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## ATTENTION BIAS TO CLIMATE CHANGE IMAGES FOLLOWING EMOTIONAL INDUCEMENTS OF PRIDE AND GUILT

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ATTENTION BIAS TO CLIMATE CHANGE IMAGES FOLLOWING EMOTIONAL  
INDUCEMENTS OF PRIDE AND GUILT

By

Caleb William Coughtry-Carpenter

THESIS

Submitted to  
Northern Michigan University  
In partial fulfillment of the requirements  
For the degree of

MASTER OF SCIENCE

College of Graduate Studies and Research

November 2023

## SIGNATURE APPROVAL FORM

Thesis Title:

Attention Bias to Climate Change Images Following Emotional Inducements of Pride and Guilt

This thesis by Caleb Coughtry-Carpenter is recommended for approval by the student's Thesis Committee and Department Head in the Department of Psychological Science and by the Dean of Graduate Studies and Research.

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## ABSTRACT

### ATTENTION BIAS TO CLIMATE CHANGE IMAGES FOLLOWING EMOTIONAL INDUCEMENTS OF PRIDE AND GUILT

By

Caleb William Coughtry-Carpenter

Climate change is the most important issue facing modern day humans, and the solutions are not developing at a quick enough rate. In many cases, human-derived climate effects have crossed the threshold to becoming irreversible, and, as we remain inactive, are continuing to worsen as mitigating steps are not taken. Some of the most devastating effects facing humans include rising sea levels that threaten to flood coastal regions, and heatwaves of heightened intensity which threaten access to potable water and loss of food crops. Humans are not the only victims of climate change. Ecosystems are also greatly threatened by climate change as native species have continued to go extinct as a direct result of factors like overexploitation, pollution, land development, and the introduction of non-native species. Climate change policies and technological solutions, with particular regard to emotional/affective qualities, would be better communicated with a stronger understanding of attention. There is much debate regarding how attention is allocated. The present study aimed to alter attention bias towards climate-relevant images using emotional inducements of either pride or guilt, and assess change in attention bias with an eye-tracking device. It was found that participants induced to experience pride engaged in attentive avoidance of the climate change images, and negative images of climate change elicited greater attention bias than positive images of climate change. There was no interaction between the inducement condition and image valence.

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2023

## **DEDICATION**

This thesis is dedicated to all my family who have helped me throughout the process of developing, conducting, and documenting this research. Mom, and Gabe thank you for all the support through the entirety of my Master's and through the rest of my education. I couldn't have done it without you guys. To all my friends, Tommy, Cassie, Colton, Chris, Corinne, Kennedy, Kyle, Sidney, and so many more. You are all so important to me and it means the world to me that you have all been there along the way. Finally, to my wonderful partner, Kelly, I cannot thank you enough for all the love and support you have provided me. Truly, I could not have done this without all of you.

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I want to thank all of the people who helped me through the process of writing this thesis. Like many others, the last few years have been difficult academically, professionally, and personally, but I am proud of the work that I was able to accomplish despite all the challenges. This project would have been impossible without the help of my advisors. Dr. Joshua Carlson, who helped with the design of this study and the editing of this thesis. Dr. Lin Fang, helped throughout the study design process and was instrumental in developing the task used. She was also kind enough to allow the use of her lab space and equipment. Dr. Jessica Thompson played a pivotal role in developing and scoring the images used in the task and providing edits to the study design. I want to thank my mother, Rachel Coughtry, for helping me throughout the editing process. The research assistants who worked alongside me were invaluable in the collection of this data. I would also like to thank my friends and colleagues, Cole Holt, Jeremy Lawrence, and Siraj Lyons despite each having graduated by the time this thesis was finalized, I couldn't have finished without their camaraderie and friendship. Finally, I would like to thank all of the staff at Northern Michigan University for offering me an education on their wonderful campus.

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## LIST OF SYMBOLS OR ABBREVIATION

Attention bias (AB) .....	3
Attention bias Modification (ABM).....	4
New ecological Paradigm (NEP).....	5
Total dwell time (TDT).....	15
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## INTRODUCTION

### **Climate Change background**

Climate change is one of the most important issues facing modern day humans. Currently, an estimated 3.3 to 3.6 people live in areas considered to be extremely vulnerable to climate change, and the countries affected are primarily small, poorer, and still undergoing industrialization in areas like Africa, Asia, Central America, and South America (Mukherji et al., 2022). The primary effects of the changing climate include the worsening of major weather events like hurricanes, droughts, heatwaves, and heavy precipitation (Mukherji et al., 2022). All of these effects stem from greenhouse gasses primarily of anthropogenic origin, which is estimated to have been 59+/-6.6 GtCO<sub>2</sub>-eq in 2019 (Mukherji et al., 2022). This is a remarkable 54% increase in gas emissions from 1990 (Mukherji et al., 2022). Multiple predictive models have been presented, which typically range from the best- and worst-case scenarios depending on our behavior today (IPCC, 2023). What each of these proposed models have in common, however, is that we will almost certainly see increases in temperature regardless of our current actions simply because of the current CO<sub>2</sub> cumulation in the atmosphere (IPCC, 2023; Mukherji et al., 2022; S. H. Schneider, 2001).

Climate change is caused by a variety of factors, but it is difficult to cover the entirety of the possible drivers of climate change. There is a clear consensus that human activity is the primary contributor to the changes of climate (Fakana, 2020; Syvitski et al., 2020). Climate change is an issue that will, if it hasn't already, affect everyone. Rising temperatures allow for a proliferation of viral vectors, like mosquitoes and ticks, reduce the food production in arid

countries residing in the Global South, and intensify weather throughout the planet (Haines, 2004; Mukherji et al., 2022). We won't be the only victims of climate change either, as up to a million species are facing extinction in the next few decades, and this rapid species loss is the direct result of human alterations to land and ocean environments (Tollefson, 2019).

Solutions, such as renewable energy, are being developed and implemented to improve the efficiency of existing energy producing technology, and building more efficient infrastructure (Pittock, 2009). There have been strides to incentivize green industry like the inflation reduction act (*Inflation Reduction Act Guidebook | Clean Energy*, 2023), which is giving \$400 billion in funding to clean energy projects like electric vehicle tax incentives. While these changes are undeniably positive and steps in the right direction, there is still room to continue advocating for better and better climate policies. A 2023 poll found that 56% of Americans believe that the federal government is not doing enough to combat climate change effects (Tyson et al., 2023). Additionally, policies which aim much higher than the inflation reduction act, like the Green New Deal which aimed to transition entirely to renewable energy over the following decade, are extremely popular. With one poll finding that 81% of registered voters either “somewhat support”, or “strongly support” the Green New Deal (Gustafson, A. et al., 2018). Even with the large support for new climate initiatives, it remains imperative that new strides are continually made to improve the climate for generations to come. A primary method in doing so involves the dissemination of information surrounding the issues of climate change, and the field of psychological science plays a unique role in this discourse. Particularly with regard to the application of attention bias modification to guide attention to climate information and avoid disengagement. Attention bias is already being studied, and proving effective as a tool to alter purchasing behavior in customers (Schröter et al., 2021; Streicher et al., 2021). Therefore,

applying this body of research to the development of more convincing, and more attention-grabbing persuasive materials for political groups, organizations, and educational bodies is a logical next step.

## **Attention Bias Background**

### **What is attention bias?**

Attention bias (AB) is an unconscious and automatic response to stimuli, and refers to a behavior where cognitive resources are allocated to attend to certain stimuli over others (Azriel & Bar-Haim, 2020). This has a variety of applications in various psychological subfields, particularly with regard to the understanding and treatment of anxiety disorders through attention bias modification (Mogg & Bradley, 2016). Attention bias has been assessed as a precursor to addiction relapses but results are still inconclusive and further research is required (Field et al., 2014). Other research has shown attention bias modification to be effective in minimizing the urge to drink alcohol in heavy drinkers (Field & Eastwood, 2005). Attention bias modifications have even been shown to reduce cortisol in expectant mothers (Dennis-Tiwary et al., 2017). The application of attention bias modification has been demonstrated to be effective in a variety of different applications and could be an effective tool in altering climate related behavior as well.

### **Paradigms of Attention Bias**

There are two competing ideas surrounding the allocation of attention to anxiety provoking stimuli (Weierich et al., 2008). The first, called vigilance-avoidance, suggests that attention is first allocated to the threatening stimuli, and then followed by an avoidant AB (MacLeod & Mathews, 1988; Mathews & MacLeod, 1994). Alternatively, the attention maintenance hypothesis argues that attention is held consistently on the threatening stimuli and disengagement with the threatening stimuli is very difficult (Weierich et al., 2008). Even still,

when attention bias is studied considering other emotions, like disgust, this can result in an AB away from the affectively congruent stimuli (disgusting stimuli) (Rothermund et al., 2008; Vogt et al., 2011). To further muddy the water, other research has demonstrated that affective priming can have the opposite effect and promote a bias *towards* the primed emotion (Smith et al., 2006). Each hypothesis is seemingly at odds with each other, and one of the purposes of the present research is to provide data to further investigate the role that affect has on altering attention bias, particularly with regard to climate change.

### **Past Attention Bias Manipulation Techniques, Associated Issues, and Solutions**

The most common applications of attention bias modification (ABM) are in the treatment of anxiety disorders, and involve the use of a modified probe task (ABM-threat-avoidance training) where a target probe always follows an image that is **not** threatening therefore reducing AB toward the threatening images and anxiety (MacLeod & Clarke, 2015; MacLeod & Mathews, 2012). Unfortunately, the effectiveness of these modified probe tasks, especially with regard to individual differences research, is unreliable and replications have not been consistent (Cristea, Kok, et al., 2015; Cristea, Mogoșe, et al., 2015).

Several studies have demonstrated that the dot probe lacks the reliability to assess individual difference in participants and, in large part, should be avoided for other methods of AB assessment like eye tracking or EEG (Carlson et al., 2023; Schmukle, 2005). Attention bias, as measured by an eye tracker, has been used in numerous studies (Armstrong & Olatunji, 2012), and has been demonstrated to be a reliable measure of attention bias (Skinner et al., 2018). Eye tracking allows for real-time recording of viewing behavior onto highly customizable trials. Data points like fixation count, fixation order, dwell time, and even pupil diameter are among the large number of variables that can be captured using eye tracking. For these reasons, eye tracking



is now becoming a common tool for measuring AB and offers many different methods of attention bias assessment, and has been demonstrated to be a largely reliable tool in other areas of psychology; which is why it was chosen for the purposes of the present study (Duque & Vázquez, 2015; Shechner et al., 2013).

### **Attention Bias to Climate Change Images**

Attention bias has not only been studied when considering disorders, like anxiety or depression, but has also been studied for differences in viewing behavior toward climate change images. In one study, it was found that participants with greater environmental orientation, as measured using the New Ecological Paradigm (NEP), demonstrated greater levels of attention bias to climate change images (Carlson et al., 2019). Another study found similar results in that participants with greater pro-environmental tendencies attended more to climate change images, but only when those images were more negative overall (Meis-Harris et al., 2021). It should be noted that the Meis-Harris et al., (2021) study used a much broader collection of images related to climate change (trains, cars, reusable cups, paper cups, etc.), whereas the Carlson et al., (2019) study used climate images with a much narrower focus on causes and solutions (industrial buildings, solar panels, windmills, etc.). Further, a study conducted by Luo and Zhao (2019), argued that attention bias to climate change images stems from motivational relevance, meaning that people who are skeptical of climate change do not look at evidence for as long as people who are not skeptical. This was found by presenting participants with graphs of global temperature changes and tracking gaze patterns. Participants who self-identified as liberals demonstrated greater proportional dwell time to the parts of the graph that better demonstrated the presence of climate change (i.e. the rising portion of the graph), whereas conservatives

demonstrated greater proportional dwell time on parts of the graph that did not show change in climate (i.e. the flatter portions of the graph).

In another experiment described in the same study (Luo & Zhao, 2019), attention bias was manipulated using the same change in temperature graph, only, in this case, either the rising portion of the graph was highlighted (showing greater climate change recently), or the flat portion of the graph was highlighted (showing no climate change). Liberals exposed to the graph with the rising portion highlighted were more likely to donate or sign a petition, but the inverse was true of conservatives. Instead, they were more likely to donate or sign a petition when they were shown the graph with the flat portion highlighted. This experiment demonstrates what the authors call “a motivated attention framework” which suggests that people prioritize images that confirm or otherwise affirm their beliefs/needs. The same is argued in Vogt et al., 2011, where participants exposed to disgusting objects attended more to images of cleanliness. In this case, the participants experienced a negatively valenced emotion and sought out stimuli to alleviate this negative emotion.

### **Affect and Attention Bias**

As described in previous sections, attention bias has been modified using altered versions of various probe tasks (Carlson et al., 2022; MacLeod & Clarke, 2015; MacLeod & Mathews, 2012; Mogg & Bradley, 2016); however, attention bias has also been modified using affective inducements as pre-task manipulations (Vogt et al., 2011). Participants induced to feel disgust using fake disgusting objects (plastic feces, bugs made of believably slippery plastic, bags filled with mashed food to resemble vomit, etc.), or were exposed to neutral objects (erasers, stress balls, rolls of tape, etc.) and then performed a dot probe task containing images depicting cleanliness, disgusting images, and neutral images. Results of the dot probe task showed that

participants who experienced the disgusting objects prior to the dot probe would attend more to the images of cleanliness (Vogt et al., 2011). From this experiment, we have evidence that attention bias can be manipulated using an affective inducement prior to assessing images of varying affective quality.

Affective inducements have already been demonstrated to be effective in altering the overt climate behavior of participants, like willingness to sign a petition or donate an amount of money to a climate organization, and this has been shown by Schneider et al. (2017). In this study, the authors used affective inducements of pride and guilt prior to a measure of overt climate behavior. In this case, choosing to shop for “green” consumer goods, likelihood of choosing to act in environmentally friendly ways (“unplug their appliances and charges when not using them”), or donating to a real climate organization. This study found that participants exposed to the pride condition were more likely to engage in pro-environmental behavior. Pride and guilt were selected for the present study for a number of reasons. First, an effective methodology of inducement had already been established by Schneider et al. (2017). Second, pride and guilt are understood to be fundamental when performing various behaviors within social contexts, such as how an individual treats the environment around them and how this impacts those around him or her (Baumeister et al., 1994). The aim of the current study was to assess the possibility of climate related affective inducements (as used by Schneider et al., (2017)) in influencing covert behavior like attention bias as other research has indicated that AB to climate images is influenced by environmental attitudes (Carlson et al., 2022; Geoffrey Beattie & Laura McGuire, 2012).

## HYPOTHESES

**H<sub>a</sub>**= Pride induced participants will express increased dwell time on climate-relevant images, and guilt induced participants will express increased dwell time on climate-irrelevant images and the background.

**H<sub>b</sub>** = Guilt induced participants will express a greater attention bias to positively valenced climate change images (i.e., increased dwell time) and demonstrate avoidance of the negatively valenced climate change images.

**H<sub>c</sub>**= Positively valenced climate change images will have greater dwell times than negatively valenced images.

**H<sub>d</sub>** = A positive correlation will be found between pro-environmental attitudes and attention bias to climate change images.

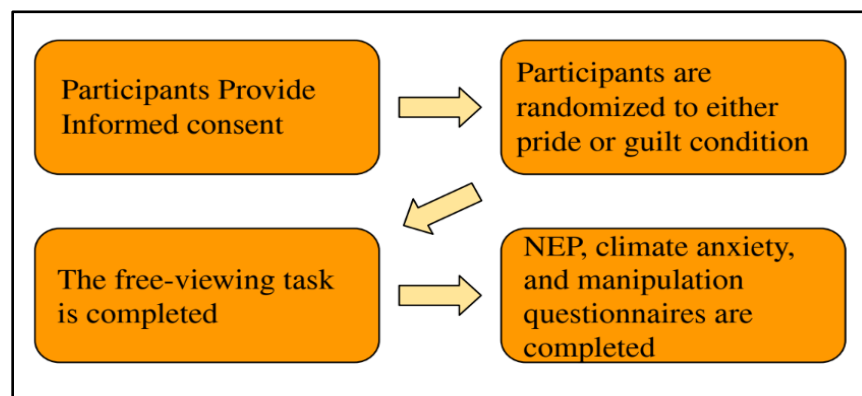
## METHODS

41 participants (32 being female, and 9 male) were recruited from undergraduate classes at Northern Michigan University with course credit as incentive to participate. The average age of the sample was 21.02 with an SD of 3.78. Political orientation was gathered as a self-report metric and our sample consisted of 3 conservatives (7%), 25 liberals (61%), 7 independents (17%) and 6 with no political affiliation (15%). Participants were first screened to have normal or corrected to normal vision. If this was the case, they were offered an informed consent form. Participants were randomly assigned to an experimental condition: Either a “pride” induced group, or a “guilt” induced group. The affective induction process is described in the following section. Each participant had an equal chance of assignment to either of the conditions. In total, 21 participants were assigned to the pride condition and 20 participants were assigned to the guilt condition.

### **General Study Procedure**

Participants were provided with an informed consent form, given the opportunity to ask questions about the study, and were allowed to rescind their consent at any time. They were then randomly assigned to either a guilt inducement or a pride inducement condition identical to the procedure described in schneider (2017). *Affective forecasting* was used as the method of emotional inducement and was conducted immediately prior to a *free viewing task*. This involved the presentation of five hypothetical climate related scenarios with a pro-environmental choice and an anti-environmental choice. Participants then rated levels of pride and guilt had they performed one of the two behaviors described in the choice scenarios. For more information see

section “Affective Inducement,” for the specific choice scenarios used, see appendix A. Eye movements were recorded by an eye-tracking device while performing a *free viewing task*. Following the completion of the task, participants were given each of the questionnaires, including the New Ecological Paradigm (NEP), the climate anxiety scale, and a manipulation check to assess post task levels of pride and guilt. All research activities and materials were approved by an internal Northern Michigan University (NMU) Institutional Review Board (IRB) prior to the first day of enrolment.



**Figure 1 Study order of events:** Depicts the order of events for study participants.

## Materials

### Affective Inducement

Participants were randomly assigned one of two possible between groups conditions. In both groups, identical vignettes were read portraying a climate change scenario with two choices, either a pro-environmental choice or an anti-environmental choice. In the pride condition, participants were asked the level of pride they would experience if they actually chose to perform the pro-environmental choice. The guilt condition participants were asked to provide the level of guilt they would have experienced if they had actually behaved as described in the anti-environmental choice in the vignette. Five vignettes were presented to each group and

participants responded to a single item for each vignette using a Likert style scale from 1 - 9 (1 being not at all guilty/proud, and 9 being extremely guilty/proud). For a complete list of the affective inducements used refer to appendix A. All inducements were adopted from Schneider et al., (2017). The induction process was performed prior to starting the free viewing task.

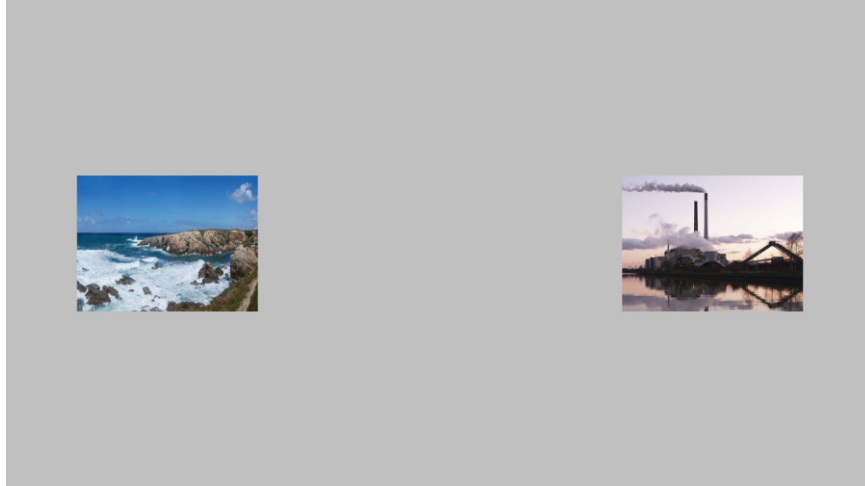
### **Stimuli**

Images for the free viewing task were taken from a database (<https://affectiveclimateimages.weebly.com>) containing 320 images rated for relevance to climate change (1-9 low-high), valence (1-9 negative-positive), and arousal (1-9 calm-exciting) (Lehman et al., 2019). These images were rated by 67 participants who did not participate in the present research. Images rated highest in relevance to climate change largely contained depictions of polar bears, melting ice, power plants giving off smog, flooded/deforested areas, solar panels, and windmills just to list a few. Images rated lower in relevance spanned much broader categories and contained various depictions of buildings, rocks, crowds, and various landscapes, again, just to cover a few. Of the 320 images in the database, 80 were adopted to be used in the present study. Images were first filtered so that any including text were not included. Then the 40 lowest rated images in terms of relevance to climate change, and the 40 highest rated images for relevance to climate change were used in the present study. The highly relevant images were further divided into groups of positive and negative images, which included the 20 most positive images and the 20 most negative images. Images were considered “relevant” to climate change if they were rated  $\geq 6$  for relevance, and images were “positive” if they were rated  $\geq 5$  on the valence scale. Images were considered “irrelevant” if they scored  $\leq 4$  on the relevance scale. Irrelevant images were also affectively neutral in contrast with the relevant images.

## **Free Viewing Task**

*Free viewing task:* Participants were seated 119.38cm (47in) away from a computer monitor, and a chin rest was placed to minimize head movement. The eye tracking camera and participant were adjusted as such that their eyes were centered in the view of the camera. The free viewing task presented participants with two images presented simultaneously on the screen for a total of 4000 milliseconds. Each image was presented twice through the entire task. Once on the left side of the screen and once on the right side of the screen. A total of 80 trials were presented sequentially to the participant in a random order. 40 of the trials contained a positive relevant climate image, and the other 40 contained a negative climate change image. Each trial began with the presentation of a central fixation cross (a plus sign, +) for 500ms, and that fixation was confirmed by the researcher with a button press to confirm each trial begins with a consistent initial fixation point and to correct any drift from the true fixation point. Following the fixation cross, a climate relevant image was presented along with an irrelevant image. One on the left and one on the right side of the screen. Each image occupied a visual angle of  $5.2535^\circ$  and were equivalent in all dimensions. Participants were instructed to observe each of the images freely and that they would be determining if the images were equally pleasant. This was done by pressing either “1” or “2” on a keyboard. The participant’s response was not timed and was not considered as part of analysis; instead, this was performed to obscure the purpose of the study.





**Figure 2 Example trial image:** Example of a trial presented to participants. This particular trial used a negative, climate relevant image (right) and a neutral, climate irrelevant image (left). Each trial is presented to participants for 4000ms.

### **Eye-Tracking Camera specifications**

1. Eye-link (2000 Hz EyeLink Portable Duo, SR Research) eye-tracking equipment.
2. Records gaze behavior at a sampling rate of 1000 Hz. Has a threshold of  $\geq 100$ ms.
3. Stimulus presentation and eye movement recording were controlled by E-prime3.
4. Conducted in remote mode with a target sticker on participant's forehead.
5. A calibration and validation procedure were performed prior to each task. If validation was poor for 3 attempts, the participant would be excluded from participation.
6. Finally, a drift correction procedure was performed for each trial where a fixed point on the screen is corroborated with the measured point by the camera. Any difference between the two is then accounted for.

### **Questionnaires**

**New Ecological Paradigm (NEP):** The NEP is a 15 item questionnaire meant to measure agreement with a positive ecological paradigm or with agreement with the dominant social paradigm (DSP) (Anderson, 2012; Dunlap et al., 2000). An example item of the NEP:

“We are approaching the limit of the number of people the Earth can support.” An example item from the DSP: “Humans have the right to modify the natural environment to suit their needs.” These statements were then rated on a standard 5-point Likert scale (1-5 strongly disagree-strongly agree). NEP scores were collected because previous research suggested that a relationship exists between NEP scores and attention bias to climate change images (Carlson et al., 2019). DSP scores are reverse coded to create a single index for an overall NEP score, which is how it will be referred to for the remainder of the present study. This score is intended to provide a value representing the participant's pro-ecological worldview and environmental concern.

**Climate Anxiety:** The climate anxiety questionnaire aims to provide a reliable psychometric score to climate change derived anxiety (Clayton & Karazsia, 2020). It is a 22-item survey meant to measure climate anxiety across a variety of subsets including: Cognitive impairment from climate change anxiety, functional impairment from climate change anxiety, personal experience with climate change, and behavioral engagement with climate change related actions. Each item is rated for the frequency the statements are true using a 5-point Likert scale (1-5 never-almost always). Example items include: “I have nightmares about climate change”, and “I find myself crying because of climate change.” Higher scores indicate greater levels of climate change derived anxiety (Clayton & Karazsia, 2020).

**Manipulation check:** A manipulation check was conducted at the end of the experimental session. This consisted of a two-item questionnaire where participants rated their current pride and guilt. Participants rated each emotion on a Likert style scale from 1 - 9 where 1 was not at all guilty/proud and 9 was extremely guilty/proud. Independent sample t tests were conducted where the condition assignment acted as the grouping variable and the reported level

of pride and guilt as the dependent variable. There was no difference in self-reported levels of pride between the two groups ( $p = .74$ ), and the same was found for the self-reported levels of guilt ( $p = .76$ ). This could suggest that the inducement was not effective or that the delay between the inducement occurring and the manipulation check was too long, minimizing the effect of the inducement.

### **Attention Bias Index Development**

Two regions of interest (ROI) were created using Data Viewer from Eye-Link, one for the left image and one for the right. ROI size was kept identical for all analysis. Any trials where participants' gaze never entered either ROI were excluded from analysis. This included a total of just 16 trials or 5.911e-05% of the total trials across all participants. Then, multiple indices of attention bias were developed. First, total dwell time (TDT) in milliseconds on the climate relevant images was used as the dependent variable. Second, a proportional dwell time (PDT) on the climate relevant image as a percentage of the 4000-millisecond trial. PDT and TDT are functionally similar in that they gauge overall attention to the relevant climate image irrespective of the distractor images. A primary goal of this study is to ascertain which image qualities are most attention grabbing for the use of persuasive materials like advertisements, billboards, and brochures. TDT is useful in that it allows for a real-world approximation to the presentation of information in the form of individual doses similar to billboards or brochures. Information presented this way is typically not paired with simultaneously present opposing images, and instead measuring the overall time spent on these images informs how effective they could be in these applications. Similar methodology has been used in other studies as well (García-Blanco et al., 2015). The final index of attention bias was calculated by taking the total dwell time on the irrelevant image, in milliseconds, and subtracting it from the total dwell time spent on the

climate relevant image creating a dwell time difference (DDT) score. This creates an attention bias score that is relative to the distractor image, and has been implemented in other studies (Soleymani et al., 2020).

### **Analysis plan**

An exploratory assessment of inducement responses was performed using an independent-samples t test between reported pride and guilt during the inducement procedure using self-reported pride and guilt as dependent variables (DV) and group assignment as independent variables (IV).

Each hypothesis was assessed using the following statistical tests. All analyses were performed using R version 4.3.1 (R Core Team, n.d.):

***H<sub>a</sub>**= Pride induced group will express increased dwell time on climate-relevant images, and guilt induced participants will express increased dwell time on climate-irrelevant images and the background.*

***H<sub>b</sub>** = Guilt induced participants will express a greater attention bias to positively valenced climate change images and demonstrate avoidance of the negatively valenced climate change images.*

***H<sub>c</sub>**= Images related to climate change which were previously rated by an independent sample as having a positive valence will have greater dwell times than negatively rated images.*

H<sub>a</sub>, H<sub>b</sub> and H<sub>c</sub> were tested using each of the attention bias indices (described earlier) acting as DVs. Then a mixed factorial Analysis of Variance (ANOVA) was conducted with trial type acting as the within groups IV and affective inducement groups acting as the between groups IV.

***H<sub>d</sub>** = A positive correlation will be found between NEP scores and attention bias to climate change images.*

To test H<sub>d</sub>, a Pearson's R was used to assess the relationship between NEP scores and attention bias using DDT index. Then a partial correlation was conducted between the same variables, controlling for affective inducement grouping. Further, an independent samples t test was performed between the affective inducement groups on NEP scores.

## RESULTS

### **Inducements results**

Participants reported how proud/guilty they would have felt had they engaged in the behaviors described in the induction procedure. To assess differences in responding between the two conditions, an independent t test was used on the reported guilt and the reported pride scores. Participants in the pride condition rated levels of pride during the affective inducement procedure, participants in the guilt condition provided levels of guilt during the same procedure. Each rated the requisite emotion on a 9-point scale with the same anchors. Participants reported significantly higher scores of pride ( $M = 6.98$ ) than scores for guilt ( $M = 5.40$ ),  $t(42.48) = 3.85$ ,  $p < .001$ . This result replicates what was found in Schneider et al., (2017) and is expected since there is motivation to report greater levels of positive emotions and under report negative emotions (Cohen & Sherman, 2014; Higgins, 1987; Steele, 1988).

### **Attention bias results**

#### **Dwell Time Difference Index**

Our primary metric for attention bias was calculated using a formula where total dwell time on the irrelevant climate change image, in milliseconds, was subtracted from the total dwell time on the target image for each trial, also in milliseconds (Soleymani et al., 2020). Using this metric, positive values indicate that there is a bias toward the target image, and a negative value indicates that there is a bias towards the neutral, or irrelevant image for that trial. These scores can then be averaged across the independent variable levels for analysis.

Mixed factorial ANOVAs were performed using trial type (positive vs. negative) as the within group variable and induction condition (pride vs. guilt) as the between group condition. Shapiro-Wilk tests of normality were conducted for each of the eye tracking indices (dwell time by trial type) both negative and positive trial types had normally distributed dwell time differences  $p = .67$ , and  $p = .54$ , respectively. There was a significant main effect for the inducement condition,  $F(1, 39) = 5.42, p = .025, \eta_p^2 = .122$ , where pride induced participants had an average dwell difference time of  $-135.00$  and guilt participants had a difference score of  $-0.86$ . Additionally, a main effect was found for trial type,  $F(1, 39) = 36.35, p < .001, \eta_p^2 = .482$ , such that negative trials had a difference score of  $58.40$  and positive images had a difference score of  $-197.00$ . However, an interaction effect was not found between trial type and condition assignment,  $F(1, 39) = 1.16, p = .287, \eta_p^2 = .029$ . See table 1 for means and SD's.

Induction condition	Trial type	Mean	SD
Pride	Positive	-240	216
Pride	Negative	-29.3	208
Guilt	Positive	-152	202
Guilt	Negative	151	283

**Table 1 Average dwell difference score by group and trial type:** Shows the average attention bias using dwell time difference (DDT) score as the index. A positive value indicates greater attention bias to the target image and a negative value suggests an attention bias away from the target image.

### Total Dwell Time index

A mixed factorial ANOVA was used with the inducement condition (pride v. guilt) acting as the between groups variable, and trial type (positive v. negative) acting as the within subjects variable. Greenhouse Geisser corrections were used for all analysis. There was not a significant main effect for the inducement condition,  $F(1, 39) = .00, p = .983, \eta_p^2 < .001$ . Participants in the

pride condition dwelled on climate relevant images for an average of 1569ms, and guilt induced participants dwelled for an average of 1570ms. There was a significant main effect for the trial type,  $F(1, 39) = 38.66, p < .001, \eta_p^2 = .50$ . Where positive climate images were dwelled upon for an average of 1502ms, and negative climate images were dwelled on for an average of 1637ms. See table 2 for means and SD's. The interaction effect between the two variables was not found to be statistically significant,  $F(1, 39) = .97, p = .33, \eta_p^2 = .024$ .

Induction type	Trial type	Mean (ms)	SD
Pride	Positive	1512	147
Pride	Negative	1626	165
Guilt	Positive	1492	311
Guilt	Negative	1648	283

**Table 2 Average total dwell time by group and trial type:** Shows the average total dwell time on the climate relevant image organized by trial type and induction type.

### Proportional Dwell Time Index

Finally, proportional dwell time was used as another index for attention bias on the target images, i.e., the dwell time on the target image as a percentage of the total trial time. Another ANOVA was conducted with trial type (positive vs. negative) as the within group variable and induction condition (pride vs. guilt) as the between group variable. A Greenhouse Geisser correction was also used. The results of this ANOVA were similar to what was found previously. There was no effect of inducement,  $F(39, 1) = .05, p = .83, \eta_p^2 = .001$  (Pride  $M = .419$ , Guilt  $M = .415$ ), but a main effect for trial type was found,  $F(39, 1) = 34.55, p < .001, \eta_p^2 = .47$  (Negative images  $M = .435$ , Positive images  $M = .400$ ). See table 3 for means and SD's. Again, no interaction was detected,  $F(39, 1) = .81, p = .373, \eta_p^2 = .02$ .

Induction type	Trial type	Mean	SD
Pride	Positive	.41	.03
Pride	Negative	.43	.04
Guilt	Positive	.40	.08
Guilt	Negative	.44	.08

**Table 3 Average proportional dwell time by group and trial type:** Shows the average proportion of time spent dwelling on the climate relevant image. A value of 1 would indicate that all of the trial time was spent dwelling on the climate relevant image. These values are organized by induction and trial type.

Index	Pride		Guilt		<i>F</i> (1, 39)	$\eta^2$
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
DDT	-135	235	-.856	287	5.42*	.122
TDT	569	164	570	304	0.00	<.001
PDT	.42	.04	.42	.08	.05	.001

**Table 4 ANOVA results for eye tracking indices:** Mean and *F* scores organized by inducement condition and index. DDT index is the only index that demonstrated significant difference in attention bias by inducement condition.

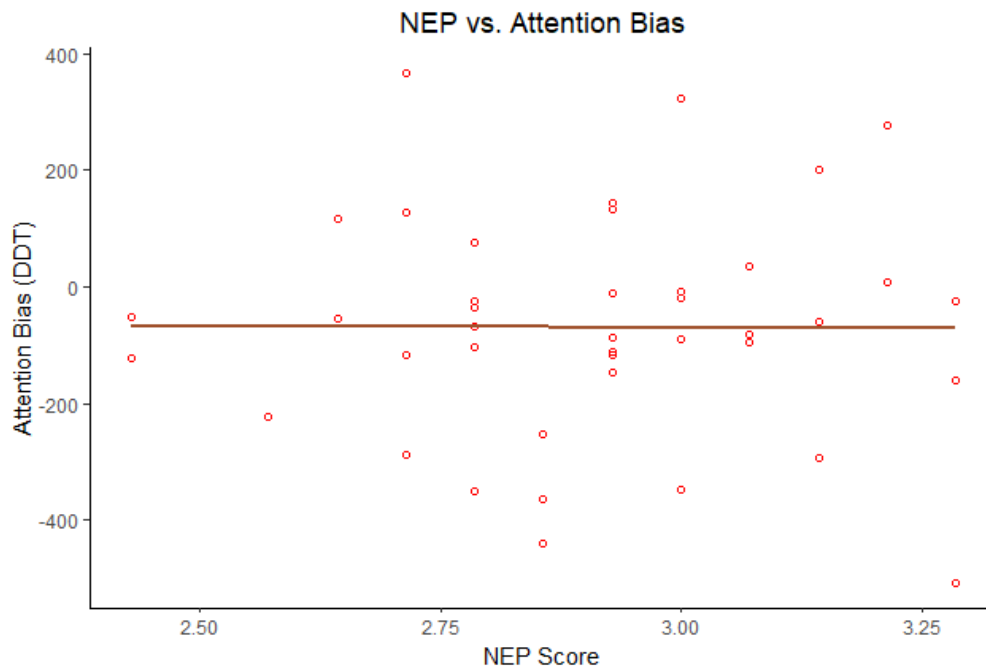
## Questionnaire results

### NEP

Previous studies suggested that a relationship exists between attention bias to climate relevant images and NEP scores (Carlson et al., 2019). A single-sided Pearson correlation was conducted between NEP scores and the AB index calculated using dwell time differences described earlier and assumed a positive relationship. No relationship was found between the two scores ( $r(39) = -.004$ , 95% CI = [-.264, 1.000],  $p = .509$ ). See figure 3 for the graphed relationship between these two variables.



This finding is unexpected, but there is the possibility that the pretest induction produced an effect modifying the NEP index muddying any relationship between these scores. To test this hypothesis, an independent samples t test was conducted using the NEP index as the dependent variable and condition assignment as the independent variable. It was found that participants did respond differently to the NEP dependent on group assignment. Participants in the pride condition responded significantly lower ( $M = 2.84$ ) than participants in the guilt condition ( $M = 2.98$ ) ( $t(38.98) = -2.09, p = .044$ ). Effect sizes for differences between groups were assessed using Cohen's  $d$  and a result of  $d = .67$  was found, which suggests medium effect size. It should be noted that this may not be solely responsible for the minimization of the relationship between NEP scores and attention bias and should be further investigated with a partial correlation controlling for group assignment.



**Figure 3 NEP vs Attention bias graph:** Plots the relationship between New Ecological Paradigm (NEP) scores with attention bias calculated using dwell time difference scores (DDT) index scores for attention bias. No relationship was found for questionnaire and attention bias scores. A line of best fit for the variables is shown above in red.

To further assess the relationship between attention bias and NEP scores, a single-sided partial correlation was conducted between DDT scores and NEP scores. After controlling for group affiliation (i.e., which condition the participants were assigned to) a relationship between attention bias and NEP scores still was not detected,  $r(39) = -.13, p = .21$ . One final single-sided partial correlation was conducted between total dwell time on the climate relevant images and NEP scores while controlling for condition. This correlation remained insignificant,  $r(39) = -.1, p = .57$ . It is possible that a substantially larger sample could detect a relationship between these two variables when controlling for pride and guilt inducements.

### **Manipulation Check**

Participants' self-reported levels of pride and guilt were captured using two single item responses, one for each targeted emotion, to assess the effectiveness of the affective inducements performed prior to the task. This was done after the free viewing task and the questionnaires. This is a separate analysis from what was done in a previous section. No significant differences were detected between the two groups in either of the self-reported levels of pride or guilt. Pride induced participants reported, on average, 3.52 on a pride scale, and 3.48 on a guilt scale. Guilt induced participants reported an average of 3.6 on the pride scale, and 3.4 on the guilt scale (each scale used a 9-point Likert response). Two independent samples t tests were performed on the level of reported pride and guilt using affective inducement assignment as the independent group variable for each. For self-reported pride, there was no significant difference between the two conditions ( $p = .7474$ ); likewise, there was no significant difference in reported guilt between the two assigned conditions ( $p = .7646$ ). Finally, a paired samples t test was conducted between self-reported pride and guilt which also showed no significant difference in responding ( $p = .4526$ ) with a mean difference of .121.

Induction	Reported Pride	Reported Guilt
Pride	3.52	3.48
Guilt	3.60	3.40

**Table 5 Manipulation check average responses:** Describes the mean scores of the reported levels of pride and guilt during the manipulation check organized by the affective inducement condition. “Induction” refers to the condition assignment, and the mean reported levels of pride and guilt are shown under “Reported Pride” and “Reported Guilt.”

## DISCUSSION

The present research aimed to modify attention bias to climate change relevant images using pre-task affective inducements. This study used affective inducements focused on climate change choice scenarios and a free-viewing task using climate change images to measure attention bias. It was anticipated that guilt induced participants would engage in an avoidant bias away from climate change images, and that this effect would be more notable when viewing negatively valenced climate change images with the inverse being true for the pride induced participants. We also anticipated that attention bias to climate relevant images would be correlated with NEP scores.

*H<sub>a</sub> = “Pride induced group will express increased dwell time on climate relevant images, and guilt induced participants will express increased dwell time on climate-irrelevant images and the background”*

From the results, we were able to conclude that inducements of pride produced an attention bias away from climate relevant images and guilt induced participants demonstrated relative ambivalence between the relevant and irrelevant images. This result is troubling because it seems to oppose some of the previous findings surrounding attention bias to climate stimuli. Going through the literature on attention bias, there is a pattern of findings that repeatedly indicate that attention is biased towards stimuli that are most relevant to an individual at the point in time when the stimulus is presented. These biases can be both innate and learned. For example, there is a wide swath of research showing the innate fear of snakes that we, and many other primates, share (Blanchette, 2006; Isbell, 2006; Soares et al., 2014; Van Strien & Isbell,

2017). This is a useful adaptation since an effective ability to detect dangerous stimuli is, of course, extremely relevant to an organism's survival. However, stimuli that have not been *evolutionarily* relevant to our survival for long enough to develop innate changes to our physiology (e.g., guns & syringes) also capture attention (Blanchette, 2006). There is evidence that people can also be biased towards stimuli that validates their own unique world views. For example, conservatives will tend to bias attention to climate change information that weakly supports the validity of climate change, whereas liberals will tend towards the inverse (Luo & Zhao, 2019). In our case we found that participants exposed to a pride induction biased their attention away from climate images and guilt induced participants seemed to express a relative ambivalence to the relevance of the images. However, there still remains little reasoning for the apparent avoidance present in pride induced participants.

A possible explanation for our findings could be the presence of an “attention counter-regulation mechanism” (Rothermund et al., 2008) where attention is biased away from the affectively congruent stimuli. A speculative reason being the implicit awareness of the current affective state and subconsciously biasing attention away from the congruous stimuli to counteract a persistent bias to the congruous stimuli. Similar results were found by Rothermund et al., (2008), where participants demonstrated an attention bias towards the oppositely valenced stimuli; however, the results of this study are not a one to one parity with the present research. Our sample only demonstrated this apparent counter-regulation when in the pride inducement condition, this effect was not found with participants induced to feel guilt. Additionally, pride and guilt are far more abstract affective states than simply feeling positive and negative (as used in the 2008 Rothermund study), which does pose difficulty drawing direct comparisons between these two bodies of research. In addition to difficulties comparing to other research, it brings into

question the specific mechanisms causing the inducement effects. It is possible that pride/guilt have unique qualities responsible for the differences in attention bias. Alternatively, the noted effects could be due to pride and guilt simply being positive or negative relative to each other.

Rothermund et al., (2008) does argue several other points that could explain the present result. It is possible that a prideful affective state decreases the relative valence of the climate change images, so it could be argued that, when in a prideful state, the climate images lose an affective quality thus minimizing the relevance of the stimuli. This is due to the relative differences in overall affective state. In this case, when experiencing pride, the overall valence of the relevant images is minimized in contrast with the irrelevant images, therefore the irrelevant images are then more attention grabbing. The speculative reasoning for the effects noted in our study still leaves something to be desired but does offer a tentative explanation. Further investigation of these effects should be undertaken, and possible directions will be expounded upon in later sections.

The lack of notable main effect for the inducement condition for total dwell time (TDT) and proportional dwell time (PDT) indices could be the result of several factors. The pre-task induction might not create an effect strong enough to be detected using TDT and PDT indices, or the targeted emotions might not create a large enough effect to be detected by these indices. This is supported by the fact that the manipulation check was not affected by the affective condition assignment. When using the dwell time difference (DDT) index, a significant effect between the two inducement groups were detected. It should be noted that there were trial type main effects found for all of the indices, this section relates only to the lack of affective induction main effects for TDT and PDT indices. DDT is a useful index for attention bias because it provides a contextual bias score for each trial. Both TDT and PDT communicate very little information for

each trial, since each only communicates information related to the targeted image. DDT, on the other hand, provides a score that is relative to the irrelevant image.

When only considering total dwell time or proportional dwell time, the value created for each trial ignores the amount of time spent on the irrelevant image. Additionally, the dwell time outside of the ROIs (i.e., the gray background of the task) was considered a null value for all of the indices. Due to these factors, the TDT and PDT lack a great deal of internal validity, because each ignores the time spent on the opposing irrelevant image. For example, a hypothetical participant could spend 2000ms of the 4000ms trial gazing upon the target image, a large percentage of the trial time, but if they spent the other 2000ms on the opposing irrelevant image this cannot be considered a “bias.” Alternatively, another hypothetical participant could spend the same amount of time maintaining their gaze on the target image (2000ms), but instead spend the rest of the trial never having gazed at the irrelevant image and just maintaining their gaze on the background. This would certainly be considered an attention bias to the target image, but, if only the total dwell time and proportional dwell time on the target image is considered, then no difference would be detected between these two hypothetical participants. Using the difference value between the dwell time on the target image and the irrelevant image allows for accurate assessments of attention bias trial by trial and would accurately show the differences in attention bias between these two hypothetical participants. For these reasons, DDT was selected as the primary metric for analysis.

*H<sub>b</sub> = “Guilt induced participants will express a greater attention bias to positively valenced climate change images and demonstrate avoidance of the negatively valenced climate change images”*

It was initially believed that experiencing guilt would result in avoidant gaze patterns similar to what was found in Vogt et al., 2011. It was thought that guilt would result in some level of discomfort, which would then lead to seeking relief through the avoidance of the negative climate change images. This was not supported by our results. There was no noted interaction between trial type and inducement condition, which makes further investigation of any simple effects of the sample inappropriate. However, looking at the raw means of dwell time differences between the trial types within the guilt induced participants (see table 1) it does *appear* to show a relationship between a guilty affective state and increased dwell time on the negative climate change images. With this in mind, it is possible that with larger samples a significant interaction effect would be detected. It is also worth noting that there was a much smaller difference in viewing behavior (see table 1) between the positive and negative climate change images for the pride induced group. Unfortunately, with the present data set, further examination of any relationship is difficult without running multiple tests, which then runs the risk of introducing increased type I error into the results and was therefore avoided.

It is also unfortunate that, if the interaction effect had reached significance, it would likely be in the opposite direction of what was anticipated given the direction of the dwell time difference means. Guilt induced participants appeared to demonstrate an attentional bias towards the negative climate change images. Instead of an avoidant behavior, a priming effect seems to be occurring from the guilt inducement similar to results of Smith et al., (2006) and Leung et al., (2009). In the papers listed, participants demonstrated an attention bias towards stimuli that appeared to be similar in affective quality. In Leung et al., (2009), it was found that participants with a clinical depression diagnosis were more likely to attend to “depressive words”, which was not found to be the case with a control group lacking a depression diagnosis. There are obvious



differences between this study and the present research, the largest being that the Leung et al., (2009) paper used participants with a clinical diagnosis whereas the present research used a pre-task manipulation. The 2006 paper published by Smith et al., is a much closer comparison to the present research, where participants were first primed with either positive or negative stimuli, which is then followed by a measure of attention bias.

Another possible explanation of this tentative relationship could be an initial misunderstanding of the relevant motivation following the inducement procedure. Several studies of attention bias suggest that biased attention is the result of motivational relevance (Luo & Zhao, 2019; Vogt et al., 2011), which means that therein lies some conscious or unconscious reasoning for placing attention on one stimuli in favor of another. Attention can be biased to items that are relevant to survival, like food or depictions of sex (Isbell, 2006; Most et al., 2007; Soares et al., 2014; Tapper et al., 2010); however, attention can also be biased through learned associations (Blanchette, 2006) and momentary shifts in affective states (Rothermund et al., 2008; Smith et al., 2006; Vogt et al., 2011). Therefore, it was believed that experiencing guilt through affective inducements would result in further negative feelings when viewing negative climate images, and therefore would result in the attentive avoidance of these images. Again, this was not supported with the present study.

Other research has highlighted that anxious individuals are more likely to attend to threatening stimuli, and further reinforce negative emotions like anxiety (Mathews & MacLeod, 1994; Mogg & Bradley, 2016). Essentially the inverse of the previously highlighted research and much more in line with the present findings. It has been argued that the competing theories of attention bias result from disparities between top-down inhibitory responses to threat and bottom up processing (Mogg & Bradley, 2016). Our results suggest that experiencing guilt produces an

attention bias towards negative climate change images, which aligns more closely with theories suggesting negative emotions (like guilt and anxiety) are maintained through facilitation of negative/threatening stimuli. There is a paucity of research focused on similar modalities of attention bias manipulation using affective priming, however, there are some studies suggesting that attention can be biased to affectively congruent stimuli (Leung et al., 2009; Smith et al., 2006). This presents two possible explanations for the results found: attention could be biased to the negative climate change images due to assessing them as threatening, which would be in line with research previously mentioned (Mathews & MacLeod, 1994; Mogg & Bradley, 2016), or that attention is biased to affectively congruent images (Leung et al., 2009; Smith et al., 2006).

If you recall from the introduction, there are two leading theories related to attention bias and threatening images: vigilance avoidance and attention maintenance (MacLeod & Mathews, 1988; Mathews & MacLeod, 1994; Weierich et al., 2008). Our results more closely align with the attention maintenance theory for attention bias to threatening images since a notable attention bias toward the negative climate change images was observed. Alternatively, our results could also be explained through attention being primed to the affectively congruent images, which similar effects have been found in previous research (Leung et al., 2009; Smith et al., 2006). Each could explain the results found in the present study, and each is not even mutually exclusive from the other; however, more research will need to take place to conclude one way or another.

**H<sub>c</sub>** = *“Images related to climate change which were previously rated by an independent sample as having a positive valence will have greater dwell times than negatively rated images.”*

It was initially anticipated that all participants, regardless of condition assignment, would show a bias towards the positively rated climate change images. This was not supported by our

results since greater attention bias was found for the negative climate change images (relative to the positive images). This is, again, a puzzling finding since previous research has reported the opposite being the case (Carlson et al., 2020). A possible explanation for the discrepancies between the previous studies and the present study lies in the differing methodological processes. In the study conducted by Carlson et al., (2020), a dot probe paradigm was used and this included relatively short trial times (500ms v. 4000ms). Longer trial times could allow for an initial fixation upon the positive climate change images in line with the hypothesis, but this effect is then obfuscated through avoidance of the positive image due to inhibition of return (IOR) effects during the rest of the trial time (Klein & Ivanoff, 2008).

IOR refers to the suppression of attention to stimuli which were previously attended to. Since trial times were longer in the present study, compared to previous research in attention bias to climate change images, this may allow for participants to initially fixate upon the positive climate change image and then disengage from those images and reorient attention elsewhere. Additionally, the previous studies used dot probe paradigms, which tend to measure initial fixations on an image; whereas the present research allows for greater time to scan the images presented. This could be explored by looking at gaze patterns during each of the trials (i.e., the order of fixations), however, is outside the scope of the present study. Future analysis of the available data should look at fixation patterns or first half trial dwell time. If findings demonstrate a reliable pattern of initial fixations upon the positive climate change images, or dwell time within the first half of the trial, it could be argued to support the initial hypotheses. The IOR hypothesis does provide some explanation for why our results are somewhat contrary to other findings. Unfortunately, it is not an unflawed hypothesis. There exists a substantial body of research using similar methods to those used in the present study and there does not appear to be

any sort of IOR effects in this prior research. To further complicate matters, each image, both climate relevant and irrelevant were shown twice, which could result in greater IOR effects upon the second viewing of the images.

*H<sub>a</sub> = “A positive correlation will be found between NEP scores and attention bias to climate change images”*

H<sub>a</sub> was not supported since no relationship was present between attention bias to climate change images and NEP scores. This is despite controlling for group assignment to either pride or guilt. However, a small statistically significant difference in NEP scores existed between the pride and guilt conditions. This may indicate that the induction condition altered NEP responding, however, even controlling for group assignment using a partial correlation, there remained no relationship between attention bias and NEP scores.

It was believed that a significant, positive relationship between NEP scores and attention bias to climate change images would be present due to earlier findings providing similar results (Carlson et al., 2019); however, it should be noted that in another study, the relationship between attention bias to climate change images and NEP scores was reversed (Carlson et al., 2020). The opposing findings between the two older studies suggest that the relationship between NEP scores and climate attention bias is broadly unreliable between samples. It is possible that the inducement procedure altered the results of the NEP scores, and this is partly supported, since pride induced participants demonstrated a statistically lower score than the participants in the guilt condition; however, it should be noted that the difference is small, but nevertheless interesting and should be further explored. Attempts were made to evaluate the possibility that the affective inducements produced some artifacts responsible for the discrepancy of results. A

partial correlation was conducted between attention bias to climate images and NEP score while controlling for group assignment; however, this correlation was also found to be non-significant.

Without further exploration it is impossible to say for certain, but a speculative reasoning for the difference in responding is due to the guilt induction increasing overall concern for the environment and the pride condition reducing overall concern for the environment; however, this is in opposition to a study using the same affective inducements, which found that participants, when exposed to the pride inducement, were more likely to engage in self-reported pro-environmental behaviors (C. R. Schneider et al., 2017). The difference in NEP scores should be further explored when considering affective inducements of pride and guilt.

### **Limitations**

This study is limited by a number of factors. First, no difference was found in the manipulation check between the two conditions. This could show that the inducement conditions were ineffective in adequately inducing the targeted emotions but could also be the result of the delay between the affective induction occurring and the manipulation check being performed. This is likely, since an identical inducement procedure was used in this study as was described in Schneider et al., (2017); In which, a significant difference was detected through the use of a very similar manipulation check. The primary difference between the current study and Schneider et al., (2017) is the length of time between inducement and manipulation check. In the Schneider et al. study, the manipulation check was performed shortly after participants completed short self-report measures, whereas, in the present study, a sizable gap in time was present between the inducement and the manipulation check since the task was of a longer length. This could result in any effect from the affective inducements ceasing to be detectable once the manipulation check was performed. It is also worth pointing out that the Schneider et al., (2017) study had a much

larger sample (1050 participants through Amazon's Mechanical Turk) which would allow for the detection of very small effects, whereas the present study was substantially smaller. Regardless, this result makes drawing strong conclusions from the attention bias results difficult.

Future research should look to reduce the time between affective induction procedure and the manipulation check to ensure that any condition effects are adequately measured. This poses challenges for studies looking to use similar structures to the present research since free-viewing tasks are inherently lengthy. A possible solution is to modify the affective induction process itself to include both pride and guilt on the same sliding scale (e.g., 1 being extremely guilty, and 9 being extremely proud), but keep the content of the vignettes the same. This would at least provide a relative score to compare between the two conditions; however, it is also possible that the small modification of the wording could limit the potency of the induction. Another direction worth pursuing would be to include a baseline measure of affective state prior to the affective induction procedure and the manipulation check. This would allow for a pre-test & post-test point of comparison using the manipulation check and baseline measurement as opposed to the comparisons in the reported pride and guilt between the two experimentally manipulated groups.

In the same vein, the lack of a control group (i.e., a group that receives a neutral inducement) makes drawing strong inferences from the inducement conditions difficult. A control group was not used due to recruitment limitations. There was also a shortage of climate change images that had been previously rated for valence and relevance to climate change, which then required the use of duplicate images. This could complicate results particularly when factoring IOR effects since images will no longer be novel after their first viewing. Further, we were limited in sample demographics. Almost all of the participants recruited to participate were young, liberal, female, and all were college students. This limits the applicability of the results to

a wider population. Due to the wide disparity between the group sizes with regard to political orientation, analyzing group differences would result in greatly underpowered and inappropriate with the present dataset.

Multiple indices were developed for attention bias and only one was found to produce a significant difference in attention bias between the affective inducement conditions. This could, again, suggest that the inducement conditions were not effective in inducing the targeted emotions, or that the effects they do produce are so minute they only create extremely small differences in attention bias between climate relevant and climate irrelevant images. The selected affective inducements are also more abstract emotional states, which could be complicating our results. Since pride and guilt are rather nuanced affective states, it muddies the interpretation of the results when assessing between group effects and attention bias to the climate change images. It is possible that “pride” is simply internalized as a vaguely positive affective state and this positive feeling is the primary driver of our main effects, or it could be that there is a unique quality of pride that is driving our effects. The same can also be said for the guilt condition in that it is possible that “guilt” is internalized as a negative emotion and that is a primary drive of our results, or there could be some underlying unique quality of “guilt” that is responsible for our findings. Pride, within the present study, is more important when considering the relative positive nature of the emotion vs any unique qualities of it, since guilt did not appear to meaningfully change attention bias between the relevant and irrelevant images.

### **Future directions**

There are several future directions available following the conclusions of this study. Since threat has been a significant point of interest related to attention bias, assessments should be conducted to measure the level of perceived threat posed by the climate images used. This

data will inform how these images are viewed and why they may catch attention in the unique ways that have been detected in the present research. Additionally, future analysis of the current data set should look to assess the patterns of image viewing (i.e., the order of fixations during the trial) of the participants. This could provide evidence either for or against the vigilance avoidance theory of attention bias to threatening images. Since vigilance avoidance posits that attention is initially biased toward threatening images and, after an initial viewing, attention is then biased away from the threatening image. In the same vein, additional indices of attention bias should be used for assessing the present data set. For example, proportional attention bias can be calculated with the time spent on the relevant image divided by the summed total of dwell time on the relevant and irrelevant image. The present study used total dwell time on the relevant image divided by the total trial length. The differences between the two methods is subtle, but using the alternative method, it is possible to account for the time spent dwelling outside the ROIs. This method could provide a more sensitive method of gauging attention bias with the removal of fixations outside of the established ROIs.

Further assessment should be conducted with other affective inducements, and with equivalent numbers of conservatives and liberals. Simply inducing a more generic feeling of “good” vs “bad” (similar to Rothermund et al., 2008) would make drawing strong conclusions from the viewing patterns of the climate change images easier; alternatively, a wide variety of affective inducements could be used. This would then allow for a multitude of points of comparison, but this would also require a large increase in total  $N$ . In the same vein, future studies should seek to gather further affective scores for the images used. This could include the perceived threat from the images, if the images induce feelings of anxiety, or even if they invoke anger. This would then offer multiple points of comparison between the affective qualities of the



images versus various pre-task inducements. The present research included items related to the relative pleasantness of images presented for each trial. Each image pair was rated as equally pleasant, or not equally pleasant. This was meant to distract from the true purpose of the present study but could offer another point of study in the future. This could involve removing trials in which the images were rated as differentially pleasant. Removing these trials would control for differences in overall pleasantness, and greater variance would be accounted for by the experimentally induced emotions. In a separate future study, other stimulus specific differences, like visual complexity should also be measured and again controlled for, again, this would increase the amount of variance accounted for through the experimental inducements.

Between the inducements, there was also a significant difference in NEP reporting, which offers another avenue of future research. This would likely resemble a replication of the study conducted by Schneider et al., (2017), but include self-report measures like the NEP and climate anxiety index. With the present data set, another future direction includes assessing correlations between attention bias and NEP scores, but between the two inducement conditions.

Additionally, there should be assessment of the same relationship, but between the positive and negative target images. There is evidence to suggest that political orientation plays a significant role in biasing attention to climate change images (Luo & Zhao, 2019). As mentioned above, the present sample was composed primarily of liberals, making any analysis of group differences impossible. A sample with an adequate mix of conservatives and liberals would be extremely useful in determining which affective inducement(s) is/are most effective in biasing attention between the two groups.

Finally, future research should use an updated database of climate relevant images as the images collected and rated for the present research were gathered almost half a decade ago

(Lehman et al., 2019). Even in this relatively short period of time, there have been significant changes surrounding climate change and the issues that have been most prominent. For example, in the present selection of images, there is a picture of Al Gore, and, rather humorously, this image is considered to be “low” in relevance to climate change. Clearly, the issues surrounding climate change have evolved and our research should evolve as well. Another area of climate change that would be worth investigating in this body of study is nuclear energy. Nuclear energy is a hotly contested form of energy production, among both environmentalists and those in the oil and gas industry. No images of nuclear power plants were present in any of the trials, so future studies should include them due to the relative affective ambiguity of them.

## CONCLUSIONS

This study has elucidated several interesting effects that pose difficult to interpret implications. We found significant effects for both our affective induction and trial type; however, many of these effects were in an unexpected direction. Interaction effects were also found to be non-significant, making some interpretations inappropriate. In the case of the present study, participants induced to experience pride demonstrated a significant attention bias away from the climate change images, and a preference for the irrelevant images. Whereas the guilt induced participants viewed the irrelevant and climate relevant images an (approximately) equivalent amount of time. Dwell time differences between the positive and negative trial types reveal that the negatively valenced climate change images elicited greater attention bias.

Due to the non-significant interaction effects, it is impossible to make strong simple effect conclusions. Although there appears to be an apparent increase in attention bias to the negative climate change images when participants were induced to experience guilt. These findings have many implications for how effective communication regarding climate change should be done; specifically, what affective qualities should be used in communicating issues related to climate change? Despite the non-significant interaction effects, a purely visual assessment of the dwell time difference scores, stratified across the positive and negative trial types, suggest the possibility that inducing feelings of guilt and using images with a negative affective valence is most effective at guiding attention to climate change images. This claim requires further investigation including larger sample sizes, and a paired sample t test between the positive & negative trial types within the guilt induced group. Additionally, further gaze

pattern analysis should be conducted to weed out possible IOR effects. It is possible that, due to the longer trial time, participants initially attended to the images in line with the hypotheses, but then attention was moved towards the other image and never returned due to IOR effects. Future analysis should assess attention bias indices using only the first half of the trial time to account for avoidance of target images resulting from IOR effects.

Finally, attention bias to the climate change images is independent of a pro-ecological worldview, as measured by the NEP, which suggests that the individual differences in ecological worldview are not the primary driving factors for the observed differences in attention bias effects. Interestingly, participants exposed to the pride condition reported lower scores on the NEP than participants in the guilt condition. This suggests that either a prideful affective state diminishes a pro-ecological worldview, or guilt encourages a pro-ecological worldview. Regardless, the multitude of findings covered in the present study have fascinating implications and ask several questions worth exploring in future research. Affect is a woefully understudied avenue of attention bias modification and offers many new ways to change how we view the world.

## REFERENCES

- Anderson, M. (2012). New Ecological Paradigm (NEP) Scale. *Berkshire Encyclopedia of Sustainability*, 6, 260–262.
- Armstrong, T., & Olatunji, B. O. (2012). Eye tracking of attention in the affective disorders: A meta-analytic review and synthesis. *Clinical Psychology Review*, 32(8), 704–723. <https://doi.org/10.1016/j.cpr.2012.09.004>
- Azriel, O., & Bar-Haim, Y. (2020). Attention bias. In *Clinical handbook of fear and anxiety: Maintenance processes and treatment mechanisms* (pp. 203–218). American Psychological Association. <https://doi.org/10.1037/0000150-012>
- Baumeister, R. F., Stillwell, A. M., & Heatherton, T. F. (1994). Guilt: An interpersonal approach. *Psychological Bulletin*, 115(2), 243–267. <https://doi.org/10.1037/0033-2909.115.2.243>
- Blanchette, I. (2006). Snakes, spiders, guns, and syringes: How specific are evolutionary constraints on the detection of threatening stimuli? *Quarterly Journal of Experimental Psychology* (2006), 59(8), 1484–1504. <https://doi.org/10.1080/02724980543000204>
- Carlson, J. M., Fang, L., Coughtry-Carpenter, C., & Foley, J. (2023). Reliability of attention bias and attention bias variability to climate change images in the dot-probe task. *Frontiers in Psychology*, 13, 1021858. <https://doi.org/10.3389/fpsyg.2022.1021858>
- Carlson, J. M., Kaull, H., Steinhauer, M., Zigarac, A., & Cammarata, J. (2020). Paying attention to climate change: Positive images of climate change solutions capture attention. *Journal of Environmental Psychology*, 71, 101477. <https://doi.org/10.1016/j.jenvp.2020.101477>
- Carlson, J. M., Lehman, B. R., & Thompson, J. L. (2019). Climate change images produce an attentional bias associated with pro-environmental disposition. *Cognitive Processing*, 20(3), 385–390. <https://doi.org/10.1007/s10339-019-00902-5>
- Carlson, J. M., Voltz, M., Foley, J., Gentry, L., & Fang, L. (2022). Changing how you look at climate change: Attention bias modification increases attention to climate change. *Climatic Change*, 175(3), 16. <https://doi.org/10.1007/s10584-022-03471-3>
- Clayton, S., & Karazsia, B. T. (2020). Development and validation of a measure of climate change anxiety. *Journal of Environmental Psychology*, 69, 101434. <https://doi.org/10.1016/j.jenvp.2020.101434>
- Cohen, G. L., & Sherman, D. K. (2014). The Psychology of Change: Self-Affirmation and Social Psychological Intervention. *Annual Review of Psychology*, 65(1), 333–371. <https://doi.org/10.1146/annurev-psych-010213-115137>
- Cristea, I. A., Kok, R. N., & Cuijpers, P. (2015). Efficacy of cognitive bias modification interventions in anxiety and depression: Meta-analysis. *The British Journal of Psychiatry*, 206(1), 7–16. <https://doi.org/10.1192/bjp.bp.114.146761>

- Cristea, I. A., Mogoșe, C., David, D., & Cuijpers, P. (2015). Practitioner Review: Cognitive bias modification for mental health problems in children and adolescents: a meta-analysis. *Journal of Child Psychology and Psychiatry*, 56(7), 723–734. <https://doi.org/10.1111/jcpp.12383>
- Dennis-Tiwary, Deneffrio, & Gelber. (2017). Salutary effects of an attention bias modification mobile application on biobehavioral measures of stress and anxiety during pregnancy. *Biological Psychology*, 127, 148–156. <https://doi.org/10.1016/j.biopsycho.2017.05.003>
- Dunlap, R., Liere, K. D., Mertig, A., & Jones, R. (2000). Measuring Endorsement of the New Ecological Paradigm: A Revised NEP Scale. *Journal of Social Issues*, 56, 425–442.
- Duque, A., & Vázquez, C. (2015). Double attention bias for positive and negative emotional faces in clinical depression: Evidence from an eye-tracking study. *Journal of Behavior Therapy and Experimental Psychiatry*, 46, 107–114. <https://doi.org/10.1016/j.jbtep.2014.09.005>
- Fakana, S. T. (2020). *Causes of Climate Change: Review Article*.
- Field, M., & Eastwood, B. (2005). Experimental manipulation of attentional bias increases the motivation to drink alcohol. *Psychopharmacology*, 183(3), 350–357. <https://doi.org/10.1007/s00213-005-0202-5>
- Field, Marhe, & Franken. (2014). *The clinical relevance of attentional bias in substance use disorders / CNS Spectrums | Cambridge Core*. <https://www.cambridge.org/core/journals/cns-spectrums/article/abs/clinical-relevance-of-attentional-bias-in-substance-use-disorders/F3EACDABBEBC8464A4C6D19CBB32D15A>
- García-Blanco, A., Salmerón, L., & Perea, M. (2015). Attentional capture by emotional scenes across episodes in bipolar disorder: Evidence from a free-viewing task. *Biological Psychology*, 108, 36–42. <https://doi.org/10.1016/j.biopsycho.2015.03.010>
- Geoffrey Beattie, & Laura McGuire. (2012). See no evil? Only implicit attitudes predict unconscious eye movements towards images of climate change. *Semiotica*, 2012(192), 315–339. <https://doi.org/10.1515/sem-2012-0066>
- Gustafson, A., Rosenthal, S., Leiserowitz, A., Maibach, E., Kotcher, J., Ballew, M., & Goldberg, M. (2018). The Green New Deal has Strong Bipartisan Support. *Yale Program on Climate Change Communication*. <https://climatecommunication.yale.edu/publications/the-green-new-deal-has-strong-bipartisan-support/>
- Haines, A. (2004). Health Effects of Climate Change. *JAMA*, 291(1), 99. <https://doi.org/10.1001/jama.291.1.99>
- Higgins, E. T. (1987). Self-discrepancy: A theory relating self and affect. *Psychological Review*, 94(3), 319–340.
- Inflation Reduction Act Guidebook | Clean Energy*. (2023). The White House. <https://www.whitehouse.gov/cleanenergy/inflation-reduction-act-guidebook/>
- Intergovernmental Panel On Climate Change (Ippc). (2023). *Climate Change 2022 – Impacts, Adaptation and Vulnerability: Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (1st ed.). Cambridge University Press.

<https://doi.org/10.1017/9781009325844>

- Isbell, L. A. (2006). Snakes as agents of evolutionary change in primate brains. *Journal of Human Evolution*, 51(1), 1–35. <https://doi.org/10.1016/j.jhevol.2005.12.012>
- Kaddo, J. R. (2016). *Climate Change: Causes, Effects, and Solutions*.
- Klein, R. M., & Ivanoff, J. (2008). Inhibition of return. *Scholarpedia*, 3(10), 3650. <https://doi.org/10.4249/scholarpedia.3650>
- Lehman, B., Thompson, J., Davis, S., & Carlson, J. M. (2019). Affective Images of Climate Change. *Frontiers in Psychology*, 10. <https://www.frontiersin.org/articles/10.3389/fpsyg.2019.00960>
- Leung, K.-K., Lee, T. M. C., Yip, P., Li, L. S. W., & Wong, M. M. C. (2009). Selective attention biases of people with depression: Positive and negative priming of depression-related information. *Psychiatry Research*, 165(3), 241–251. <https://doi.org/10.1016/j.psychres.2007.10.022>
- Luo, Y., & Zhao, J. (2019). Motivated Attention in Climate Change Perception and Action. *Frontiers in Psychology*, 10. <https://www.frontiersin.org/articles/10.3389/fpsyg.2019.01541>
- MacLeod, C., & Clarke, P. J. F. (2015). The Attentional Bias Modification Approach to Anxiety Intervention. *Clinical Psychological Science*, 3(1), 58–78. <https://doi.org/10.1177/2167702614560749>
- MacLeod, C., & Mathews, A. (1988). Anxiety and the allocation of attention to threat. *The Quarterly Journal of Experimental Psychology Section A*, 40(4), 653–670. <https://doi.org/10.1080/14640748808402292>
- MacLeod, C., & Mathews, A. (2012). Cognitive Bias Modification Approaches to Anxiety. *Annual Review of Clinical Psychology*, 8(1), 189–217. <https://doi.org/10.1146/annurev-clinpsy-032511-143052>
- Mathews, A., & MacLeod, C. (1994). Cognitive approaches to emotion and emotional disorders. *Annual Review of Psychology*, 45, 25. <https://doi.org/10.1146/annurev.ps.45.020194.000325>
- Meis-Harris, J., Eyssel, F., & Kashima, Y. (2021). Are you paying attention? How pro-environmental tendencies relate to attentional processes. *Journal of Environmental Psychology*, 74, 101591. <https://doi.org/10.1016/j.jenvp.2021.101591>
- Mogg, K., & Bradley, B. P. (2016). Anxiety and attention to threat: Cognitive mechanisms and treatment with attention bias modification. *Behaviour Research and Therapy*, 87, 76–108. <https://doi.org/10.1016/j.brat.2016.08.001>
- Most, S. B., Smith, S. D., Cooter, A. B., Levy, B. N., & Zald, D. H. (2007). The naked truth: Positive, arousing distractors impair rapid target perception. *Cognition and Emotion*, 21(5), 964–981. <https://doi.org/10.1080/02699930600959340>
- Mukherji, A., Thorne, P., Cheung, W. W. L., Connors, S. L., Garschagen, M., Geden, O., Hayward, B., Simpson, N. P., Totin, E., Blok, K., Eriksen, S., Fischer, E., Garner, G., Guivarch, C., Haasnoot, M., Hermans, T., Ley, D., Lewis, J., Nicholls, Z., ... Yassaa, N. (2022). *SYNTHESIS REPORT OF THE IPCC SIXTH ASSESSMENT REPORT (AR6)*.

- Pittock, A. B. (2009). *Climate change: The science, impacts and solutions* (2. ed). Earthscan.
- R Core Team. (n.d.). *R: A language and Environment for Statistical Computing* (R-4.3.1) [Computer software]. R Foundation for Statistical Computing. <https://www.R-project.org/>
- Rothermund, K., Voss, A., & Wentura, D. (2008). Counter-regulation in affective attentional biases: A basic mechanism that warrants flexibility in emotion and motivation. *Emotion*, 8(1), 34–46. <https://doi.org/10.1037/1528-3542.8.1.34>
- Schmukle, S. C. (2005). Unreliability of the dot probe task. *European Journal of Personality*, 19(7), 595–605. <https://doi.org/10.1002/per.554>
- Schneider, C. R., Zaval, L., Weber, E. U., & Markowitz, E. M. (2017). The influence of anticipated pride and guilt on pro-environmental decision making. *PLOS ONE*, 12(11), e0188781. <https://doi.org/10.1371/journal.pone.0188781>
- Schneider, S. H. (2001). *What is 'dangerous' climate change? 411*.
- Schröter, I., Grillo, N. R., Limpak, M. K., Mestiri, B., Osthold, B., Sebti, F., & Mergenthaler, M. (2021). Webcam Eye Tracking for Monitoring Visual Attention in Hypothetical Online Shopping Tasks. *Applied Sciences*, 11(19), Article 19. <https://doi.org/10.3390/app11199281>
- Shechner, T., Jarcho, J. M., Britton, J. C., Leibenluft, E., Pine, D. S., & Nelson, E. E. (2013). Attention Bias of Anxious Youth During Extended Exposure of Emotional Face Pairs: An Eye-Tracking Study. *Depression and Anxiety*, 30(1), 14–21. <https://doi.org/10.1002/da.21986>
- Skinner, I. W., Hübscher, M., Moseley, G. L., Lee, H., Wand, B. M., Traeger, A. C., Gustin, S. M., & McAuley, J. H. (2018). The reliability of eyetracking to assess attentional bias to threatening words in healthy individuals. *Behavior Research Methods*, 50(5), 1778–1792. <https://doi.org/10.3758/s13428-017-0946-y>
- Smith, N. K., Larsen, J. T., Chartrand, T. L., Cacioppo, J. T., Katafiasz, H. A., & Moran, K. E. (2006). Being bad isn't always good: Affective context moderates the attention bias toward negative information. *Journal of Personality and Social Psychology*, 90(2), 210–220. <https://doi.org/10.1037/0022-3514.90.2.210>
- Soares, S. C., Lindström, B., Esteves, F., & Öhman, A. (2014). The Hidden Snake in the Grass: Superior Detection of Snakes in Challenging Attentional Conditions. *PLOS ONE*, 9(12), e114724. <https://doi.org/10.1371/journal.pone.0114724>
- Soleymani, A., Ivanov, Y., Mathot, S., & De Jong, P. J. (2020). Free-viewing multi-stimulus eye tracking task to index attention bias for alcohol versus soda cues: Satisfactory reliability and criterion validity. *Addictive Behaviors*, 100, 106117. <https://doi.org/10.1016/j.addbeh.2019.106117>
- Steele, C. M. (1988). The Psychology of Self-Affirmation: Sustaining the Integrity of the Self. In *Advances in Experimental Social Psychology* (Vol. 21, pp. 261–302). Elsevier. [https://doi.org/10.1016/S0065-2601\(08\)60229-4](https://doi.org/10.1016/S0065-2601(08)60229-4)
- Streicher, M. C., Estes, Z., & Büttner, O. B. (2021). Exploratory Shopping: Attention Affects In-Store Exploration and Unplanned Purchasing. *Journal of Consumer Research*, 48(1), 51–76. <https://doi.org/10.1093/jcr/ucaa054>



- Syvitski, J., Waters, C. N., Day, J., Milliman, J. D., Summerhayes, C., Steffen, W., Zalasiewicz, J., Cearreta, A., Gałuszka, A., Hajdas, I., Head, M. J., Leinfelder, R., McNeill, J. R., Poirier, C., Rose, N. L., Shotyk, W., Wagreich, M., & Williams, M. (2020). Extraordinary human energy consumption and resultant geological impacts beginning around 1950 CE initiated the proposed Anthropocene Epoch. *Communications Earth & Environment*, 1(1), Article 1.  
<https://doi.org/10.1038/s43247-020-00029-y>
- Tapper, K., Pothos, E. M., & Lawrence, A. D. (2010). Feast your eyes: Hunger and trait reward drive predict attentional bias for food cues. *Emotion (Washington, D.C.)*, 10(6), 949–954.  
<https://doi.org/10.1037/a0020305>
- Tollefson, J. (2019). Humans are driving one million species to extinction. *Nature*, 569(7755), 171–171.  
<https://doi.org/10.1038/d41586-019-01448-4>
- Tyson, A., Funk, C., & Kennedy, B. (2023). What the data says about Americans' views of climate change. *Pew Research Center*. <https://www.pewresearch.org/short-reads/2023/08/09/what-the-data-says-about-americans-views-of-climate-change/>
- Van Strien, J. W., & Isbell, L. A. (2017). Snake scales, partial exposure, and the Snake Detection Theory: A human event-related potentials study. *Scientific Reports*, 7(1), Article 1.  
<https://doi.org/10.1038/srep46331>
- Vogt, J., Lozo, L., Koster, E. H. W., & De Houwer, J. (2011). On the role of goal relevance in emotional attention: Disgust evokes early attention to cleanliness. *Cognition and Emotion*, 25(3), 466–477.  
<https://doi.org/10.1080/02699931.2010.532613>
- Weierich, M. R., Treat, T. A., & Hollingworth, A. (2008). Theories and measurement of visual attentional processing in anxiety. *Cognition & Emotion*, 22(6), 985–1018.  
<https://doi.org/10.1080/02699930701597601>

## APPENDIX A

### **Guilt Inducement:**

#### **Scenario 1:**

Imagine that you are the head of a small start-up company that is deciding whether or not to enact environmentally friendly practices. These include providing recycling bins throughout the office and introducing a reusable mug policy in the staff kitchen area. Recycling reduces waste that has to be burned and conserves resources. Reusable mugs avoid the use of Styrofoam cups which are bad for the environment since they never decompose. However, if you choose to enact green practices you have to stay 10min longer at the end of the day each day to ensure that the dishwasher is loaded and started and you have to get to work 15min earlier every day to make sure that the recycling bins are set up properly and to unload the dishwasher. If you stick with the regular trash bins and the Styrofoam cups in the staff kitchen, you would not have to spend the extra time.

**Imagine you choose to stick with using regular trash bins and Styrofoam cups. How guilty would you feel after having made this decision?**

**How guilty would you feel after having made this decision?**

9-point scale: not at all guilty- extremely guilty

1 - Not at all guilty      2      3      4      5      6      7      8      9 - Extremely guilty

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**Scenario 2:** Imagine that you are buying a new car. You could buy an environmentally friendly, highly fuel efficient car (such as a hybrid vehicle), which is much better for the environment, and reduces local air pollution by reducing vehicle emissions. However this type of vehicle is also significantly more costly. Or you could purchase a cheaper but less fuel efficient vehicle, freeing up that money to be put to other “better” uses right away.

**Imagine you choose the cheaper, less fuel-efficient vehicle. How guilty would you feel after having made this decision?**

**9-point scale: not at all guilty- extremely guilty**

1 - Not at all guilty      2      3      4      5      6      7      8      9 - Extremely guilty

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**Scenario 3-5:** For the next set of questions, we want you to consider that you are shopping for three products: (a) a dishwasher, (b) a household cleaner, and (c) a backpack.

**Scenario 3:** Imagine that you are out shopping for a dishwasher, and you are choosing between two kinds. Below are brief descriptions of the two products that you are choosing between. Please read them carefully.

**PRODUCT A**

**Sub-Zero ED40 Elite Dishwasher (\$1,100)**

- Comes in choice of stainless steel or white exterior with black chrome trim
- Features a revolutionary heated drying system that eliminates water spots
- Has powerful water sprays but produces no sound

**PRODUCT B**

**Sub-Zero Eco-Friendly Dishwasher (\$1,100) **

- Has a standard 40-minute running cycle
- Uses a recirculating water system to save water
- Is made with recycled components

**Now imagine that you choose to select the Sub-Zero ED40 Elite Dishwasher. Imagine how guilty you would feel having made this decision. On the scale below, indicate the level of guilt you predict you would feel.**

**9-point scale: not at all guilty- extremely guilty**

1 - Not at all guilty      2      3      4      5      6      7      8      9 - Extremely guilty

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**Scenario 4:** Imagine that you are out shopping for a household cleaner, and you are choosing between two types. Below are brief descriptions about the two cleaners that you are choosing between. Please read them carefully.

**PRODUCT A**

**Lysol Industrial Strength Household Cleaner (\$7)**

- Awarded most effective cleaner on the market award
- Chemically engineered to cut through the toughest grease, rust and mold
- Kills 99.9% of germs on contract

**PRODUCT B**

**Lysol Natural Household Cleaner (\$7)** 

- Made from biodegradable nontoxic materials
- Contains no acids, dyes, or harsh chemicals
- Not tested on animals

**Now imagine that you choose to select the Lysol Industrial Strength Household Cleaner. Imagine how guilty you would feel having made this decision. On the scale below, please indicate the level of guilt you predict you would feel.**

**9-point scale: not at all guilty- extremely guilty**

1 - Not at all guilty      2      3      4      5      6      7      8      9 - Extremely guilty

---

**Scenario 5:** Imagine that you are out shopping for a backpack, and you are choosing between two kinds. Below are brief descriptions of the two backpacks that you are choosing between. Please read them carefully.

**PRODUCT A**

**North Face Ultra-Strength backpack (\$64)**

- Contains eight different storage compartments for maximum versatility
- Stylish design crafted with water-resistant coating
- Solid construction lasts twice as long as the next leading brand on the market

**PRODUCT B**

**North Face Eco-Life backpack (\$64) **

- Made from 100% organic and recycled fibers
- Utilitarian design minimizes waste in the construction process
- Comes with instructions on how to recycle the backpack when you are done with it

**Now imagine that you choose to select the North Face Ultra-Strength backpack. Imagine how guilty you would feel having made this decision. On the scale below, please indicate the level of guilt you predict you would feel.**

**9-point scale: not at all guilty- extremely guilty**

1 - Not at all guilty      2      3      4      5      6      7      8      9 - Extremely guilty

## APPENDIX B

### **Pride Inducement:**

#### **Scenario 1:**

Imagine that you are the head of a small start-up company that is deciding whether or not to enact environmentally friendly practices. These include providing recycling bins throughout the office and introducing a reusable mug policy in the staff kitchen area. Recycling reduces waste that has to be burned and conserves resources. Reusable mugs avoid the use of Styrofoam cups which are bad for the environment since they never decompose. However, if you choose to enact green practices you have to stay 10min longer at the end of the day each day to ensure that the dishwasher is loaded and started and you have to get to work 15min earlier every day to make sure that the recycling bins are set up properly and to unload the dishwasher. If you stick with the regular trash bins and the Styrofoam cups in the staff kitchen, you would not have to spend the extra time.

**Imagine you choose to enact green practices by providing recycling bins and introducing a reusable mug policy.**

**How proud would you feel after having made this decision?**

**9-point scale: not at all proud - extremely proud**

1 - Not at all proud      2      3      4      5      6      7      8      9 - Extremely proud

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**Scenario 2:** Imagine that you are buying a new car. You could buy an environmentally friendly, highly fuel efficient car (such as a hybrid vehicle), which is much better for the environment, and reduces local air pollution by reducing vehicle emissions. However this type of vehicle is also significantly more costly. Or you could purchase a cheaper but less fuel efficient vehicle, freeing up that money to be put to other “better” uses right away.

**Imagine you choose the hybrid vehicle. How proud would you feel after having made this decision?**

**9-point scale: not at all proud - extremely proud**

1 - Not at all proud      2      3      4      5      6      7      8      9 - Extremely proud

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**Scenario 3-5:** For the next set of questions, we want you to consider that you are shopping for three products: (a) a dishwasher, (b) a household cleaner, and (c) a backpack.

**Scenario 3:** Imagine that you are out shopping for a dishwasher, and you are choosing between two kinds. Below are brief descriptions of the two products that you are choosing between. Please read them carefully.

**PRODUCT A**

**Sub-Zero ED40 Elite Dishwasher (\$1,100)**

- Comes in choice of stainless steel or white exterior with black chrome trim
- Features a revolutionary heated drying system that eliminates water spots
- Has powerful water sprays but produces no sound

**PRODUCT B**

**Sub-Zero Eco-Friendly Dishwasher (\$1,100) **

- Has a standard 40-minute running cycle
- Uses a recirculating water system to save water
- Is made with recycled components

**Now imagine that you choose to select the *Sub-Zero Eco-Friendly Dishwasher*. Imagine how proud you would feel having made this decision. On the scale below, indicate the level of pride you predict you would feel.**

**9-point scale: not at all proud - extremely proud**

1 - Not at all proud      2      3      4      5      6      7      8      9 - Extremely proud

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**Scenario 4:** Imagine that you are out shopping for a household cleaner, and you are choosing between two types. Below are brief descriptions about the two cleaners that you are choosing between. Please read them carefully.

**PRODUCT A**

**Lysol Industrial Strength Household Cleaner (\$7)**

- Awarded most effective cleaner on the market award
- Chemically engineered to cut through the toughest grease, rust and mold
- Kills 99.9% of germs on contract

**PRODUCT B**

**Lysol Natural Household Cleaner (\$7)** 

- Made from biodegradable nontoxic materials
- Contains no acids, dyes, or harsh chemicals
- Not tested on animals

**Now imagine that you choose to select the *Lysol Natural Household Cleaner*. Imagine how proud you would feel having made this decision. On the scale below, please indicate the level of pride you predict you would feel.**

**9-point scale: not at all proud - extremely proud**

1 - Not at all proud      2      3      4      5      6      7      8      9 - Extremely proud

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**Scenario 5:** Imagine that you are out shopping for a backpack, and you are choosing between two kinds. Below are brief descriptions of the two backpacks that you are choosing between. Please read them carefully.

**PRODUCT A**

**North Face Ultra-Strength backpack (\$64)**

- Contains eight different storage compartments for maximum versatility
- Stylish design crafted with water-resistant coating
- Solid construction lasts twice as long as the next leading brand on the market

**PRODUCT B**

**North Face Eco-Life backpack (\$64)** 

- Made from 100% organic and recycled fibers
- Utilitarian design minimizes waste in the construction process
- Comes with instructions on how to recycle the backpack when you are done with it

**Now imagine that you choose to select the *North Face Eco-Life backpack*. Imagine how proud you would feel having made this decision. On the scale below, please indicate the level of pride you predict you would feel.**

**9-point scale: not at all proud - extremely proud**

1 - Not at all proud      2      3      4      5      6      7      8      9 - Extremely proud

## APPENDIX C



Graduate Studies and Research  
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### Memorandum

**TO:** Joshua Carlson  
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Jimmy Martin  
Grace Westerick  
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Josh Yang  
Nina Ratulowski  
Alyssa Ingrodi  
Anna Patterson  
Lin Fang

**DATE:** February 9, 2023

**FROM:** Lisa Schade Eckert  
Dean of Graduate Studies and Research

**SUBJECT:** **IRB Proposal HS23-1363**  
**IRB Approval Date 2/9/2023**  
Proposed Project Dates: **1/1/2023-12/30/2023**  
"Eye tracking Assessments of Attention Toward Complex Images"

Your proposal "Eye tracking Assessments of Attention Toward Complex Images" has been approved by the NMU Institutional Review Board. Include your proposal number (HS23-1363) on all research materials and on any correspondence regarding this project.

- A. If a subject suffers an injury during research, or if there is an incident of non-compliance with IRB policies and procedures, you must take immediate action to assist the subject