reading the pro-American essay (M = 6.31, SD = 1.47), $F(1,316) = 40.27$, $p < .001$, $\eta_p^2 = .11$. There was also a significant main effect of type of environments on participants' attitude towards the authors such that participants who saw pictures of degraded natural environments (M = 5.55, SD = 1.76) reported lower affinity towards the author compared to participants who saw pictures of intact nature (M = 5.94, SD = 1.56), $F(1,316) = 4.08$, $p < .05$, $\eta_p^2 = .01$. In contrast, results showed no significant interaction effect of types of environment and types of essays. Results, thus, did not provide support for hypothesis 3a and 3b.

Although there was no interaction effect between types of environments and types of essays, a series of regressions was carried out to test for potential moderation effects of self-esteem on each of the significant main effects. Types of environments were first dummy coded. After centering self-esteem and computing the interaction terms of the dummy code and self-esteem, the dummy code, self-esteem, and the interaction were entered into a simultaneous regression model. The same procedure was done for type of essays. Out of the two analyses, only the multiple regression model done with types of environments showed a significant result. Even though self-esteem was not associated with changes in thoughts of death, the Type of Environment x Self-esteem interaction was significant (b = -.08, SE_b = 04., β = -.17, $p < .05$). Decomposition of the interaction revealed that people high in self-esteem gave higher scores to the essay authors after seeing pictures of intact natural environments than after seeing pictures of degraded natural environments. On the other hand, people low in self-esteem gave higher scores to the essay authors after seeing pictures of degraded natural environments than after seeing pictures of intact natural environments. In other words, self-esteem influences how people react to the essay authors such that those high in self-esteem expressed a more positive attitude

towards the essay authors regardless of viewpoints when viewing intact nature versus degraded nature, whereas those low in self-esteem reported the opposite pattern.

Two-way MANOVAs were performed on the PANAS positive and negative affect scales. Similar to study 2, results showed that while there was no significant interaction effect on affect, types of environment had a statistically significant effect on both positive affect, F (1,315) = 13.907, p<.001, η_p^2 = .042, and negative affect, F(1,315) = 82.630, p<.001, η_p^2 = .208. Correlation analysis between affect and essay reaction within each condition revealed a positive relationship between positive affect and essay reaction for participants who read pro-American essays regardless of the type of environments they looked at. See Table 7 for correlation coefficients and p values.

Study 4

While results from Study 3 did not provide support for an interaction effect between types of environments and types of essays on participants' reactions to different worldviews, results suggested that self-esteem has some effect on people's expression of death anxiety. Thus, Study 4 attempted to replicate the results found in Study 1 and to investigate self-esteem as a potential moderator in guarding against anxiety about death.

Methods

Participants. Participants were 301 college students from Introductory Psychology classes at a large public university in the Rocky Mountain region completing the study for course credits. The sample consisted of 202 women, 97 men, and two non-binary individuals, with ages ranging from 18 to 35 years old (M = 19.61, SD = 2.08). The sample comprised 73.3% White, 4.3% Black, 14.7% Hispanic, 4.7% Asian, and 3% other ethnicities.

Procedures. Procedures from Study 1 were utilized in Study 4

Measures. In addition to all the measures used in Study 1, participants were asked to complete the RSE (used in Study 3) as part of the personality measure portion.

Results

A one-way between subjects ANOVA was conducted to compare the effect of different types of environments on thoughts of death in built environments, intact nature, and degraded nature conditions (See Table 8 for descriptive statistics and *F* values for all analyses). There was not a significant effect of types of environments on the number of death related words completed for the three conditions, $F(2, 298) = 2.35$, $p = .10$. Although differences between number of death-related words completed across conditions were not statistically significant, the number of words completed by participants in the degraded nature condition remained higher ($M = 3.14$, $SD = 1.26$) than built environments condition ($M = 2.82$, $SD = 1.11$) and intact nature condition ($M = 2.84$, $SD = 1.14$) similar to Study 1.

A series of regressions was carried out to test for potential moderation effects of authoritarianism, neuroticism, nature relatedness, and self-esteem (See Table 9 for all analyses). Types of environments were first dummy coded. After centering authoritarianism and computing the interaction terms of each dummy code and authoritarianism, the two dummy codes, authoritarianism and the interaction were entered into a simultaneous regression model. The same procedure was done for neuroticism, nature relatedness, and self-esteem. All four analyses showed no significant result.

As Study 3 suggested that self-esteem might impact participants' expression of death-anxiety, a one-way between subjects ANOVA was then conducted to test for the difference in self-esteem among the three condition groups. There was not a significant effect of types of environment on self-esteem for the three conditions, $F(2, 297) = .33$, $p = .72$. Although

differences between self-esteem rating across conditions were not statistically significant, the self-esteem rating coming from participants in the intact nature condition was the highest (M = 1.91, SD = .57).

One-way MANOVAs were also performed on the PANAS positive and negative affect scales. Results showed that types of environment had a statistically significant effect on only negative affect, $F(2,297) = 72.713$, $p<.001$. Results from correlation analysis between affect and number of death related words completed revealed a positive relationship between negative affect and awareness of death in participants who looked at images of degraded nature. See Table 10 for correlation coefficients and p values.

CHAPTER 3 – DISCUSSION

The gravity of climate change and its consequences are most often at odds with the incompetent manner with which we have been dealing with it. Such discrepancy presents us with a conundrum: why are we so inadequate at addressing a matter so vital and urgent? Using terror management theory, the current project attempted to explain such inaction towards climate change as resulting from people's reaction to the impending doom of death when faced with information and visual stimuli that symbolically link the environment with destruction. Based on the idea that nature can remind people of death (Koole, 2003; Koole & Van den Berg, 2005) and that people tend to engage in distal defense mechanisms after being reminded of death (e.g., Arndt et al., 1997; Goldenberg et al., 2001) this study examined human interaction with degraded nature, represented though photographic stimuli, and possible reactions to such exposure. The four studies in this project provided varied results.

While Study 1 provided results supporting hypothesis 1: Participants who looked at images of degraded natural environments filled out more death-related words than participants who looked at images of other environments, results from study 4 did not replicate such patterns. Although not hypothesized, results from Study 1 also identified nature-relatedness as a moderator in participants' accessibility to death-thoughts: those high in nature-relatedness experienced a higher effect of mortality salience when viewing degraded nature versus the built environment, whereas those low in nature-relatedness reported the opposite pattern.

Results from Study 2 did not provide support for hypothesis 2: there was no interaction effect between types of environments and types of essays on participants' reactions to essay

authors. However, there was a significant main effect for types of essays such that participants across conditions reacted negatively towards authors expressing anti-American worldviews.

Results from Study 3 did not provide support for hypothesis 3a. Similar to Study 2, although there was no interaction effect between types of environments and types of essays, there was a significant main effect for types of essays. Hypothesis 3b predicted that people with low self-esteem, when exposed to degraded nature, will give lower scores to anti-American essays and higher scores to pro-American essays while people with high self-esteem when exposed to degraded nature will not differentiate in their responses to either pro or anti-American essay. However, results from Study 3 showed a different pattern: regardless of type of essays, after viewing pictures of intact nature those high in self-esteem expressed a more positive attitude towards the essay authors than those low in self-esteem, whereas after viewing pictures of degraded nature those low in self-esteem expressed a more positive attitude towards the essay authors than those high in self-esteem. Such results are contrary to TMT literature which suggests that self-esteem could reduce death anxiety and mitigate defensive reactions to reminders of death (e.g., Arndt & Greenberg, 1999; Harmon-Jones et al., 1997). Since it is unclear whether results for hypothesis 3b are interpretable based on the theory established in TMT research, the moderation effect of self-esteem in Study 3 will not be further discussed.

Regarding the linkage of affect and mortality salience, results also showed mixed results. While results from Study 1 suggested an effect of type of environments on affect such that participant feel most negative after looking at images of degraded nature and most positive after looking at images of intact nature, results from Study 4 only showed significant effect of environments on negative affect. Furthermore, correlation analysis revealed only one significant positive relationship between negative affect and awareness of death after looking at pictures of

degraded nature in Study 4. This pattern was not observed in Study 1. Similarly, while results from Study 2 and Study 3 suggested significant main effects of type of environments on positive and negative affect, the only positive correlation observed in both study is between positive affect and reaction to authors in participants who looked at images of intact nature and read pro-America essays. Such results suggested that images of different environments can evoke strong emotional reactions yet there is no substantial evidence suggesting a link between affect and mortality salience effect. This is consistent with the pattern observed in most TMT studies (e.g., Boyd et al., 2017; Harmon-Jones et al., 1997; Kesebir, 2014). Thus, the impact of stimuli on affect will not be further discussed.

The following section will focus on discussing failure to replicate the results from Study 1 to Study 4 and lack of evidence for worldview defense effect in Study 2 and Study 3. Specifically, the discussion will provide possible explanations for the pattern of results and explore the implication of such results for TMT in general.

Accessibility to thoughts of death

Study 4 did not replicate the significant main effect and moderation effect found in Study 1. One possible conclusion is that the significant results obtained in Study 1 were false and were due to Type I Error, or that Study 4 lacked power to detect subtle effects. To determine whether or not the results found in Study 1 were due to Type 1 Error, a post hoc power analysis was done with Study 4 using the effect observed in Study 1 using the GPower program. Results from the post hoc power analysis suggested that if we assumed the effect size observed in Study 1 is the true effect of the stimuli, Study 4 should have a power $(1 - \beta)$ at 0.98 which means that Study 4 should have 0.98 probability of correctly rejecting the null hypothesis. As results from Study 4 failed to reject the null hypothesis, it is likely that the effect observed in Study 1 does not

resemble the real effect in nature – there is no actual effect of looking at images of degraded nature on people's accessibility to thoughts of death.

There are several factors that could explain the lack of impact of degraded nature images on accessibility to thoughts of death. First, the stimuli presented to participants might not be effective in arousing death anxiety. Although pictures within the degraded nature condition conveyed a message of destruction of the natural environment, the scenes depicted in those pictures might have not presented a state of nature so devastating that it provokes thoughts about death. Second, the word completion task might not be the best way to capture unconscious thoughts of death. Among the different ways to measure death-thought accessibility, the word completion task is characterized as a deliberative implicit measure which allows respondent to think about the item and engage in deliberation when making a decision on an item (Hayes et al., 2010). Thus, deliberative implicit measures can at times be impacted by controlled processes, such as thoughts about one's self-presentation, and become invalid (Hayes et al., 2010). While participants could have high DTA and felt inclined to complete more death-related words, participants could also recognize the inclination and decided to modify their behaviors by choosing to complete the stem as neutral words.

Results from Study 1 suggested that nature-relatedness influences the effect exposure to degraded nature and built environments such that people high in nature-relatedness scored higher in the word completion task after seeing pictures of degraded natural environments than after seeing pictures of built environments. Those low in nature-relatedness scored slightly higher in the word completion task after seeing pictures of built environments than after seeing pictures of degraded natural environments. In another words, people who highly identify with natural environments thought more about death after seeing pictures of degraded natural environments

than after seeing pictures of built environment. People who do not identify with natural environments thought about death at a similar level after seeing pictures of built environments and degraded natural environments. It is reasonable that people who scored high in nature relatedness became more disturbed seeing damaged nature as research has suggested that nature-relatedness is predictive of environmental concern and nature contact (Nisbet & Zelenski, 2013). For people who scored low in nature-relatedness, it is possible that lack of engagement with natural environments does not provoke a strong reaction to nature degradation. Thus, people with low nature-relatedness did not differ much in their reaction to images of degraded nature and built environment.

Although the moderation effect of nature-relatedness found in Study 1 was consistent with previous research suggesting a link between death-related thoughts and the natural environments as well as the relationship between nature-relatedness and environmental concerns, such an effect was not replicated in Study 4. Thus, the moderation effect of nature-relatedness may also have indicated sample-specific variance in Study 1, but because there are plausible interpretations of Study 1's results, further research would be needed to resolve the discrepancies in the current results.

Worldview defense as a coping mechanism against thoughts of death

According to past research (e.g., Greenberg et al., 1994), worldview defense is defined as the difference between participants' ratings of both anti- and pro-America essays. Thus, the larger difference indicated increased worldview defense. Results from several studies testing the cultural worldview defense effect consistently show a main effect of the mortality salience on people's worldview defense (e.g., Arndt et al., 1997; Routledge et al., 2008). Specifically, people who were exposed to the mortality salience condition demonstrated an increase in worldview

defense compared to people who were exposed to the control condition. In this particular study, however, worldview defense was operationalized as participants' ratings of either an anti- or a pro-America essay. Higher scores suggested more favorable view of the author. This approach was modeled after a study done by Goldenberg et al. (2001) which investigated humans' need to distinguish themselves from animals especially after being reminded of death. In one experiment, participants were asked to write about either their own death (mortality salience condition) or dental pain (control condition). Participants then read one of two essays: one that talked about the similarity between humans and animals and one that described humans as distinct from animals. The essays were followed by questions that assessed reactions to the essay and opinions of the author. Results showed a significant main effect of type of essays such that participants in both conditions reacted positively to essays describing humans as unique. Results also showed a significant interaction effect between type of essay and mortality salience condition such that people in the control condition did not have different views on either type of essay whereas people in the mortality salience condition reacted more negatively toward the essay described human as similar to animals.

As the second and third hypothesis stipulated that people who are exposed to intact nature should not react differently to either type of essay, the current study expected to replicate the pattern found in Goldenberg et al. (2001). While both studies 2 and 3 found a main effect for type of essay, no interaction effect was replicated. Interestingly, Study 3 found a main effect for type of environment such that people who looked at degraded nature reacted more negatively to the author of either essay than people who looked at intact nature. Such pattern is consistent with the TMT research on how confrontation with our own creatureliness and the natural environments could remind people of death which then lead to engagement in worldview defense

mechanism. The main effect of type of environments found in Study 3 also suggested that regardless of types of essays, exposure to degraded nature negatively impacted participants' attitude to others' opinions.

A possible explanation for lack of the predicted interaction effect could be due to the strong main effect of type of essay. Indeed, results pattern observed in Study 3 showed emerging interaction effect that was overshadowed by the main effect of type of essay. When data for Study 2 was collected in 2018, it was almost 2 years after the 2016 presidential election – an election that pushed the United State of America to one of the most divisive environments it has been in. Since then, people have been living in an alienating environment as rhetoric about patriotism and individual freedom becomes ubiquitous. Such an environment could drive people's reactions toward an opinion that is different from theirs, in this case critical of the USA, to the extreme. Indeed, there exists evidence indicating a trend towards hostile interactions between groups. Results from a survey conducted by Pew Research Center on race in America in 2019 suggested that more than half Americans (65%) say "it has become more common for people to express racist or racially insensitive views" since the 2016 presidential election (Pew Research Center, 2019). Slightly less than half Americans (45%), or more than four in ten people, say this has become more acceptable (Pew Research Center, 2019). Not only do racist view become more prevalent, but it also results in more hate crimes. A recent report examining the Federal Bureau of Investigation's hate crime statistic in 2019 suggested that hate crimes in the United States rose to their highest level ever since 2008 with more murders motivated by hate being recorded. (Center for the Study of Hate and Extremism, 2020). The report showed that the overall increase in hate crimes was fueled by a rise in attacks against Hispanic and Jewish individuals (Center for the Study of Hate and Extremism, 2020). Thus, the environment in which

data for this study was collected could have prompted individuals to react negatively toward those who harbor different viewpoints regardless of circumstances. Such extreme reactions then obscured any potential effect of exposure to degraded nature on participants' death anxiety and thus world-view defense mechanism.

Revisiting Terror Management Theory

While results from Study 1 provided support for the connection between degraded natural environments and anxiety about death, results from other studies offered inconclusive evidence for such connection and the impact of exposure to degraded nature to behavioral responses. Results from Study 3 also suggested inconsistencies with TMT's anxiety-buffer hypothesis. Specifically, while it is expected that people with high self-esteem would be better in guarding against death-thoughts and not engage in worldview-defense mechanism regardless of condition, results showed that people high in self-esteem reacted positively to the essay authors after seeing pictures of intact natural environments than after seeing pictures of degraded natural environments. On the other hand, people low in self-esteem gave higher scores to the essay authors after seeing pictures of degraded natural environments than after seeing pictures of intact natural environments. Such patterns indicated potential concerns regarding applying TMT in contemporary environmental research.

As the field of psychology is grappling with a "replication crisis" and concerns about false positive research findings (e.g. Open Science Collaboration, 2015; Simmons et al., 2011), studies from TMT are among the classic psychological findings being tested for replicability. To investigate the replication issues with TMT findings, 21 labs with a total of 2,220 participants experimentally tested whether original author involvement improved replicability of a classic finding from Greenberg et al., 1994 about the impact of unconscious thought of death on

worldview-defense (Klein et al., 2019). Results from the original study suggested that participants who wrote about death reacted more positively to authors of the pro-American essay than to authors of the anti-American essay author, compared to participants who wrote about watching television (Greenberg et al., 1994). However, results from the random-effects meta-analysis completed on the results obtained across labs indicated "little evidence for an overall effect of mortality salience in these replications" and that "there was minimal or no heterogeneity in effect sizes across site" (Klein et al., 2019, p. 19). Overall, the study was inconclusive in determining whether original author involvement improves replicability due to lack of results replications across labs (Klein et al., 2019). Explanations provided for the inconclusive results included the possibilities that the previous finding were false positives and that the conditions necessary to obtain the reported effects are not yet understood or perhaps no longer exist in contemporary culture (Klein et al., 2019). Thus, the mixed results in the current project might be a reflection of the non-replicability observed in TMT findings.

Anxiety as a factor in humans' reactions to climate change

The current study was a preliminary attempt at investigating whether or not the TMT framework can be used to explain human behaviors to climate change. As images of degraded natural environments are often linked to climate change, the four studies in this project were built on the hypothesis that seeing scenes of damaged nature might remind people of their own death and thus prevent them from further engaging with nature and pro-environmental behaviors. While results from Study 1 suggested that degraded nature can make people think more about death, this effect was not replicated in Study 4. Furthermore, analysis of results from Studies 2, 3, and 4 indicated several inconsistencies with the existing TMT research. Thus, it appears that

TMT might not the most fitting framework for the understanding of human behaviors regarding climate change.

One pattern that was consistent throughout this project was the main effect of types of essay in Study 2 and Study 3. Regardless of which environment participants were exposed to, results suggested that participants reacted positively to authors of the pro-American essay and negatively to authors of the anti-American essay. Indeed, the main effect of types of essay was so large that it was likely to eclipse the emerging interaction effect in Study 3. Such trend was hypothesized to be a likely reflection of the social climate in the recent years (as discussed above). Perhaps anxiety about the social environments is what prevent people from feeling connected with the natural environments and their perils?

In 2019, the American Psychiatric Association published their annual public opinion poll about mental health. According to the report, about two in three Americans said they are extremely or somewhat anxious about keeping themselves and their family safe, paying bills, and their health (American Psychiatric Association, 2019). Nearly one in three said they are more anxious than they were last year; more than four in ten said they are about as anxious as they were last year; and about a quarter said they are less anxious than last year (American Psychiatric Association, 2019). Those results indicate a strong presence of anxiety within society that has shown no sign of subsidizing. As research suggests a negative relationship between connection to nature (or nature-relatedness) and overall anxiety (Martyn & Brymer, 2014), questions about directionality arise: does feeling connected to nature lower anxiety or does anxiety prevent one from feeling connected to nature? Findings from a recent study about the relationship between nature-relatedness and psychopathy-related personality indicate that connection to nature is positively related to empathy and negatively related to callous and uncaring facets of personality

(Fido & Richardson, 2019). Furthermore, results suggest empathy as the mediator between nature-relatedness and callous and uncaring traits (Fido & Richardson, 2019). If anxiety impacts one's ability to connect with nature, it appears then high level of anxiety and low feeling of relatedness could lead to even more emotionally-disengaged attitudes to one's surrounding environment – including nature.

Strengths

Along with Koole & Van den Berg (2005) works on TMT and nature, the current study is one of the first few psychological experiments to test nature's potential effect of provoking thoughts of death. This study is also one of the first few experiments to test such an effect with natural environments that have been damaged. Moreover, this study is one of few studies to explore the effect of intact and degraded environments on human psyche in a controlled setting.

Although results from this project are inconclusive in establishing the relationship between exposure to degraded nature to death-thoughts and subsequent behaviors of worldview defense, the project contributes in several ways to the literature. As results from this project are consistent with the issues presented in the study done by Many Labs (Klein et al., 2019) on TMT findings, the project adds to the existing data testing the replicability of TMT. On a broader level this project also reflects the "replication crisis" occurring in psychology, specifically social psychology experiments. Findings from this project also provide evidence regarding the application of TMT in studying humans' reactions to climate change, such that the TMT framework might not be a fitting guide for further investigation into climate change related behaviors. Finally, the project's results (or lack thereof) allow for potential research ideas examining the role of anxiety in how people behave towards degraded natural environments.

Limitations and future research

In keeping with the protocol used in previous TMT research, the project's use of old stimuli (i.e., pro- and anti-American essays) and measures (i.e., word completion task) might have caused inflation of results (in Study 2 and 3) or failed to capture desired effects (no replication of Study 1's results). On the other hand, miss-application of the methods used to measure cultural worldview defense might have been the reason for a lack of significant results in Study 2 and 3. Notably, the stimuli used in this project for the degraded nature condition, although often link to climate change, do not clearly convey the message of climate change. Thus, results can only be interpreted in relation to damaged natural environments. Research using actual news stories on climate crisis or images of damaged nature along with more information and context might not only broaden the scope of interpretation and implication of results but also better simulate people's experience of browsing through their news feed and possibly provoke a stronger effect.

Regarding future research, further investigation into the role of anxiety in humans' reaction to climate change might provide some clues for behavior change. Specifically, research can focus on how anxiety impacts the way individuals choose to engage or disengage from information about climate change. Would anxiety increase apathy and self-serving behaviors that prevent one from confronting the impending doom of climate change? Do people's anxieties about immediate concerns (e.g., paying bills, child rearing) tend to overshadow seemingly distant concerns? Or in other words, does general anxiety eclipse eco-anxiety? Pursuing answers for those research questions might not only help us understand our relationship with climate change but also bring us to the next steps necessary to save both ourselves and Earth.

CHAPTER 4 – CONCLUSION

Terror Management Theory is one of several theories proposed to study human-nature relationship and the lack of human actions in combating climate change (e.g., Dickinson, 2009; Wolfe & Tubi, 2018). Although past TMT research suggests a link between natural environments and thought of death, as well as impact of reminder of death on people's behaviors, the present study did not find evidence supporting similar hypotheses. Additionally, recent projects aiming to replicate TMT results have failed to provide support for the theory and its hypotheses (Klein et al., 2019). Thus, TMT might not be a good tool for the understanding of humans' reactions to degraded natural environment and climate change. Future research focusing on anxiety and how it impacts our relationship with nature might better help elucidate humans' reaction to degraded nature as well as climate change and how to promote more environmentally friendly behaviors.

TABLES

Table 1

ANOVA Results for Study 1

	Descriptive Statistics				One-way ANOVA
	Built Environments	Intact Natural Environments	Degraded Natural Environments	Total	F(2,229)
Death-related words	2.82(1.29)	2.44(1.12)	3.18(1.13)	2.81(1.22)	7.72**
PANAS positive	28.88(8.68)	29.58(8.57)	25.35(8.36)	27.93(8.70)	5.50***
PANAS negative	15.89(6.64)	15.85(6.39)	22.10(9.10)	17.97(8.02)	17.95***
EPQ-R	5.51(3.79)	6.50(3.35)	5.72(3.69)	5.91(3.62)	1.61
RWA	84.95(21.92)	77.83(20.37)	76.00(20.56)	79.55(21.21)	3.90*
NR-6	3.37(1.01)	3.61(.83)	3.46(.81)	3.48(.89)	1.40

*p<.05, **p<.01, ***p<.001

Table 2

Moderated Regression Analysis Results for Study 1

Items	*b*	SE_b	*β*	*p*
Neuroticism				
neuro_CEN[1]	.027	.037	.080	.466
Intact_DC[2] x neuro_CEN	-.034	.054	-.054	.537
Built_DC x neuro_CEN	.022	.051	.039	.673
Right wing Authoritarianism				
RWA_CEN	-.006	.007	-.109	.344
Intact_DC x RWA_CEN	.010	.009	.096	.290
Built_DC x RWA_CEN	.006	.009	.059	.533
Nature-relatedness				
nature_CEN	.239	.165	.175	.148
Intact_DC x nature_CEN	-.123	.230	-.049	.593
Built_DC x nature_CEN	-.462	.212	-.221	.031*

[1]The variable was centered. [2]The variable was dummy coded

Table 3

Correlations between Affect and Awareness of Death for Study 1

	Death-related words		
	Built Environments	Intact Natural Environments	Degraded Natural Environments
PANAS positive	-.198	-.035	.087
PANAS negative	-.083	.058	-.080

Table 4

ANOVA Results for Study 2

	Descriptive Statistics			Main Effects		
	Pro-America	Anti-America	Total	Type of essay F(1,237)	Type of environment F(1,237)	Interaction F(1,237)
Intact	6.47(1.56)	5.55(1.98)	6.01(1.83)			
Degraded	6.19(1.45)	5.34(1.87)	5.76(1.72)	15.80**		
Total	6.34(1.51)	5.44(1.92)		*	1.23	.03

*p<.05, **p<.01, ***p<.001

Table 5

Correlations between Affect and Worldview Defense for Study 2

	Reaction to essay authors			
	Intact Natural Environments		Degraded Natural Environments	
	Pro-America	Anti-America	Pro-America	Anti-America
PANAS positive	.316*	.136	.245	.062
PANAS negative	-.052	.346**	-.161	.243

*p<.05, **p<.01

Table 6

ANOVA Results for Study 3

	Descriptive Statistics			Main Effects		
	Pro-America	Anti-America	Total	Type of essay F(1,316)	Type of environment F(1,316)	Interaction F(1,316)
Intact	6.32(1.50)	5.53(1.54)	5.94(1.56)			
Degraded	6.29(1.44)	4.85(1.77)	5.55(1.75)	40.27***		
Total	6.31(1.47)	5.18(1.69)			4.08*	3.43

*p<.05, **p<.01, ***p<.001

Table 7

Correlations between Affect and Worldview Defense for Study 3

	Reaction to essay authors			
	Intact Natural Environments		Degraded Natural Environments	
	Pro-America	Anti-America	Pro-America	Anti-America
PANAS positive	.308**	.150	.233*	-.128
PANAS negative	-.016	-.064	.109	.099

*p<.05, **p<.01

Table 8

ANOVA Results for Study 4

	Descriptive Statistics				One-way ANOVA
	Built Environments	Intact Natural Environments	Degraded Natural Environments	Total	
Death-related words	2.82(1.11)	2.84(1.14)	3.14(1.26)	2.93(1.18)	2.35[1]
PANAS positive	27.89(8.61)	28.55(8.71)	25.86(7.65)	27.43(10.38)	2.86[2]
PANAS negative	15.91(6.51)	15.61(6.24)	27.41(10.38)	19.71(9.67)	72.31***[1]
RSE	1.85(.49)	1.91(.57)	1.86(.53)	1.87(.53)	.33[2]
EPQ-R	6.39(3.60)	6.62(3.57)	6.45(3.67)	6.49(3.60)	.11[1]
RWA	72.33(20.76)	75.02(20.74)	75.52(21.44)	74.31(20.96)	.67[1]
NR-6	3.58(.92)	3.53(.96)	3.67(.82)	3.59(.90)	.60[1]

*p<.05, **p<.01, ***p<.001
[1]F(2,298), [2]F(2,297)

Table 9

Moderated Regression Analysis Results for Study 4

Items	*b*	SE_b	*β*	*p*
Neuroticism				
neuro_CEN[1]	.022	.032	.067	.493
Intact_DC[2] x neuro_CEN	.006	.046	.011	.889
Built_DC x neuro_CEN	-.003	.046	-.005	.953
Right wing Authoritarianism				
RWA_CEN	.001	.005	.009	.925
Intact_DC x RWA_CEN	-.005	.008	-.050	.529
Built_DC x RWA_CEN	-.013	.008	-.127	.111
Self-esteem				
esteem_CEN	-.195	.218	-.088	.371
Intact_DC x esteem_CEN	-.100	.300	-.028	.739
Built_DC x esteem_CEN	-.218	.326	-.052	.504
Nature-relatedness				
nature_CEN	.033	.142	.025	.815
Intact_DC x nature_CEN	.114	.188	.054	.543
Built_DC x nature_CEN	-.088	.193	-.039	.648

[1]The variable was centered. [2]The variable was dummy coded

Table 10

Correlations between Affect and Awareness of Death for Study 4

		Death-related words	
	Built Environments	Intact Natural Environments	Degraded Natural Environments
PANAS positive	-.115	.108	-.010
PANAS negative	-.010	-.100	.234*

*p<.05

FIGURES

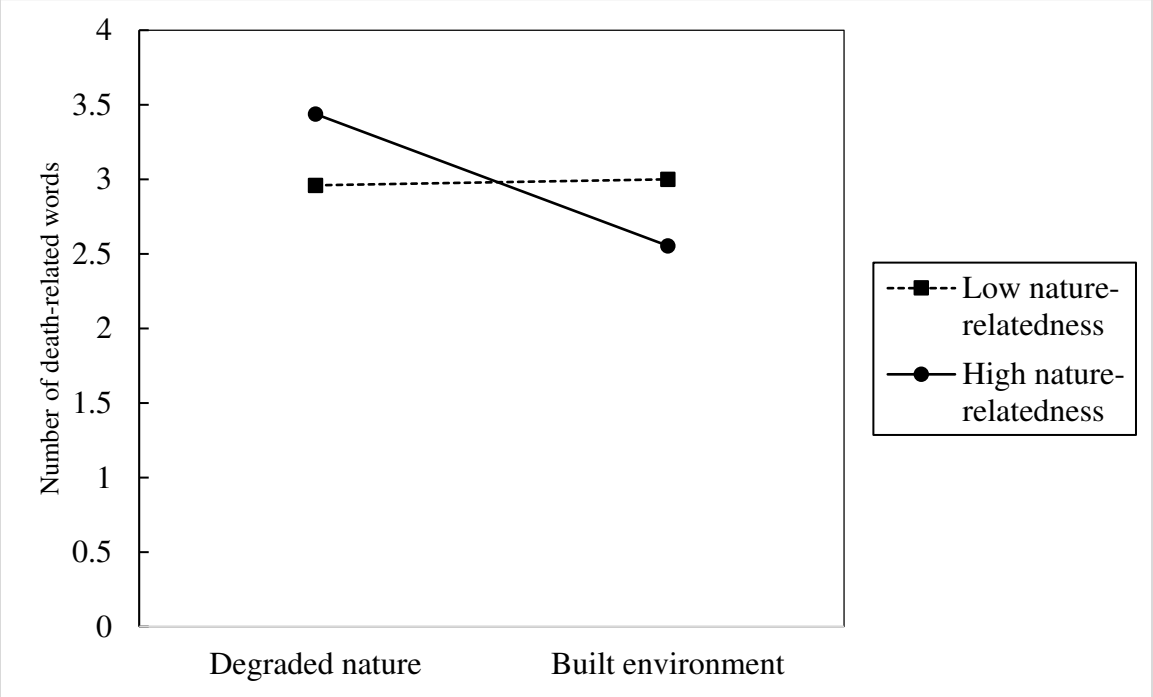

Figure 1. Study 1 - Moderation effect of nature-relatedness on thoughts of death

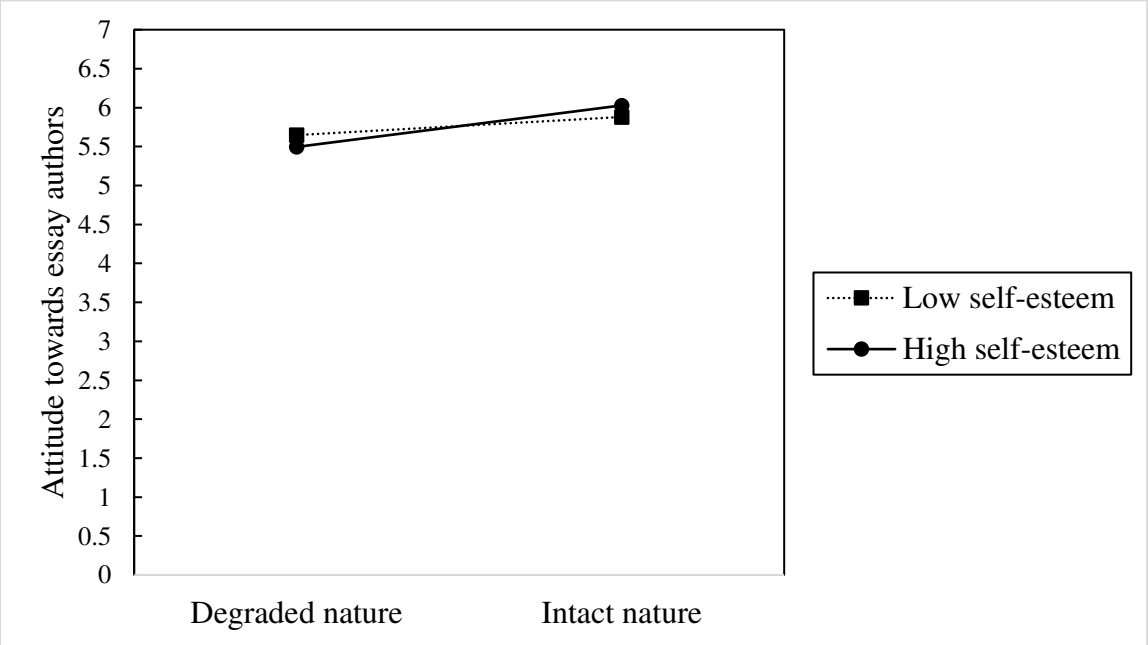

Figure 2. Study 3 – Moderation effect of self-esteem on reaction to essay authors

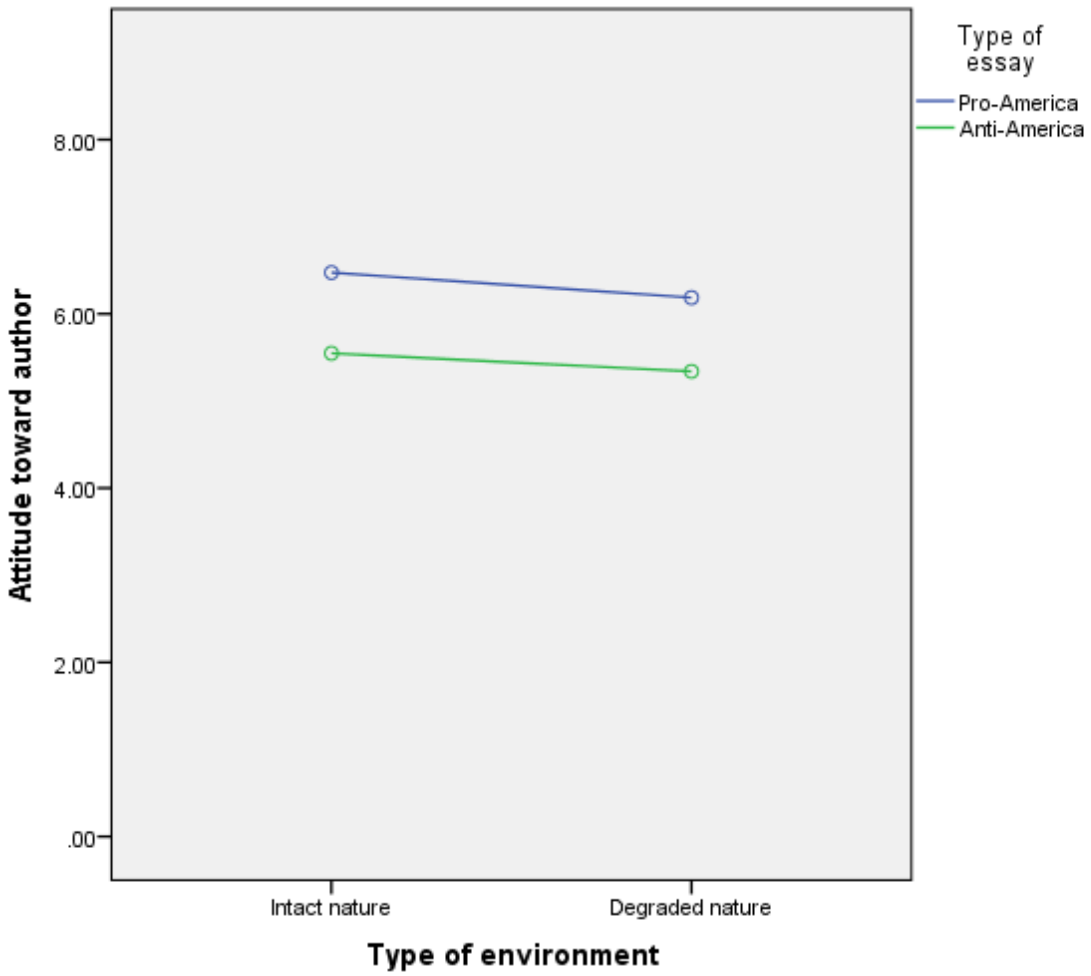

Figure 3. ANOVA results from Study 2

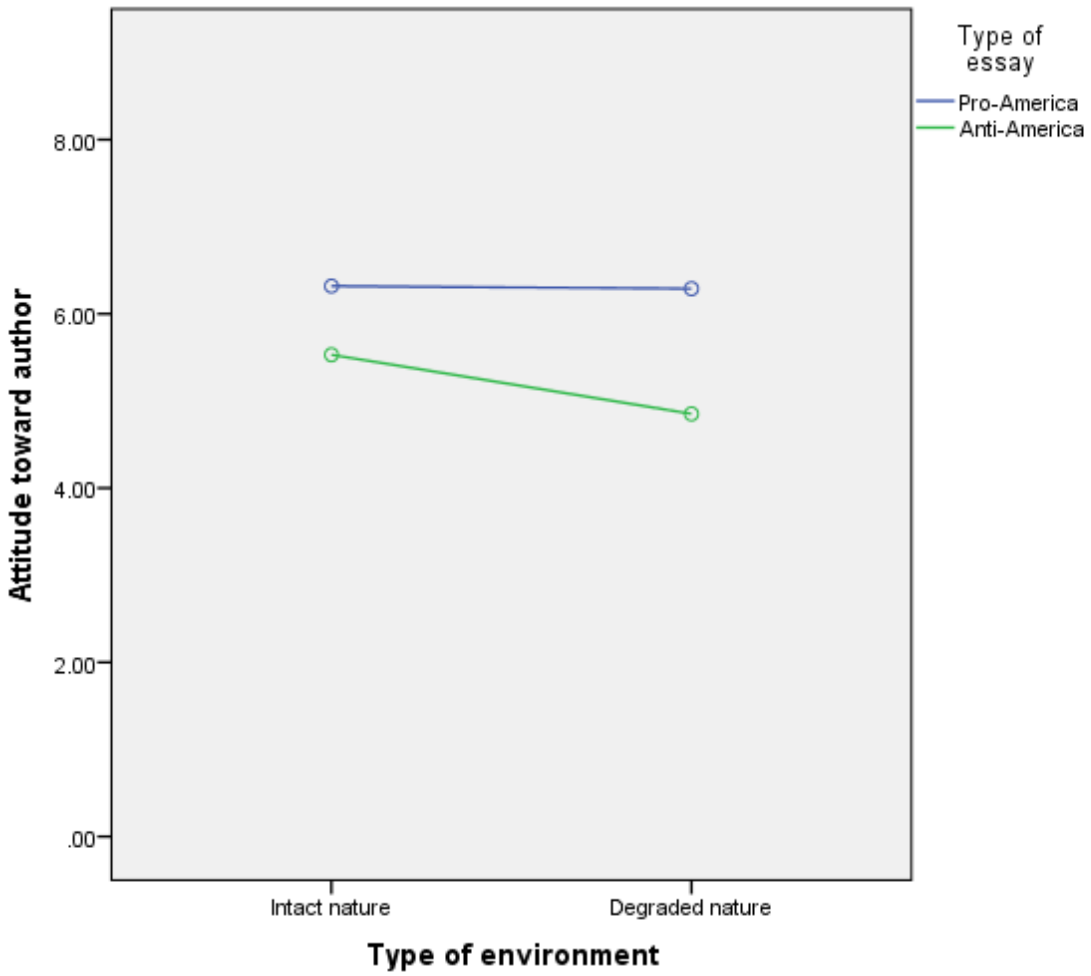

Figure 4. ANOVA results from Study 3

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APPENDIX

Images of intact natural environments

Images of degraded natural environment

Images of built environments