INTERACTION OF DISGUST SENSITIVITY AND TYPE OF NATURE EXPOSURE ON MOOD AND ANXIETY

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DEDICATION

For my father, who taught me the power of nature and showed me how everything is connected.

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ABSTRACT

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E. O. Wilson (1984) asserted human beings have an innate tendency to be drawn into an emotional relationship with nature based on our evolutionary history. This relationship with nature has been shown to impact several aspects of psychological well-being and also be impacted by situational and personality factors. The current study investigates the relationship between someone's connection to nature, their sensitivity to disgust, and the way they are exposed to nature, either using technology or physical exposure. This study used a video of a natural area as a technological means of exposing people to nature. Disgust sensitivity, connection to nature and mood were measured using different previously validated scales. Results showed that exposure to nature, regardless of type of exposure, decreased anxiety and negative affect. Technology nature exposure decreased positive affect while physical nature exposure increased positive affect. Disgust and connectedness to nature were not significant predictors of anxiety or mood regardless of exposure type. This research provides future directions for investigating how nature impacts mood.

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CHAPTER I

INTRODUCTION

Perspectives and beliefs about the natural environment vary widely across individuals. Perspectives and beliefs are grounded cognitively, which only allows for part of the human experience. When considering someone's emotional connection to nature, the differences continue. An individual's relationship to nature is going to be characterized by their previous experiences in nature, and how they understand what constitutes the natural environment. The idea of what nature is, holds wide variability from virgin rainforests, never touched by human beings, to nearly domesticated squirrels living in a human-built park in the middle of a bustling urban environment. This variability increases the complexity of human being's relationship to nature since different people could define nature differently.

Regardless of how people understand what nature includes, the type of connection someone has to nature may impact their daily mood and psychological well-being, drastically. Previous research shows a relationship between an individual's exposure to nature and many different psychological constructs including: attentional capacity (Kuo & Taylor, 2004; Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009; Taylor, Kuo, & Sullivan, 2001), mental health symptoms such as depression (South, Hohl, Kondo, MacDonald, & Branas, 2018), mood (Browning et al., 2020), life satisfaction (Mayer & Frantz, 2004), and overall subjective well-being (Passmore & Howell, 2014). Each of

these constructs impacts an individual's daily life and functioning. If the relationship between nature and human beings can be understood, then different interventions may be developed to help improve an individual's mood, utilizing their relationship with nature. Researchers have begun to explore this connection within the field of ecopsychology. Understanding how mood and anxiety is related to nature exposure may help individuals live more fulfilled lives.

To help broaden our understanding of the relationship human beings have with nature, considering the role of technology is crucial. Technology has advanced to the point that stunning and life-like photographs can capture nature's beauty in an instant. Video and virtual reality technology can record nature to create an even more immersive experience. This type of technology allows for interaction with the environment not just with visual stimulus but with auditory stimulus, as well. Unquestionably, technology has impacted human beings' relationship to nature, and this change takes different forms (Louv, 2008). Technology allows us access to some experiences in nature that would be impossible otherwise, such as images of outer space, or a view of the ocean floor. On the other hand, technology may begin to create distance between people and nature. As an example, some children grow up without understanding where vegetables come from before they are sold in a grocery store (Louv, 2008). Technology may serve as a double-edged sword, which can serve to bring people closer to nature or create distance between people and nature.

Technology is not the only important factor when considering the relationship people have with nature. Another important component impacting an individual's relationship to nature is sensitivity to disgust. Disgust has multiple functions. One of the primary functions is identifying and avoiding potentially infectious stimuli (Curtis, Aunger, & Rabie, 2004; Rozin & Fallon, 1987). Disgust sensitivity refers to how attuned an individual is to their environment and the intensity of the emotional response they feel when confronted with disgust-salient information (Shook, Thomas, & Ford, 2019). Disgust sensitivity is a trait that varies widely among people. Some individuals are more attuned to external stimuli that elicit disgust than others, naturally. Different experiences, like previous experiences and belief systems, also impact an individual's sensitivity to disgust. Many disgust-salient stimuli can be found in natural settings, such as fecal matter and insects. When people are physically present in a natural environment, they are likely to come across some disgust-salient stimuli. If being in nature elicits a disgust response, an individual's experience of nature will be impacted. Thus, disgust sensitivity may impact the relationship between nature and mood and anxiety.

Connectedness to nature, the use of technology, and disgust sensitivity are three important factors that may influence the relationship people have with nature. This relationship is crucial because exposure to nature is related to emotional and cognitive well-being as well as overall mental health. The current study explored the interactions between disgust sensitivity, type of nature exposure, and connectedness to nature, as well as how these different variables impact mood and anxiety.

CHAPTER II

LITERATURE REVIEW

The relationship human beings have with the natural world has been explored from many angles throughout history. E. O. Wilson (1984) asserted that human beings yearn for, and seek out, contact with the natural world. Not only do human beings gravitate towards the natural world, but Wilson suggested this gravitation was an evolutionary phenomenon, stemming from the long history of human beings relying on their natural world for their survival. Wilson's argument about the deeply ingrained connection between human beings and the natural world created an epicenter for psychological research into whether this connection exists for all people, and how it defines our lived experiences as human beings.

Wilson's discussion about the relationship human beings have with nature has only become more important as the years have progressed with the continued influx of people living in urban environments and away from the natural world. A national survey showed that people reported spending 87% of their time indoors with an additional 6% in a vehicle (Klepeis et al., 2001). This makes for a staggering 93% of time spent in enclosed spaces with limited direct exposure to nature. Since spending time in nature is related to several positive psychological benefits, some may consider this number deeply disturbing. A lack of contact with nature is associated with negative mental health

symptoms, including an increase in depressive symptoms (South et al., 2018). Cognitive abilities can also be impacted if people do not spend enough time in nature, such that attention capacity, and one's ability to focus may be decreased (Mayer et al., 2009). With these changes and the urbanization of our experience happening so rapidly over the last several years, the exploration of the connection between human beings and the natural world has never been more timely.

People and Nature

Aligning with Wilson's (1984) anecdotal evidence, and his conjecture about the relationship between human beings and nature, empirical research has been conducted on the specific ways the natural environment impacts human beings in regards to physical and psychological well-being. Numerous studies have been conducted examining how exposure to the natural world impacts people. Some research has focused on an individual's specific relationship to nature, described in the literature as connectedness to nature (Mayer & Frantz, 2004). Connectedness to nature can be impacted by factors such as personality (Morton, van der Bles, & Haslam, 2017) and self-awareness (Frantz, Mayer, Norton, & Rock, 2005). Another approach to studying the relationship between nature and human beings is focusing on the impact nature has on people. Research has been conducted on how exposure to nature impacts an individual's psychological well-being (Passmore & Howell, 2014). Finally, nature-related research has been applied clinically, in order to create a new therapeutic approach called ecotherapy (Buzzell & Chalquist, 2010; Chalquist, 2009). The various approaches in the current literature help to

expand our knowledge about how nature impacts human beings and provide an important grounding point for this research.

Connectedness to Nature

Connectedness to nature is simply defined as an individual's emotional experience of nature (Mayer & Frantz, 2004). Feeling a kinship with other living things and understanding how actions impact the environment, are both examples of connectedness to nature (Mayer & Frantz, 2004). It is an inherently individual relationship, which can be influenced by a variety of factors. Previous research has defined and operationalized an individual's connection to nature to the point of creating an empirical measure of connectedness to nature (Frantz & Mayer, 2014). Frantz and Mayer (2014) suggested connection to nature as one of the critical components to eliciting, and predicting pro-environmental behavior, such as electricity conservation.

Part of understanding connectedness to nature as a phenomenon is exploring how connectedness to nature varies among individuals. Research has been conducted exploring which individual factors may influence how connected an individual feels to nature (Frantz et al., 2005). Researchers focused on objective self-awareness (OSA), defined as when an individual sees themselves as the focus and other aspects of their world as the background. Frantz et al. predicted that when OSA increased connectedness to nature would decrease, except when an individual has strong environmental beliefs as part of their personality. This hypothesis was supported by their research indicating that an individual's perception of themselves impacts their overall connectedness to nature.

Aside from perspective, personality also impacts connection to nature. Researchers investigated how narcissistic personality traits impacted connectedness to nature (Frantz et al., 2005). Their results indicated only one component of narcissistic personality created a disconnection with nature, exploitativeness and entitlement. Exploitativeness and entitlement are characterized by a decreased sense of personal responsibility and a lack of tolerance. When participant's scores of exploitativeness and entitlement were elevated, they were less connected with nature (Frantz et al., 2005). These results indicated that our understanding of ourselves and some of our base personality traits impact how connected we feel to nature. The results of these previous studies suggest that connectedness to nature is developed and impacted by perspective and personality factors.

Another important part of perspective on the self is how individuals view their separate identities. Research has been conducted on how an individual's understanding of their identity impacts their relationship to nature (Morton et al., 2017). This research focused on how an individual's different social identities impacted the restorative effects of exposure to nature. Participants were either primed to think of themselves as an "urbanite" or a "ruralite." Researchers found that when the primed identity was congruent with the nature task, the restorative benefits increased (Morton et al., 2017). This research provides more detailed information about how identity impacts the restorative aspects of nature. Connectedness to nature may fluctuate based on which of the individual's identities is primed and at the forefront of one's mind at a given time.

Although some research has been conducted investigating how personality and identity impact connectedness to nature, as yet, limited research has been conducted to explore how different cultural identities (e.g., gender, ethnic background, social class) impact connectedness to nature. Some research has focused on how exposure to nature may alleviate depressive symptoms, specifically for those living in low-income housing (South et al., 2018), while other research has focused on the role gender and income play in reducing attention-deficit hyperactivity disorder (ADHD) symptoms through nature exposure (Kuo & Taylor, 2004). This research is discussed in further detail later and serves as a first step to investigating different cultural identities. While a detailed exploration of cultural identity is outside of the scope of this project, it exists as a possible future direction for this research.

Nature Exposure and Psychological Well-Being

Psychological well-being is broadly defined as an individual's overall mental and psychological health. This includes cognitive components such as attentional capacity and memory, mindfulness, mental health symptoms such as depression and anxiety, mood and affect, as well as general life satisfaction.

Considering this broad interpretation, psychological well-being has been defined in different ways in previous studies. Specifically, well-being has previously been defined in terms of hedonic and eudaimonic well-being (Passmore & Howell, 2014). Hedonic well-being focuses on emotional well-being and the feeling of pleasure in one’s life and is typically measured by life satisfaction and affect. Eudaimonic well-being

focuses on how one lives one's life, or their overall functioning in social and psychological capacities. Well-being has been measured using positive and negative affect, elevation and meaning. This definition of well-being does not acknowledge cognitive components such as attention and memory but rather focuses on how an individual understands their subjective well-being (Passmore & Howell, 2014).

Attentional capacity. Attention is a cognitive component of psychological well-being. Historically, the restorative impacts of nature have been driven by the attention restoration theory (Kaplan, 1995), which postulates the reasoning behind the restorative aspect of nature is that it provides an opportunity to restore depleted attention reserves. Multiple studies have been conducted investigating how attentional capacity for different individuals can be impacted by exposure to nature, including children diagnosed with attention deficit disorder (ADD), children diagnosed with ADHD, and non-clinically diagnosed adults. This previous research is explored to increase understanding of how exposure to nature impacts attentional capacity.

The first study on the effects of nature exposure on children acknowledges the relationship between exposure to natural spaces and increased attention for nonclinical populations and explored the strength of this relationship for children diagnosed with ADD (Taylor et al., 2001). Parents were asked to assess how their child's behavior changed after completing certain activities, with specific focus on how the child's ADD symptoms were affected. In this study, researchers coded various activities as green, not green, or ambiguous. Specifically, activities were coded as green when they were likely

to take place outside, with examples including camping and playing soccer. The results indicated a decrease in ADD symptoms after children spent time in green spaces (Taylor et al., 2001). This study provided further support for the power of exposure to nature on attentional capacity with clinically diagnosed with an attentional disorder.

A more recent study explored a similar relationship with children who have been diagnosed with an attentional disorder and the effect nature has on their symptoms. The results were similar to the previous study (Taylor et al., 2001), in that ADHD symptoms were reported to have decreased after children were exposed to green outdoor spaces (Kuo & Taylor, 2004). These results expanded on previous work because researchers focused on finding differences between children on a variety of factors, not just focusing on the diagnosis. Results indicated that the reduction of ADHD symptoms did not differ based on the child's age, gender, or income group. This suggests the benefits of exposure to nature are not isolated to a certain cultural identity variable (Kuo & Taylor, 2004). This multicultural focus provides a more nuanced understanding of the relationship between nature exposure and attention.

The last study on nature's impact on attentional capacity focused on adults with no diagnosed attention conditions (Mayer et al., 2009). After exposure to a nature preserve or an urban setting, participants were giving an attentional capacity task. Results indicated that participants had increased attentional capacity after exposure to a natural setting. However, attentional capacity did not predict positive affect, which the researchers were also investigating as part of their study (Mayer et al., 2009). Reviewing

the previous research specifically about attentional capacity shows support for the attention restoration theory and provides an increased understanding of how nature exposure impacts cognitive functioning.

Mindfulness. As a component of attention, mindfulness is another important part of psychological well-being, which may also be related to an individual's relationship to nature. Mindfulness is defined as a specific focus of attention on the present moment (Barbaro & Pickett, 2016). Howell, Dopko, Passmore, and Buro (2011) focused on exploring the relationship between connectedness to nature and mindfulness and found that individuals with greater connection to nature also had greater mindfulness, specifically the awareness component of mindfulness rather than the acceptance component.

Another study explored how mindfulness impacted an individual's pro-environmental behavior (Barbaro & Pickett, 2016). Pro-environmental behaviors were actions, like choosing to recycle or buying environmentally friendly products. Results showed that mindfulness was positively correlated with participants' self-reported pro-environmental behaviors. A further study found that connectedness to nature interacted with mindfulness such that participants with higher degrees of connection to nature and mindfulness, were more likely to report engaging in pro-environmental behaviors (Barbaro & Pickett, 2016). These results indicate that nature exposure increases mindfulness, but also mindfulness can increase pro-environmental attitudes and behaviors.

Life satisfaction. Attention capacity and mindfulness are both factors that are related to exposure to nature and previous research supports nature's positive influence these factors. Life satisfaction is another component of overall subjective well-being which has been explored. Unlike with attentional capacity, results regarding the relationship between connectedness to nature and life satisfaction have been mixed. Life satisfaction serves as a broad indication of psychological well-being, which can be defined in different ways by different sets of researchers. This can make it challenging to have clear and concise results that are consistent across studies. One previous study indicated a positive correlation between connectedness to nature and life satisfaction (Mayer & Frantz, 2004). However, different research indicated no relationship between connectedness to nature and life satisfaction (Leary, Tipsord, & Tate, 2008). The differing results on these studies provided an unclear picture regarding how life satisfaction is related to exposure to nature.

Mood and anxiety. Mood and anxiety are also important factors to explore when considering people's relationship with nature and how they are impacted. As previously mentioned, connectedness to nature is inherently emotional (Mayer & Frantz, 2004). Since the relationship to nature is defined as an emotional one, it is important to explore how nature then impacts people's emotions. Negative affect, positive affect, and stress will be explored specifically to provide a more nuanced understanding of how mood is impacted by exposure to nature.

Negative affect. Negative affect is the subjective experience of distress or emotional discomfort (Watson, Clark, & Tellegen, 1988). Scared, irritable, and guilty are considered types of negative affect. Focusing specifically on how negative affect is impacted by nature exposure will allow further understanding. Previous research showed negative affect decreased after exposure to nature regardless of whether exposure was physical or through technology (Browning et al., 2020).

A recent study gathered participants from low income neighborhoods in order to determine whether exposure to nature might decrease depressive symptoms and feelings of worthlessness (South et al., 2018). The researchers in this study selected three different low income neighborhoods and randomly assigned vacant lots in these neighborhoods to different treatments. Vacant lots were either cleaned of trash; received greening treatment including planting trees, installation of a fence, and routine maintenance; or left as untreated. The randomization of which neighborhoods received each treatment allowed researchers more control in designing the experiment than simply observing an existing situation. The results indicated individuals exposed to green spaces reported less symptoms of depression than those who lived in neighborhoods which were unchanged. Results also indicated no significant difference in reported mental health symptoms between spaces that were simply cleaned of trash and those that received no treatment. This indicated the addition of trees and other plants impacted reported mental health concerns, while simply the clearing of trash, did not. Additionally, these results appear to be the most impactful in neighborhoods including residents who live below the poverty

line (South et al., 2018). Focusing specifically on individuals living in low-income housing allows for a more detailed understanding of how social class, as a cultural identity, may impact the restorative benefits of nature.

Positive affect. Positive affect is the subjective experience of pleasure, high energy, or concentration (Watson et al., 1988). Excited, proud, and determined are considered types of positive affect. Focusing specifically on how positive affect is impacted by nature exposure will allow further understanding. Positive affect increased after being exposed to nature physically (Browning et al., 2020).

Rather than focusing on the reduction of negative symptoms, one study focused on positive affect. After 2 weeks of daily exposure to nature, participants reported having increased positive affect, and increased levels of elevation, defined as "an emotion composed of feelings of warmth, openness, and inspiration" (Passmore & Howell, 2014, p. 149). Additionally, these results indicated that connectedness to nature did not moderate the relationship exposure to nature and increase in positive affect, suggesting that all individuals may improve their mood with exposure to nature regardless of how emotionally connected to nature they feel (Passmore & Howell, 2014).

Mayer et al. (2009) indicated a relationship between exposure to nature and increased positive affect. An important consideration when understanding the relationship between positive affect and connectedness to nature is that these two constructs are highly correlated. Due to the strong relationship between positive affect and connectedness to nature, individuals who have high connectedness to nature may also

have high positive affect. Participants who spent 15 minutes walking in a natural environment reported higher positive affect and were able to problem solve more quickly than other participants. However, attentional capacity was not related to exposure to nature and positive affect in this study (Mayer et al., 2009).

Anxiety. Exposure to nature in a variety of different mediums has been shown to reduce anxiety. The reduction of anxiety is related to several physical health concerns which may also be reduced by exposure to nature. A further exploration of the physical health components is beyond the scope of this work. Focus is given to how exposure to nature decreases the subjective experience of anxiety. Specifically looking at subject experience of anxiety, different researchers explored how nature impacts anxiety in daily routines, such as in office spaces and during routine exercise. In office spaces, participants who had access to either a window viewing nature or an indoor plant reported less anxiety than their counterparts with no window or plant (Chang & Chen, 2005). For people who exercise, state anxiety was decreased by exercising in natural spaces rather than indoor or more urban spaces (Mackay & Neill, 2010). This research showed how nature exposure can reduce anxiety in daily settings.

Ecotherapy

Considering the broad overview of research on how exposure to nature impacts psychological well-being, it is important to consider how general exposure to nature has been structured to help individuals. Ecotherapy was developed in the pursuit of purposefully leveraging the benefits of exposure to nature (Buzzell & Chalquist, 2010).

Ecotherapy has been defined as a broad term referring to treatments focusing on a mutually beneficial relationship between human beings and the natural world, which encapsulates, and is an applied approach to ecopsychology (Buzzell & Chalquist, 2010). A detailed review of ecotherapy research has been conducted elsewhere (Chalquist, 2009), but for this purpose it is important to have a general idea of some different components of ecotherapy and how they elucidate the relationship human beings have with nature. Ecotherapy covers a wide range of topics including green infrastructure and exercise, nature in healthcare settings, animal-assisted therapy, and horticultural therapy (Chalquist, 2009). However, much of the research in this subdiscipline pertains to the restorative aspects of nature for human beings.

Wilderness therapy. As a branch of ecotherapy, wilderness therapy focuses on providing physical and psychological training to give participants the opportunity to increase their competence through challenges (Bedard, Rosen, & Vacha-Haase, 2003). Learning new skills such as how to pitch a tent or how to start a fire allows individuals to develop a sense of competence. A meta-analysis on the effects of wilderness therapy was conducted with participants in programs for juvenile delinquents, with a specific focus on psychological functioning and recidivism rates. Results indicated an increase in self-esteem, positive behavioral changes, and an increase in interpersonal skills when compared to other treatment programs. Furthermore, a small effect size (d = .31) was found, supporting decreased recidivism rates (Bedard et al., 2003). This study showed the efficacy of therapeutic strategies involving exposure to nature, which provided further

support for the importance of the relationship between nature and the psychological well-being of individuals.

Horticulture therapy. Horticulture therapy has people focus on gardening or working with plants rather than the traditional talking therapy in psychology (Chalquist, 2009). Research has been conducted with a variety of specific populations from older individuals to individuals diagnosed with mental health conditions mostly showing positive results (Chalquist, 2009). Annerstedt and Währborg (2011) conducted a meta-analysis of studies that used what they call nature-assisted therapy (NAT). Their results, while mixed, supported the conclusion that NAT is an effective and an appropriate treatment for a variety of mental health concerns (Annerstedt & Währborg, 2011).

Green spaces. Green spaces serve as another component of ecotherapy. Not all people have access to natural, wild spaces where they can connect with nature. As mentioned previously, people are spending the vast majority of the time indoors or in enclosed spaces (Klepeis et al., 2001). Focusing on the indoor space and investigating how these spaces impact well-being is an important part of green space research.

Some previous research focuses specifically on indoors settings, such as office buildings to determine how green spaces impact functioning. In a study conducted in the Netherlands and the UK, researchers found that employees working in office spaces that incorporated greenery into their design reported higher productivity and higher work satisfaction (Nieuwenhuis, Knight, Postmes, & Haslam, 2014). Another study investigated how different lighting impacts an office environment (Canazei, Pohl, Bliem,

Martini, & Weiss, 2017). Individuals who worked in a room with an artificial skylight reported less tension and anxiety and more positive mood than their counterparts who worked in a room lit by fluorescent lamps (Canazei et al., 2017). These studies demonstrated how nature can impact indoor environments, specifically office spaces.

Aside from focusing specifically on indoor spaces, more holistic spaces such as neighborhoods or communities have also been investigated. Researchers have focused their work on how green urban areas impacted mental health conditions over time (Alcock, White, Wheeler, Fleming, & Depledge, 2014). The research conducted by Alcock et al. (2014) indicated that individuals who moved to greener urban areas showed improved mental health when compared to their baseline before the move. This positive change was maintained for the 3 years following the move allowing the researchers to discuss the possibility the participants baseline mental health had changed permanently. Additionally, individuals who moved to less green urban environments showed significantly worse mental health before the move, but they returned to their original baseline a year after the move. These results indicated that while living in a less green urban environment does not reduce overall mental health, living in a green urban environment may improve the baseline of mental health (Alcock et al., 2014).

Different researchers emphasize the importance of other senses on the impact of green spaces (Conniff & Craig, 2016). Research has primarily been focused on visual stimuli rather than other types of sensory information. Conniff and Craig (2016) suggested that auditory stimuli may be an important factor in understanding why some

green spaces offer more restorative benefits than others. Results are currently limited, but this may be an important direction for green space research. Green space research is closely related to how technology mediates the relationship between humans and nature. The relationship between nature and technology is further explored in the next section.

Technology and Nature

The rise of technology has greatly impacted the way human beings relate to the natural world. Richard Louv (2008) conducted extensive qualitative research investigating the changing ways adults expose their children to nature. Louv (2008) traveled across the nation meeting with parents and talking with children about their understanding of nature and their relationship with nature. Oftentimes Louv's interviews revealed parents who had fond memories of their own childhood, spent romping in the outdoors. However, those same parents did not allow their children those same opportunities to explore the wild. Concerns for safety were often cited as a reason to prevent children from these experiences. Through his work, Louv coined the term nature-deficit disorder (NDD). He used this term to emphasize the disconnection that has formed between the youngest generation and nature.

With the increase of different types of technology and ease of access to technology, extensive research has focused on how technology impacts mental health and psychological well-being. Researchers have found a correlation between use of technology as an avoidance strategy and negative mental health outcomes, including anxiety and depression (Panova & Lleras, 2016). Having a broad conception of the

current understanding of the relationship between technology and mental health is important before focusing more specifically on how technology impacts a relationship to nature.

Human beings have a complex relationship with technology. Technology in turn can be extremely useful and detrimental to human beings' relationship with nature (Louv, 2008). The way food is mass produced, oftentimes, out of sight, and how nature can be manufactured to certain specifications, are each ways technology can create distance between human beings and nature (Nelson, 1995; Vileisis, 2008). Additionally, viewing nature using technology can create a false perception of nature, which impacts connection and the restorative benefits of nature exposure (Cronin, 2011; Solon & Wong, 2018). On the other hand, technology can also be used to facilitate connection with nature (Mayer et al., 2009; McAllister, Bhullar, & Schutte, 2017). For example, people who live in areas with little to no access to nature may be able to access nature using a photograph, video, or virtual reality. How technology impacts the relationship between human beings and nature is multifaceted and is neither all positive nor all negative.

Technology Creating Distance between Humans and Nature

Before Richard Louv (2008), anthropologist Richard Nelson (1995) also discussed the increasing distance between humans and nature, particularly from a Western worldview. Nelson's work focused on Indigenous American populations who maintained a close relationship with nature since their livelihood relied on traditional hunter-gather practices. Through his work, Nelson came to understand the intense

isolation human beings experience as we begin to value non-human life less. Nelson suggested industrialization and moving away from hunter-gatherer cultures fostered this alienation of human beings from nature and non-human life since human life no longer relies on an understanding of and respect for the natural world. For Nelson (1995), this alienation means human life may not be sustainable as we have moved away from a love of life or, as E.O. Wilson put it, biophilia (1984).

There are many different ways that technology facilitates the creation of distance between human beings and nature. First, technology and the industrialization of food production impacts our understanding of the source of our food (Cairns & Johnston, 2018; Gamble, 2014; Vileisis, 2008). Next, technology, such as photography, is used to change the way we perceive nature and begin to manufacture a sanitized version of nature (Cronin, 2011; Solon & Wong, 2018). Finally, experiencing nature through technology may lead to an impoverished effectiveness of nature to provide psychological benefits (Kahn et al. 2008).

Food production. Using Nelson's (1995) anthropological research as a starting point, a pattern for how technology and industrialization separated humans from the natural world becomes apparent. One important aspect of the separation between people and nature resides in the food we consume. When our culture was defined by hunting and gathering for survival, an intimate knowledge of where food comes from was necessary. Now, different writers have discussed how many people do not understand where food comes from, particularly children (Louv, 2008; Vileisis, 2008). A survey conducted in

Australia found a third of children struggled to identify different fruits and vegetables, with 92% of children stating they did not know bananas grow on plants (Gamble, 2014). This gap in knowledge creates distance between children and the natural world. As this gap in knowledge grows, children become less understanding of larger ecosystems and how humans fit into them.

There may be different reasons why this gap of knowledge regarding food sources has started to appear. Some research indicated a desire of parents to protect their children from learning about the source of their food, specifically meat and the necessity of slaughtering animals (Cairns & Johnston, 2018). Louv (2008) provided additional anecdotal support for this desire to protect the innocence of his children in regard to the slaughter of animals. He discussed how he believes part of his responsibility as a parent is to protect his children as much as possible. This perspective aligns with some empirical research as well. Parental attitudes have been found to affect whether they addressed the sources of food with their children (Bray, Zambrano, Chur-Hansen, & Ankeny, 2016). Whether an individual was from an urban or rural area also impacted how they approached their children when discussing the source of food. Parents from rural areas were more likely to emphasize the importance of eating what is provided to their children regardless of their children's attitudes towards the food source. Parents from urban areas were more likely to empathize with their children's attitudes about food, regardless of whether they were similar or different. Parents from both urban and rural settings stated it was important for their children to know where their food comes from (Bray et al., 2016).

The influence of technology and the industrialization of food production partially impacts our connection to and basic understanding of nature.

Manufactured nature. As technology develops, it becomes possible to form a new relationship to nature by manufacturing natural scenes. J. Keri Cronin (2011) discussed the idea of "fake nature" being created through technology. She used the Ocean Dome in Miyazaki, Japan and the Disney Wilderness Lodge in Orlando, Florida as examples of how people have used technology to attempt to replicate nature creating fake nature. Cronin (2011) suggested the rise of manufactured nature as a tourist attraction shapes the relationship people develop with nature. As people are exposed to manufactured nature, their expectations shift to assume such scenes exist in the world without humans to create them. She also addressed the way museums add to the fake nature narrative. She focused on how museums are seen as educational and authentic representations of the world, when in fact they are created just as wilderness resorts. Examining different representations of nature allows us to draw conclusions about how people perceive nature and their expectations of nature. It is unquestionable that technology has impacted our perceptions and expectations of nature on a cultural level.

Photography also impacts the way people perceive the natural world. Wildlife photographers shared secrets that have been used to capture pictures of wild animals ranging from setting out live bait to freezing insects to slow their movements (Solon & Wong, 2018). Even further, a business has been made of farms with large predator animals such as bears, wolves and tigers that allow owners to keep animals well fed and

healthy looking for photographers to pay to take pictures. This practice begins to shape how the larger public views certain animals and expectations on what animals look like in the wild (Solon & Wong, 2018). Any empirical research conducted to investigate how photography has impacted perception of nature and people's relationship to nature is limited if it does exist. However, at least anecdotally, this serves as another way technology impacts people's relationship to nature.

Impoverished effects of nature. It is impossible to stop the advancement of technology; therefore, it becomes important to begin considering how technology may impact people's connection to nature and whether it may be detrimental. In a previous study, researchers asked this question regarding how technology impacted the restorative effects of nature (Kahn et al., 2008). Researchers measured heart rate as a response to stress in order to determine the effects of exposure to nature. Some participants were exposed to nature through a glass window while others were asked to view a similar nature scene on a high-definition television (HDTV) in real-time. The final set of participants looked at a blank wall. Participants' heart rate decreased more rapidly, the more time they spent looking at the nature scene through the window. Results indicated watching nature on an HDTV was no better than watching a blank wall at reducing stress. Kahn et al. suggested that technology has started to shift how we as a people understand nature to not being able to recognize what it is truly "wild" because we have never been exposed to it. According to the researchers, this shifting baseline impoverishes the effectiveness of nature to restore any psychological benefit because we are no longer able

to identify the type of nature that would be more effective, wild and uninhibited nature (Kahn et al., 2008). This research supports the idea that technology creates distance by which people are not able to recognize nature. These results are similar to how nature is manufactured and sanitized. Technology has been used to create distance with nature by decreasing our exposure to nature, decreasing our knowledge of food sources, and changing expectations of what natural scenes look like.

Technology Mediated Nature Connectedness

Research has been presented showing how technology can create a gap between people and the natural world. One practical concern about needing wild and uninhibited nature to receive psychological benefit is that many people do not have access to this type of nature. However, technology has also been used to attempt to rectify this gap. Research has investigated how technology can impact the relationship people have with nature and perhaps provide some of the psychological benefits of nature (Mayer et al., 2009). Participants were assigned to one of four groups either going for a walk in a natural or urban setting or watching a video of a natural or urban setting. Researchers collected information on how this exposure impacted connectedness to nature, attentional capacity, and positive emotions. While both nature conditions (video and natural) increased all measured variables, actual exposure to the natural setting increased each more sharply. These results suggest physical exposure to nature may increase the benefits of nature more than exposure to nature through technology. These results create an important foundation for how technology can be beneficial when used to expose people

to nature (Mayer et al., 2009). An important point to this research is psychological benefits were still received when nature was presented through technology.

Presenting nature through technology can be beneficial when individuals do not have access to nature physically. Other research has been conducted to focus specifically on the restorative aspects of nature when viewed through video slideshow (McAllister et al., 2017). Results showed an increase in positive affect and a decrease in negative affect after exposure (McAllister et al., 2017). Participants were exposed to wild nature, urban nature, or an urban environment through a video slideshow. Wild nature was defined as natural environments with no discernible human elements, such as a rainforest untouched by humans. Urban nature were natural environments that included some human elements, such as a concrete walkway or a built garden. While both wild and urban nature have natural elements, urban nature has other human made elements where wild nature does not. The researchers found that participants in the wild nature condition reported significantly more positive affect than participants in either of the other two conditions. The urban nature condition did not significantly differ from the urban condition, which suggested the restorative aspect of nature may be hindered by human elements. However, participants in wild nature and urban nature conditions reported significantly less negative affect than participants in the urban condition (McAllister et al., 2011). These results create a more nuanced understanding of the impact of urban components on affect. If wild nature provides the most benefit to restoring positive affect, then the use of

technology may serve as a conduit for increasing an individual's exposure to wild nature, who might not otherwise have ready access to this form of nature.

Previous research has established a link between exposure to nature and a reduction in stress and negative affect. To further explore the relationship between technology and nature specifically, researchers used a virtual reality program to expose participants to different scenes (Valtchanov, Barton, & Ellard, 2010). All participants were exposed to a stress induction task before being immersed in a virtual reality simulation. Participants were randomly assigned to either explore a forest or the control condition, which consisted of a slide show of abstract paintings. Participants' heart rate and skin-conductance responses were measured as an indication of stress. Results showed a decrease in stress for participants who were exposed to the virtual forest scene. Although the participants were fully aware of the artificial nature of the forest scene, they still received psychological benefit and stress reduction. This allowed the researchers to posit that the restorative benefits of nature are not confined to real physical exposure to nature (Valtchanov et al., 2010).

Another study used virtual reality in order to explore the relationship between exposure to nature and psychological well-being (Schutte, Bhullar, Stilinović, & Richardson, 2017). This study directly compared the effects of exposure to a natural environment to exposure to an urban environment. Results showed that participants who were exposed to an urban virtual reality had decreased positive affect while participants exposed to a natural virtual reality had similar positive affect before and after exposure.

This decrease of positive affect was more severe when the participants' trait connectedness to nature was higher. Individuals who had higher connectedness to nature experienced a larger decrease in positive affect when exposed to an urban environment. Furthermore, participants in the virtual nature condition reported a higher level of restoration after exposure. The researchers suggested virtual reality may be a useful tool to help people who are not able to be exposed to nature directly, such as hospitalized patients (Schutte et al., 2017).

A large portion of the previous research focused on the relationship between technology and nature has almost exclusively used visual cues to represent technology. Images or videos of nature and virtual reality focus on visual perception of nature. Annerstedt et al. (2013) investigated how auditory perception of nature impacts recovery from stress. Stress recovery was measured using physiological means including cortisol levels. Results indicated that participants who were exposed to a nature setting including natural sounds recovered more rapidly than individuals exposed to nature without sounds. The researchers concluded that leveraging auditory cues may help increase the restorative qualities of nature when presented through a technological medium (Annerstedt et al., 2013).

Considering all the research conducted regarding technology and nature, there are mixed results. While it seems like using technology to expose people to nature may lead to an impoverished effect of nature or wholly change the way people relate to nature, it may be the only exposure to nature they receive. It becomes difficult to determine why

some exposure to nature using a technological medium is more effective than others. Further exploration into what factors impact the efficacy of using technology as a means to expose people to nature is needed, specifically looking at different individual characteristics people may have.

Disgust and Nature

One key difference in exposure to nature through a technological means versus a physical means is avoiding certain external factors, which might trigger a disgust reaction from different individuals. For example, an individual may be exposed to bugs or insects during a physical exposure to nature and not during a technological exposure to nature. Depending on the individual's tolerance for insects, this external factor may impact the benefit one receives from physical exposure to nature. Investigating how disgust sensitivity to external factors may help explain the various results about the efficacy of exposure to nature through technology discussed in the previous section.

Since individual characteristics may impact the efficacy of the exposure to nature, this study focuses on disgust sensitivity as a specific characteristic. Disgust has been recognized by the scientific community as a basic human emotion for over a hundred years (Darwin, 1872/1965). The evolution in the scientific community's understanding of disgust has come to include understanding disgust as a function for avoiding disease or other harmful stimuli (Rozin & Fallon, 1987). Additionally, this study reviews different domains of disgust and what types of stimuli elicit a disgust response. Finally, this study reviews how our attitudes and beliefs are impacted by our sensitivity to disgust.

The relationship between sensitivity to disgust and how nature might be a source of disgust is explored. Due to the evolution of disgust, certain stimuli typically elicit a disgust response. Much of these stimuli can be found in natural environments, such as fecal matter. However, individual differences exist on different types of stimuli such as dirt, sweat, and insects. Additionally, how sensitivity to disgust impacts attitudes and beliefs about a myriad of factors is explored.

Evolution of Disgust

The scientific understanding of disgust has evolved across the years based on the most current research. Current research about the function of disgust and the development of disgust is explored to connect our understanding of disgust to our understanding of how human beings relate to nature. A specific focus is on disgust sensitivity to nature-related stimuli, such as dirt, bugs and sweat.

Although disgust has been acknowledged as a primary emotion by the scientific community for many decades, scientists continue to define the concept in a myriad of ways, depending on their specific interests. Disgust has been broadly defined as emotional discomfort resulting from sensory exposure to any stimuli deemed unpleasant (Bixler & Floyd, 1997). More specifically, disgust has also been defined by emotional discomfort resulting in the possibility of consuming contaminated stimuli (Rozin & Fallon, 1987). Both of these definitions acknowledge the emotional discomfort that stems from exposure to stimuli.

Evolutionarily, the function of disgust appears to be limiting exposure to potentially infectious stimuli (Curtis et al., 2004). Another function of disgust appears to be working as part of a larger system to help humans avoid pathogens and contaminants (Shook et al., 2019). This system is called Behavioral Immune System (BIS) and contains multiple psychological functions.

With the hypothesis suggesting disgust's function is to avoid contracting infectious diseases, certain principles were supported. Primarily, people responded with higher levels of disgust when stimuli are disease-salient rather than similar stimuli without disease salience (Curtis et al., 2004). Research was conducted using pictures with either high disease-salience or low disease-salience. Images with high disease-salience included images with a person who appeared feverish and a cloth with what appeared to be bodily fluids. Images with low disease-salience including images with a person without a fever and a cloth with what appeared to be a blue chemical substance. Results indicated images with high disease-salience were more disgusting than those with low-disease salience. These results suggested disgust has evolved to be elicited when confronted with the possibility of infectious disease (Curtis et al., 2004).

Understanding the function of disgust as a means to identify infectious diseases creates an overarching understanding of one function of disgust. However, bodily fluids contain less relevance to the current study. Nature-specific disgust stimuli is more relevant to the current study. Such nature-specific stimuli would include parasites and other carriers of infectious disease, such as ticks. Based on previous research (Curtis et

al., 2004), ticks may be identified as having high disease-salience and thus elicit more disgust. Research conducted with adolescents supports this hypothesis (Bixler & Floyd, 1999). Ticks were ranked as two of the top five most disgusting nature stimuli presented (specifically "finding a tick biting my scalp" and "finding a tick crawling on my leg;" Bixler & Floyd, 1999, p. 7). The other top three stimuli were exposure to roaches, animal droppings, and slugs. Additionally, the study results supported the idea that disgust sensitivity can then impact behaviors and decision making about selection of natural environments in which to spend time. Bixler and Floyd (1999) found that adolescents with higher levels of disgust sensitivity were more likely to select images of environmental locations that appeared cleaner (e.g., lakes with clear water and no algae). These results support the idea that disease salience increases disgust sensitivity, which may in turn influence behavior, such as selection of a natural environment to visit.

Airborne biting insects, specifically mosquitoes, are the exception to this research (Curtis & Biran, 2001). Other disease-carrying insects, such as ticks, elicit a disgust response universally. However, mosquitoes do not. Current research has not been conducted to determine why mosquitoes do not elicit the same disgust response, even in geographic areas that contain mosquitoes carrying diseases such as malaria.

Investigating the function of disgust further includes an understanding of the BIS. Disgust is a primary factor in the BIS, which comprises multiple psychological functions geared towards protecting individuals from pathogens and contaminants (Shook et al., 2019). Specific research investigated how disgust sensitivity impacts general avoidance

behaviors. Results indicated a positive correlation between disgust sensitivity and avoidance behavior. Additional results showed participants who were exposed to a disgusting experience (e.g., eating a disgusting flavored jellybean) were more likely to endorse avoidance behaviors. These results suggest more general behavior inhibition rather than avoiding only disease-salient stimuli (Shook et al., 2019). This shows a broader function of disgust than avoiding infection.

Domains of Disgust

Potentially disgusting stimuli exist on a wide continuum and can range from the concrete to the abstract (Chapman & Anderson, 2012). Examples of concrete stimuli include feces, vomit, and insects. Examples of abstract stimuli include moral transgressions and the people who commit them. Disgust has also been categorized into two types: core disgust and animal-reminder disgust (Rozin, Haidt, & McCauley, 2008). Core disgust is defined as disgust related to oral consumption of possibly contaminated stimuli. Animal-reminder disgust is defined as anything reminding humans of our animal nature leading to disgust (van Overveld, de Jong, Peters, & Schouten, 2011). The focus is placed on exploring the animal reminder hypothesis since it is more likely to be related to nature and therefore more relevant to the current study.

Animal reminder hypothesis. The animal reminder hypothesis is a theory researchers used to understand commonalities existing between seven different domains of disgust elicitors (Haidt, McCauly, & Rozin, 1994). The researchers outlined seven domains of disgust that were: food, animals, body products, sex, body envelope

violations, death, and hygiene. Researchers suggested core disgust developed based on the function of disgust as a means to prevent infectious diseases. Food, body products, and animals represented core disgust. However, the four other domains; sex, body envelope violations, death and hygiene were not explained by core disgust as avoiding oral contaminates. The researchers hypothesize that these domains elicit disgust because they serve as reminders of our animal nature thereby inducing disgust (Haidt et al., 1994). Evidence exists both in support of and in opposition of this hypothesis. Exploring the validity of the animal nature hypothesis is important to the current study because exposure to nature might also serve as a reminder of our animal nature.

Core disgust, which includes food, body products, and animals as domains, correlates with increased possibility of developing spider-phobias (Olatunji, Haidt, McKay, & David, 2008). An example of animal reminder disgust would be touching a dead body (Olatunji et al., 2008). Further research support for the animal reminder hypothesis is that humans consider ourselves superior to animals and therefore experience disgust when we are compared to animals (Rozin et al., 2008). When explored through an ethnographic lens, animal names are used as insults or to degrade others, which implies that comparison of humans to animals serve as an insult connected to feelings of disgust (Rozin et al., 2008). Additionally, people who rate highly on the animal reminder domains of disgust are more likely to avoid looking at stimuli that activates this domain, such as watching a video of a surgery (Olatunji et al., 2008). This

research for the animal reminder hypothesis supports that humans' respond to stimuli activating this domain differently than other disgust related stimuli.

Being reminded of animal nature does not necessarily elicit a disgust response. Research investigated humans' direct relationship with animals to explore the validity of the animal reminder hypothesis (Kollareth & Russell, 2017). Pleasant pictures of animals remind us of our animal nature, but people do not respond to them with disgust. Only unpleasant animal reminders were rated as disgusting (Kollareth & Russell, 2017). Reminders of our animal nature can induce sadness, fear, or disgust depending on the type of stimuli (Kollareth & Russell, 2018). The research conducted that does not support the animal reminder hypothesis focuses specifically on animals as stimuli rather than sex, body envelope violations, death and hygiene, which were the domains the hypothesis was constructed around. It appears that animals themselves do not specifically elicit disgust but rather reminders of sex, body envelop violations, death and hygiene. This provides greater clarity on how disgust operates in conjunctions with nature.

Individual Differences in Disgust Sensitivity

Disgust sensitivity varies widely among individuals and can be related to multiple different factors. Three different concepts are explored and how they contribute to individual differences in disgust sensitivity. Gender, moral attitudes, and judgements, and biophobia all have empirical evidence supporting a link to disgust sensitivity.

Gender differences. An in-depth review of many different studies found significant results showing in North America women are more sensitive to disgust than

men (Oaten, Stevenson, & Case, 2009). This difference ascribed to evolutionary differences between men and women, with women being more cautious regarding selecting a healthy mate and providing for offspring and therefore being more attuned to disease-salient information (Curtis et al., 2004).

Moral attitudes and judgements. As discussed previously, one of the domains of disgust includes abstract stimuli such as moral transgressions. Based on this evidence, a link may exist between disgust sensitivity and attitudes about moral topics. Researchers (Wagemans, Brandt, & Zeelenberg, 2018) investigated whether individuals differ in their disgust sensitivity based on different moral domains (i.e., purity, authority, loyalty, care, fairness, and liberty). Participants were asked to provide a moral judgement on hypothetical cases within each moral domain. The results showed that individuals with higher disgust sensitivity provided increased condemnation to cases in the purity moral domain (Wagemans et al., 2018). This suggests a relationship between moral attitudes and individuals' differences in disgust sensitivity.

Biophobia. As discussed previously, E. O. Wilson's (1984) concept of biophilia asserts people are drawn to life and nature. Biophobia is defined as the fear of life or things occurring in nature (Smith & Davidson, 2006). The authors suggested the development of biophobias, specifically arachnophobia, arises from the intersection of disgust of the object or situation (i.e., spiders) and the increased probability of contact. This stands to reason that people who find situations that occur in nature disgusting (i.e.,

sweating, being bitten by a tick) may be more likely to experience anxiety or fear when in a situation which increases the probability of coming into contact with them.

Considering how sensitivity to disgust impacts emotions, behaviors, and attitudes, is it reasonable to hypothesize there may be a connection with an individual's attitudes and experience in nature. Connectedness to nature is defined as an individual's emotional relationship with nature (Mayer & Frantz, 2004) and disgust is an emotion, it stands to reason a relationship should exist between these two constructs. People's connection to nature is predicated on their emotions and the physical embodiment of space. A gap exists in the literature connecting these two constructs and investigating how they interact.

Additionally, using technology to mediate how individuals are exposed to nature will impact the stimuli with which people are confronted. Technology can create a manufactured experience of nature by removing certain stimuli that elicit disgust, such as ticks and dirt. An individual's sensitivity to disgust and their connectedness to nature may impact how much their mood and anxiety are influenced when exposed to nature. Research has not investigated the possible interaction between these constructs when exploring how exposure to nature influences mood.

The Current Study

While the research reviewed has investigated how disgust sensitivity impacts attitudes and behavior avoidance, this researcher could not find any research conducted on how an individual's specific sensitivity to disgust impacts their relationship to nature

and the way they experience nature. In addition to disgust sensitivity, the role of different types of exposure to nature also remains unclear. Exposure to nature, using technology, changes the embodied experience of nature, which based on how disgust functions may drastically impact an individual's experience. The impact of nature exposure on mood and anxiety is also related to type of exposure, either technologically mediated, or through physical exposure. The previous research reviewed indicated a strong relationship between connectedness to nature and mood. The current study investigated the relationship between type of exposure to nature, disgust sensitivity, and connectedness to nature, and how each, in turn, impacts mood and anxiety.

Based on the previous literature, this study investigated the following five main hypotheses.

- Hypothesis 1: The researcher hypothesized a relationship between the type of nature exposure, (either through technology-mediated exposure or through physical exposure), and mood and anxiety. Exposure to nature through physical means will have a greater benefit to mood than exposure to nature through technology.
- Hypothesis 2: The researcher hypothesized a relationship between disgust sensitivity and mood and anxiety, such that a higher degree of disgust sensitivity will be related to increased negative affect, decreased positive affect, and increased anxiety, regardless of type of nature exposure.

- Hypothesis 3: Connectedness to nature is related to mood and anxiety with individuals who are more connected to nature experiencing decreased negative affect, increased positive affect, and decreased anxiety, regardless of the type of exposure.
- Hypothesis 4: The researcher predicted an interaction between type of nature exposure and disgust sensitivity impacting mood.
    - Hypothesis 4a: Individuals with lower disgust sensitivity experience more benefits to their mood and anxiety when exposed to nature physically rather than through technology.
    - Hypothesis 4b: Individuals with higher disgust sensitivity experience more benefits to their mood and anxiety when exposed to nature through technology.
- Hypothesis 5: The researcher predicted an interaction between type of exposure and connectedness to nature.
    - Hypothesis 5a: Individuals with higher connectedness to nature experience a greater improvement of mood when exposed to nature physically rather than through technology.
    - Hypothesis 5b: Individuals with lower connectedness to nature experience a similar improvement of mood regardless of type of nature exposure.

Hypothesis 1 investigated the relationship between the experimental manipulation and the outcome measure. Hypotheses 2 and 3 investigated the relationship between the

two moderators and the outcome measure. Hypotheses 4 and 5 investigated the interactions between the experimental manipulation and the two moderators. The sub hypotheses for Hypotheses 4 and 5 allowed for a more nuanced interpretation of the meaning of each interaction. By investigating these hypotheses, the gap in the literature regarding how disgust sensitivity and connectedness to nature impacts the benefits received from nature was addressed.

CHAPTER III

METHODOLOGY

Participants

The current study used convenience sampling to gather participants from social media and students at Texas Woman's University (TWU). Participants were recruited in two major ways. Participants were recruited using social media posts on two platforms, Twitter and Facebook. Participants were also recruited using SONA, a system for recruiting participants. Those participants recruited from the university were compensated for completing the study through course credit. Non-student participants were not compensated for completing the study.

Of the 97 participants in the study, 75.3% identified as cisgender women (*n* = 73). This is likely due to the demographics at a women-majority university, from which many participants were recruited. Cisgender men made up 21.6% of participants (*n* = 21) while 1% of participants identified as genderqueer or genderfluid (*n* = 1). Two participants did not provide information about their gender identity. Participants ranged in age from 18 to 66 years, with an average age of 31.4 years. For ethnic background, 45.4% of participants identified as White (*n* = 44), 21.6% identified as Latinx or Hispanic (*n* = 21), 14.4% identified as Black or African American (*n* = 14), 12.2% identified as Asian and

Pacific Islander (*n* = 12), 5.1% identified as Biracial or Multiracial (*n* = 5), and one participant did not provide their ethnic background information. Student (*n* = 49) and non-student participants (*n* = 48) were approximately equal, making up 50.5% and 49.5% of the sample, respectively.

To determine appropriate sample size, power was calculated using G*Power software (Faul, Erdfelder, Lang, & Buchner, 2007). According to the power analysis, 98 participants were recommended for the study to achieve the suggested power for a .05 alpha level.

One specific inclusion criterion for the study was that participants needed to have access to a natural environment. Nature was defined as a physical instance occurring naturally in the world (i.e., trees, stars, sunset, etc.). This placed a limitation on participants who were eligible for the study and is a concern as it excludes a specific group of people who may not have ready access to natural spaces in which they feel safe.

Design

The experimental manipulation in this study was how participants are exposed to nature, either physically or through the use of technology. The details of what measures and materials were used to achieve this experimental manipulation are discussed in the next section. To measure the moderating variables and the outcome variable, several measures were used during this study to assess trait and state qualities of the participants. Each measure has been used in previous research and has been demonstrated to be reliable and valid. Participants were also asked to provide basic demographic information

including their age, gender identity, and ethnic background. See Appendix A for a list of the demographic questions asked.

Experimental Manipulation

Participants were exposed to nature using different mediums in order to test the hypotheses for the study. Participants were randomly assigned to one of two groups, and they were exposed to nature physically or exposed to nature using technology. A between-subjects design was used to prevent carry over effects.

Participants who were exposed to nature physically were instructed to self-select a natural area to which they had access. This design model was used to allow for social distancing during the COVID-19 pandemic rather than having all participants use the same nature area as the study was originally designed. See Appendix B for the script of instructions the participants received for both experimental conditions. Participants were asked to sit in their self-selected natural area for 15 minutes.

Participants who were exposed to nature using technology watched a video selected by the researcher. The video uses a first-person perspective to create a realistic experience. Previous research showed video leads to a more immersive experience than viewing static images (Pearson & Craig, 2014). Since a more immersive experience has better ecological validity (Pearson & Craig, 2014), a video was used for the experimental manipulation, rather than static images. The selected video was 15 minutes long to create the same amount of exposure time as the physical nature group.

Moderators

Connectedness to nature and disgust sensitivity are the two moderator variables in this study. These variables served as moderators because they are trait characteristics of participants and were not manipulated by the researcher. Connectedness to nature was measured using the Connectedness to Nature Scale (CNS) (Mayer & Frantz, 2004). Disgust sensitivity was measured using the Disgust Sensitivity Scale (DSS; Bixler & Floyd, 1997).

Measures

Connectedness to nature scale. The CNS, as its name would suggest, was developed to assess an individual's relationship with nature (Mayer & Frantz, 2004). The developers of the measure asserted that it could be used to determine whether different situational factors and personality factors impact an individual's relationship to nature. Potential confounds, like verbal ability and social desirability, were measured and found to be uncorrelated with the CNS. The CNS consists of only one scale with no subscales and has a reliability of a = .84 (Mayer & Frantz, 2004).

The CNS measure consists of 14 questions on a 5-point Likert type scale. The poles for this scale are 1, meaning *strongly disagree*, and 5, meaning *strongly agree* (Mayer & Frantz, 2004). An example question from the scale is "I often feel a sense of oneness with the natural world around me." See Appendix C for the complete measure. The survey takes approximately 5 to 10 minutes to complete.

Disgust sensitivity scale. The DSS was developed as part of a larger instrument, including desire for modern comforts and fear expectancy, to determine how disgust impacted selection of wilderness activities (Bixler & Floyd, 1997). The creators of this scale used previous literature to identify 16 items that invoke disgust and are related to nature. A factor analysis of these items produced two factors: mild disgust (a = 0.88) and strong disgust (a = 0.88). These different subscales are separated based on the intensity of the items. The two factors were scored separately.

The DSS consists of 16 items with eight items in each of the mild and strong factors (Bixler & Floyd, 1997). Each question is on a Likert scale, with scores ranging from 0, meaning *not disgusting*, to 4, meaning *very disgusting*. An example of mild disgust is "Getting itchy from bug bites and scrapes" (see Appendix D). An example of strong disgust is "Finding a tick biting my scalp." The measure takes approximately 5 minutes to complete.

Measures of mood and anxiety. Two measures were used to quantify mood and anxiety. The Brief Measures of Positive and Negative Affect (PANAS) was used to measure state mood (Watson et al., 1988). The visual analog scale for anxiety (VAS-A) was used to measure state anxiety (Abend, Dan, Maoz, Raz, & Bar-Haim, 2014). These two measures were given to each participant twice in order to determine how their mood changed after the experimental manipulation. Rather than having a pre and post experimental manipulation score for each participant, an overall difference in mood and anxiety was calculated for each participant creating a change score. Participants' pre-

scores were subtracted from their post-scores leaving the difference between pre and post of mood and anxiety. Therefore, a negative change score indicates mood and anxiety decreased after the experimental manipulation.

Brief measures of positive and negative affect. This measure is used to assess an individual's emotional experience given a certain time frame (Watson et al., 1988). A range of different emotions are assessed when using this tool including excited, irritable, and afraid. The measure is separated into two different scales, with one measuring positive affect and one measuring negative affect. In the current study, each participant had an overall difference score for positive affect and negative affect.

The PANAS can be adapted based on the time frame. For example, a researcher could modify the PANAS to measure a participant's emotions in-the-moment, within the last week, or within the last year. Reliability varies based on the amount of time the scale is measuring. The PANAS has been assessed for reliability multiple times, including in the moment (a = 0.89), today (a = 0.90), past few days (a = 0.88), past few weeks (a = 0.87), past year (a = 0.86), and in general (a = 0.88).

This measure consists of 20 emotion words that participants are asked to rate on a Likert scale ranging from 1, meaning *very slightly or not at all* to 5, meaning *extremely* (Watson et al., 1988). The person administering the measure is able to adapt the measure to cover the amount of time she is interested in assessing. For the current study, the time frame was set to the present moment. This helped to assess how the experimental

manipulation impacted positive and negative affect in the moment. The measure takes approximately 5 to 10 minutes to complete (see Appendix E).

Visual analog scale-anxiety. This measure is used to assess an individual's anxiety at a discrete point in time (Abend et al., 2014). The measure is computerized to increase the rapidity of which data can be collected. This measure has one question, "How anxious are you right now?" Participants slide an indicator between two poles, calm and anxious (see Appendix F). The VAS-A demonstrated test-retest reliability in the range a = .84 - .96 (r = .44, p < .001).

Procedure

After agreeing to participate in the study, participants were provided with information about the study and asked to provide informed consent. The informed consent was administered online. Once participants consented to move forward in the study, they were directed to the demographic questionnaire. The demographic questionnaire included questions about age, gender identity, and racial/ethnic identity. Participants then completed the two trait measures described above, the CNS and the DSS. Since these are trait measures and not expected to change significantly over a brief amount of time, they were completed online when the participant agreed to join the study. The first portion of the study took place online where participants could complete the informed consent information at their leisure. It took approximately 25 minutes to complete this first portion of the study.

After completing the first portion of the study, participants were randomly assigned into one of two types of groups, varying by exposure to nature. The first group was exposed to nature physically, and the second group was exposed to nature using technology. Participants were asked to select a time they were available to participate in the second portion of the study without interruption. The second portion took approximately 45 minutes depending on travel time to the self-selected nature area. When deciding to begin the second portion of the study, all participants were given the PANAS and the VAS-A. As noted above, these measures were state-based and changed after exposure to the experimental conditions. Completing these measures takes approximately 10 minutes.

Following the completion of the PANAS and the VAS-A, participants in the physical nature group were instructed to go to their self-selected natural area. These participants were asked to sit within their natural area for 15 minutes. Participants in the technology nature group received a link to watch a first-person perspective video of a natural area. All participants, regardless of condition assigned, were asked to not use any technology during the study. This procedure was based on previous research investigating how technology impacts the restorative impact of nature (Mayer et al., 2009). After the exposure, participants were once again asked to complete the PANAS and the VAS-A. Following the completion of the measures, participants were debriefed and thanked for their participation. Course credit was assessed for eligible participants after completion of the study and receipt of all completed measures.

CHAPTER IV

RESULTS

A multiple regression analysis was used to analyze the data and answer the hypotheses. This analysis allowed for an overall understanding of how the experimental manipulation and moderator variables work separately from each other, and how they work together to predict anxiety, positive affect, and negative affect (Keith, 2015). Mood and anxiety served as the outcome measure for the analysis. The experimental manipulation, type of nature exposure, and the two moderators, disgust sensitivity and connectedness to nature, served as predictor variables. The interaction between the exposure type and the two moderators was also investigated. To decrease variability and increase power, two separate multiple regressions were completed investigating the relationship between exposure type and disgust sensitivity and exposure type and connectedness to nature.

After data collection, the data set was reviewed and any participants who were missing data were discarded. Due to the online nature of the study, several people only completed a portion of the study with a total of 159 people reviewing the consent form of which 48 people dropped out of the study before being assigned to an experimental condition. A total of 111 people were randomly assigned to one of the experimental conditions. Of those 111, 97 were included in the final analysis. Only participants who

completed all portions of the study, including the post-measures after the experimental condition, met the inclusion criteria. Of the 97, the physical exposure type group had 41.2% of participants (n = 40) while the technology exposure type group had 58.8% (n = 57). For the physical exposure type group, five data sets were discarded. For the technology exposure type group, nine data sets were discarded. All 14 of these data sets were discarded due to the participants not completing the affect and anxiety measures after the experimental condition.

The outcome variables were analyzed separately as anxiety, positive affect and negative affect for each individual participant. As stated previously, a pre- and post-score was gathered for each participant. A change value was calculated for each outcome variable. The change variable was created by subtracting the participant's pre-experimental manipulation score from the post-experimental manipulation score. Based on these change values, the averages can be interpreted. For example, a negative change value for anxiety would indicate anxiety decreased after experiencing the experimental manipulation. A positive change value for positive affect would indicate positive affect increased after experiencing the experimental manipulation. A negative change value for negative affect would indicate negative affect decreased after experiencing the experimental manipulation. These change values were used in all of the further analyses.

The reliability for each measure used was calculated for this sample set. The CNS had strong reliability, a = .775. The DSS also had strong reliability, a = .906. Positive affect and negative affect also had strong reliability, a = .831 and a = .886, respectively.

Before analyzing the data to determine whether each hypothesis was supported, several paired-samples *t*-tests were conducted to determine whether the experimental condition impacted the three outcome variables: anxiety, negative affect and positive affect. These analyses were conducted without the moderator variables.

Analysis was conducted investigating the differences between the three outcome variables before and after experimental exposure. A mixed model ANOVA was conducted to compare anxiety, negative affect, and positive affect scores before and after exposure to the experimental condition. There was a significant difference in anxiety scores before (M = 9.3, SD = 8.3) and after (M = 6.0, SD = 6.5) the experimental condition, regardless of the type of exposure participants received, $F(1,95) = 57.53$, $p < .01$, $\eta^2 = .38$. These results show anxiety decreased after being exposed to the experimental condition. There was a significant difference in negative affect scores before (M = 1.5, SD = 0.7) and after (M = 1.3, SD = 0.6) the experimental condition, regardless of the type of exposure participants received, $F(1,95) = 18.87$, $p < .01$, $\eta^2 = .17$. These results show negative affect decreased after being exposed to the experimental condition. There was not a significant difference in positive affect scores before (M = 2.8, SD = 1.0) and after (M = 2.8, SD = 1.1) the experimental condition if the type of exposure participants received was not explored, $F(1,95) = 0.54$, $p = .47$, $\eta^2 = .01$. These results show overall positive affect was not significantly impacted by the experimental condition.

Next, the same mixed model ANOVA was used to investigate whether type of nature exposure impacted the three outcome variables. No significant difference was found between anxiety scores for participants in the physical nature group (M = 5.3, SD = 5.1) and technology nature group (M = 6.5, SD = 7.4) after experiencing the experimental condition, $F(1,95) = 2.28$, $p = .13$, $\eta^2 = .02$. No significant difference was found between negative affect scores for participants in the physical nature group (M = 1.2, SD = 0.4) and technology nature group (M = 1.4, SD = 0.7) after experiencing the experimental condition, $F(1,95) = 0.61$, $p = .44$, $\eta^2 = .02$. A significant difference was found between positive affect scores for participants in the physical nature group (M = 2.8, SD = 1.1) and technology nature group (M = 2.8, SD = 1.1) after experiencing the experimental condition, $F(1,95) = 12.84$, $p < .01$, $\eta^2 = .12$. This indicates the different types of nature exposure were not significantly different for anxiety or negative affect, indicating participants received similar decreases in anxiety and negative affect regardless of the type of nature exposure.

Based on these results, exposure to nature using either physical or technological means significantly decreased anxiety and negative affect. For positive affect, physical exposure to nature increased positive affect while technology exposure to nature decreased positive affect. This indicates that exposure to nature through technology may negatively affect positive affect while exposure to nature physically does not.

Effect sizes for the differences between the two experimental conditions were calculated for each outcome variable using the average change for mean between the pre-

and post- data. The effect size for anxiety was considered small, Cohen's $d = 0.31$. The effect size for negative affect was considered small, Cohen's $d = 0.16$. The effect size for positive affect was considered moderate, Cohen's $d = 0.75$. Positive affect had the largest effect size of the three outcome variables, indicating positive affect was the most impacted by the type of exposure to nature. See Table 1 for details.

Table 1

Mean Values and Cohen's d for each Outcome Variable

	Physical Exposure		Technology Exposure		
	M	*SD*	*M*	*SD*	Cohen's d
Pre-Anxiety	9.43	7.49	9.28	8.88	-
Post-Anxiety	5.30	5.06	6.53	7.36	.31
Pre-Negative Affect	1.39	0.53	1.63	0.75	-
Post-Negative Affect	1.24	0.40	1.42	0.70	.16
Pre-Positive Affect	2.48	0.96	2.98	0.98	-
Post-Positive Affect	2.82	1.11	2.76	1.10	.75

Note. This table shows the mean scores for all three of the outcome variables separated into pre- and post-exposure to the experimental condition.

A bivariate correlation was conducted to investigate the relationships between the moderator variables and the outcome variables pre- and post-exposure to the experimental condition. Pre-anxiety and post-anxiety scores were strongly positively correlated ($r = .85$, $p < .01$). Pre-negative affect and post-negative affect scores were also strongly positively correlated ($r = .80$, $p < .01$). Pre-positive affect and post-positive affect scores were also strongly positively correlated ($r = .71$, $p < .01$). Disgust sensitivity

and connectedness to nature were correlated (r = -.25, p = .01). See Table 2 for further details.

Table 2

Correlations for Experimental and Moderating Variables

Variable	1	2	3	4	5	6	7	8
1. Pre-Anxiety	-	.85**	.62**	.45**	-.26**	-.11	-.13	.11
2. Post-Anxiety		-	.65**	.57**	-.25*	-.23*	-.13	.04
3. Pre-NegAffect			-	.80**	.09	.12	-.03	.18
4. Post-NegAffect				-	.14	.14	-.02	.17
5. Pre-PosAffect					-	.71**	.03	.23*
6. Post-PosAffect						-	.001	.25*
7. DSS							-	-.25*
8. CNS								-

Note. The variable DSS are the centered scores for the Disgust Sensitivity Scale. The variable CNS are the centered scores for the Connectedness to Nature Scale. Significant levels: *p < .05. **p < .01.

Hypothesis 1

The researcher hypothesized a relationship between the type of nature exposure and mood and anxiety, specifically that exposure to nature through physical means would have greater benefits. To test the first hypothesis, three independent *t*-tests were completed investigating the three outcome variables: anxiety, negative affect, and positive affect. An independent-samples *t*-test was conducted to compare anxiety scores

for the physical nature exposure and technology nature exposure conditions. There was not a significant difference in the anxiety scores for physical nature exposure (M = -4.1, SD = 4.5) and technology nature exposure (M = -2.8, SD = 4.3) conditions; $t(95) = -1.51$, $p = .13$. An independent-samples t-test was conducted to compare negative affect scores for the physical nature exposure and technology nature exposure conditions. There was not a significant difference in the negative affect scores for physical nature exposure (M = -0.2, SD = 0.5) and technology nature exposure (M = -0.2, SD = 0.3) conditions; $t(95) = 0.78$, $p = .43$. An independent-samples t-test was conducted to compare positive affect scores for the physical nature exposure and technology nature exposure conditions. There was a significant difference in the positive affect scores for physical nature exposure (M = 0.3, SD = 0.7) and technology nature exposure (M = -0.2, SD = 0.8) conditions; $t(95) = 3.58$, $p < .01$. These results indicate that the physical exposure to nature condition increased positive affect more than the technology exposure condition. In fact, it appears that, on average, participants reported experiencing less positive affect after the technology nature exposure condition than they reported before completing the experimental condition. This is indicated by the negative mean score indicating that on average participants' positive affect decreased.

Hypothesis 1 was partially supported in that the results support a relationship between type of nature exposure and the outcome variables. The second part of the hypothesis was partially supported in that physical exposure to nature did indeed have

greater benefits by increasing positive affect than technology exposure to nature. However, both types of nature exposure decreased anxiety and negative affect.

Hypothesis 2

The researcher hypothesized a relationship between disgust sensitivity and mood and anxiety, such that a higher degree of disgust sensitivity would be related to increased negative affect, decreased positive affect, and increased anxiety, regardless of type of nature exposure. The second hypothesis examined the relationship between the first moderator variable, disgust sensitivity, and the three outcome variables: anxiety, negative affect, and positive affect. A multiple linear regression was calculated to predict anxiety based on exposure type and disgust sensitivity. The regression equation was found not statistically significant ($F(2, 94) = 1.29$, $p = .28$) with an R^2 of .01. A second multiple linear regression was calculated to predict negative affect based on exposure type and disgust sensitivity. The regression equation was found not statistically significant ($F(2, 94) = 0.31$, $p = .73$) with an R^2 of .03. Since the results were not statistically significant and the amount of variance explained by these first two models was small, this portion of Hypothesis 2 is not supported. The third, and final, multiple linear regression testing this hypothesis was calculated to predict positive affect based on exposure type and disgust sensitivity. A significant regression equation was found ($F(2, 94) = 6.48$, $p < .01$) with an R^2 of .12. These results indicate that positive affect was the only outcome variable that the disgust sensitivity moderator was able to predict.

The results of the study partially supported Hypothesis 2 in that positive affect was significantly impacted by disgust sensitivity, explaining 12.1% of the variance in the model. However, the hypothesis was not supported in that anxiety and negative affect were not significantly predicted by disgust sensitivity.

Hypothesis 3

Hypothesis 3 mirrored Hypothesis 2 focusing on the moderating variable of connectedness to nature. Connectedness to nature was hypothesized to be related to mood and anxiety with individuals who are more connected to nature experiencing decreased negative affect, increased positive affect, and decreased anxiety, regardless of the type of exposure. A multiple linear regression was calculated to predict anxiety based on exposure type and connectedness to nature. The regression equation was found not statistically significant ($F(2, 94) = 2.51$, $p = .09$) with an $R^2$of .05. A second multiple linear regression was calculated to predict negative affect based on exposure type and connectedness to nature. The regression equation was found not statistically significant ($F(2, 94) = 0.43$, $p = .65$) with an $R^2$of .01. Since the results were not statistically significant and the amount of variance explained by these first two models was small, this portion of Hypothesis 3 is not supported. The third, and final, multiple linear regression testing this hypothesis was calculated to predict positive affect based on exposure type and connectedness to nature. A significant regression equation was found ($F(2, 94) = 6.79$, $p < .01$) with an $R^2$of .13. These results indicate that positive affect was the only outcome variable that the connectedness to nature moderator was able to predict.

Again, the results partially support Hypothesis 3 in that 12.6% of the variance in the model is explained predicting positive affect with connectedness to nature. However, the hypothesis was not supported in that anxiety and negative affect were not significantly predicted by connectedness to nature.

Hypothesis 4

The fourth hypothesis examined the interaction between the experimental manipulation and the first moderator, disgust sensitivity. It was tested using a multiple regression analysis. In order to determine whether there was an interaction between the experimental manipulation and two moderators, the continuous measures of disgust sensitivity and connectedness to nature was centered and then multiplied with the experimental manipulation to create a cross-product term (Keith, 2015).

The same multiple linear regression analyses used to calculate Hypothesis 2 were used to determine the interaction between the experimental manipulation and the moderators on predicting the three outcome variables. The first regression analysis examined was for anxiety. The regression equation was found not statistically significant ($F(1, 93) = 0.94$, $p = .43$) with an $R^2$of .03. Since the results were not statistically significant and the amount of variance explained by the model is small, this portion of hypothesis four is not supported. A second multiple linear regression was calculated to predict negative affect based on interaction between exposure type and disgust sensitivity. The regression equation was found not statistically significant ($F(1, 93) = 0.89$, $p = .91$) with an $R^2$of .01. The third, and final, multiple linear regression testing this

hypothesis was calculated to predict positive affect based on the interaction between exposure type and disgust sensitivity. The regression equation was found not statistically significant ($F(1, 93) = 3.03$, $p = .09$) with an $R^2$of .03. These results indicate that the interaction between exposure type and disgust sensitivity does not explain a statistically significant amount of variance in the outcome variables.

The researcher predicted an interaction between type of nature exposure and disgust sensitivity impacting mood. This hypothesis was not supported since the model with the interaction did not significantly predict the variance in the relationship. Likewise, Sub-Hypotheses 4a and 4b were also not supported since they predicted how differing amounts of disgust sensitivity would impact the benefits of nature.

Hypothesis 5

The fifth hypothesis examined the interaction between the experimental manipulation and the second moderator, connectedness to nature, using the same linear regressions used during Hypothesis 3. A multiple linear regression was calculated to determine whether the interaction between the experimental manipulation and the moderator would predict anxiety. The regression equation was found not statistically significant ($F(1, 93) = 2.24$, $p = .20$) with an $R^2$of .02. Since the results were not statistically significant and the amount of variance explained by the model is small, this portion of Hypothesis 5 was not supported. A second multiple linear regression was calculated to predict negative affect based on interaction between exposure type and connectedness to nature. The regression equation was found not statistically significant

($F(1, 93) = 0.29$, $p = .84$) with an R^2 of less than .01. The third, and final, multiple linear regression testing this hypothesis was calculated to predict positive affect based on the interaction between exposure type and disgust sensitivity. The regression equation was found not statistically significant ($F(1, 93) = 4.73$, $p = .43$) with an R^2 of .01. These results indicated that the interaction between exposure type and connectedness to nature does not explain a statistically significant amount of variance in the outcome variables.

The researcher predicted an interaction between type of nature exposure and connectedness to nature impacting mood. This hypothesis was not supported since the model with the interaction did not significantly predict the variance in the relationship. Likewise, Sub-Hypotheses 5a and 5b were also not supported since they predicted how differing amounts of connectedness to nature would impact the benefits of nature.

CHAPTER V

DISCUSSION

This study functioned as a more nuanced exploration of the emotional benefits people receive from exposure to nature. Previous research investigated how using technology to mediate the delivery of nature to people supported receiving similar cognitive and emotional benefits (Mayer et al., 2009; McAllister et al., 2011; Valtchanov et al., 2010). However, the results of this study were mixed in the way that technology exposure to nature impacted mood and anxiety.

The results of the study were mixed in supporting the hypotheses. Overall, the experimental manipulation of type of nature exposure impacted mood and anxiety in different ways. Physical nature exposure decreased anxiety and negative affect post-exposure while increasing positive affect. Technology nature exposure had similar results in that anxiety and negative affect were also decreased. However, the difference occurred in positive affect. Rather than increasing positive affect like physical nature exposure, those individuals who were exposed to nature through technology actually experienced a decrease in positive affect post-exposure. Previous studies have demonstrated how positive affect may increase when exposed to nature (Passmore & Howell, 2014; Mayer et al., 2009). The study supports these previous findings.

It is important to note that the three outcome variables all operated on state characteristics, constructs that are transient and likely to change. As part of the development of the measure used for anxiety, results showed that measure captured state anxiety while being correlated to state anxiety (Abend et al., 2014). Likewise, the measure used to capture positive and negative affect also showed state affect changes (Watson et al., 1988). The moderator variables of disgust sensitivity and connectedness to nature served as trait-based constructs.

The results indicated a decrease in positive affect associated with technology exposure to nature and provide a more nuanced view of the effects of nature on mood. These findings may be explained by the amount of screen time participants engaged in prior to completing the study. A meta-analysis of previous research conducted with children and adolescents suggested a parabolic relationship between screen time and positive affect, along with other mental health factors (Oswald, Rumbold, Kedzior, & Moore, 2020). Since this meta-analysis reviewed many different studies, the amount of screen time and green time. At least one study in the meta-analysis categorized low and high screen time as less than 3 hours per day and more than 3 hours per day, respectively. This research also suggested exposure to nature may ameliorate the detrimental mental health effects of screen time. Different studies also used different amounts of green time, which does not provide a clear picture on how much or what type of green time provides this ameliorating effect (Oswald et al., 2020). The decrease in positive affect in the technology exposure group may be a reflection of the amount of screen time reducing

positive affect while the decrease in anxiety and negative affect may be related to the exposure to nature providing a buffering effect.

Due to the design of the current study, information was not collected asking participants for the amount of screen time and green time they engaged in for the day. More variance exists in the study because this factor was not controlled or monitored. The amount of screen time and green time participants experienced before participating in the study may have fluctuated widely across participants.

Another explanation for the decrease in positive affect in the technology exposure group may be technology diminishes the restorative aspect of nature only for positive affect. Previous research found a similar result with positive affect being increased in physical nature exposure and decreased in technology nature exposure conditions (Browning et al., 2020). An important consideration is understanding the relationship between positive and negative affect. Research extending for the past several decades has shown support for affective biopolarity (as one increases the other decreases) and affective independence (positive and negative affect can operate separately; Dejonckheere et al., 2018). More recent research suggested affective experience varies widely across individuals, specifically people who experience affective biopolarity have more severe depressive symptoms (Dejonckheere et al., 2018). These results pertain to the current study as it may provide an explanation for the change observed in positive affect and not negative affect. Individuals in the study may have varied in their experiences of affect.

The two moderating variables explored in this study, disgust sensitivity and connectedness to nature, did not predict changes in anxiety and negative affect after exposure to nature in either of the conditions. This indicates that the impact disgust sensitivity and connectedness to nature have on anxiety and negative affect was not large enough to be detected by the power in this study. Disgust sensitivity and connectedness to nature both predicted positive affect after exposure to nature. Disgust sensitivity and connectedness to nature explained 12.1% and 12.6% of the variability in the model for positive affect respectively. Determining why disgust sensitivity and connectedness to nature significantly predicted positive affect but not anxiety or negative affect will require further research. As discussed above, it is possible that positive and negative affect operate independently (Dejonckheere et al., 2018). This suggests the type of exposure to nature impacts positive affect in a way negative affect is not impacted. It is important to also note that neither of the interaction effects predicted were supported. This suggests that while disgust sensitivity and connectedness to nature impacts positive affect, there are not interaction effects between exposure type and the two moderators.

Limitations

Due to the COVID-19 pandemic, the methodology of the study was reconfigured to ensure health and safety guidelines were met during data collection. Because of this change, participants were asked to self-select a natural area that they had ready access to rather than going to a predetermined natural area selected by the researcher. This introduced more variability into the study since how people selected their natural area

and why types of areas were selected was at the discretion of the participants. Likewise, since participants were not observed during the study in either of the experimental conditions, there is a possibility that participants were not wholly focused on their natural experience. In the technology exposure group, participants viewed the same video while people in the physical exposure group all had different natural experiences. This also increases the variability within the data.

This limitation may extend further since individuals who were randomly assigned to the physical nature exposure condition had more choice in what they were doing when compared to the individuals in the technology nature exposure condition. Individuals in the technology nature exposure condition did not have a choice about what type of nature video they would watch. This element of freedom to choose may explain some of the results of the study.

Additionally, it appears that individuals were less likely to complete the study if assigned to the physical exposure group. Although participants were randomly assigned, the technology exposure group had 17 more participants with usable data than the physical exposure group. The type of individuals who choose to leave the study incomplete may have shifted the results, particularly if participants were more likely to leave the physical exposure group.

Another limitation to address is the possibility of decreased internal validity since the pre- and post-measures of the three outcome variables were the same. Since the outcome measures were conducted as a within-subjects variable, there is a possibility of

decreased internal validity as the measures were not counterbalanced. All participants received the complete measure of all three outcome variables before and after the experimental condition.

Future Directions

This study reveals many avenues for further investigation. Disgust sensitivity did not explain a significant portion of variance in the model created. However, this creates possibilities to explore other moderating variables, which may impact how exposure to nature influences mood and anxiety. In the research that established the DSS in this study, wilderness fear expectancy and desire for modern comforts were also explored (Bixler & Floyd, 1997). These researchers found that fear expectancy and desire for modern comforts both predicted selection of natural areas and expressed interest in different recreational activities. Individuals who scored higher on fear expectancy and desire for modern comforts were less likely to endorse a preference for wildland environments rather than a manicured park and were less likely to express interest in outdoor recreational activities (Bixler & Floyd, 1997).

The current study's results suggest disgust sensitivity is not a moderating variable in the relationship between type of nature exposure and mood, but it is possible that fear of wilderness might be. Previous research has noted the strong relationship between fear and disgust sensitivity, specifically when considering phobias (Smith & Davidson, 2006). Considering exposure to nature using technology would nullify the desire for modern comforts, a future direction for this research might be to explore whether individuals with

high desire for modern comforts receive more mood benefits from exposure to nature through technological means.

Related to disgust sensitivity and fear expectancy is childhood exposure to nature. Previous research showed individuals who had disgust and fear-evoking experiences in nature while children were less likely to be sensitive to disgust or fear in natural environments as adults (Sugiyama, Hosaka, Takagi, & Numata, 2021). Additionally, childhood exposure to nature increases tolerance of wildlife as an adult (Ngo, Hosaka, & Numata, 2019). These results indicate the long-lasting implications of childhood experiences on beliefs and attitudes as an adult (Ngo et al., 2019). Due to this, childhood nature experiences may also impact both an individual's connectedness to nature and their mood after being exposed to either physically or technologically. Further research could explore how childhood experiences impact an individual's attitudes and beliefs about nature, which in turn influence the efficacy of exposure to nature as an intervention to improve mood and decrease anxiety.

Clinical Implications

The connection humans have with nature has been used in ecotherapy previously. Clinical implications for this study include further information for ecotherapy and related fields, specifically as it relates to positive affect. Different forms of ecotherapy have been shown to improve physical health such as medical recovery, pain reduction, and dementia as well as to treat mental health concerns such as Posttraumatic Stress Disorder (PTSD), ADHD, and to improve cognitive and emotional functioning (Chaudhury & Banerjee,

2020). However, many studies focus on decreasing symptoms such as depression or inattention and taking a general view such as overall well-being or life satisfaction (Chaudhury & Banerjee, 2020). This study implies that positive affect may be improved by physical exposure to nature, which may allow clinicians to encourage individuals to seek out physical time in nature as part of their self-care routines or as a component of a coping plan. These results support a strengths-based approach to mental health care rather than a traditional medical model of symptom reduction, a hallmark of the author's discipline, counseling psychology (American Psychological Association, 1999).

The final results of the study provide a more nuanced view into how exposure to nature impacts mood and anxiety. The way nature impacts positive affect is inherently different than how negative affect and anxiety are impacted. To improve positive affect, physical exposure to nature appears to be the most effective type of nature exposure.

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APPENDIX A

Demographic Information

1. Age: _____

2. Gender Identity:

    a. Cisgender Woman

    b. Cisgender Man

    c. Transgender

    d. Genderqueer/Genderfluid

    e. Other

3. Ethnic background:

    a. Alaskan/Indigenous

    b. White, Non-Hispanic

    c. Black or African American

    d. Latinx/Hispanic

    e. Asian/Pacific Islander

    f. Biracial/Multiracial

    g. Other

APPENDIX B

Participant Instructions

Physical Nature Exposure Group

Welcome to part two of the Interaction of stimuli sensitivity and type of nature exposure on mood and anxiety study. The second portion of the study will require 50 consecutive minutes of your time. Thank you for agreeing to participate.

For the second portion of the study, you have been randomly assigned to participate in the Physical Nature Exposure group. This means you will be spending 15 minutes in nature as part of the study. Select a natural area where you feel comfortable spending 15 minutes. This natural area can be any natural environment to which you have ready access. Natural areas can include: a park, sitting under a tree, watching the sun rise or set etc. When spending time in nature, please refrain from using any technology or speaking with anyone.

You will answer a few questions before and after spending time in nature. You may find it most convenient to make a mobile device with you to answer the questions after you have spent 15 minutes in nature.

Please take a few moments to consider what you would like to use for your natural area. Once you are ready, please continue.

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that

word. Indicate to what extent you feel at this moment (you feel this way right now, that is, at the present moment). Use the following scale to record your answers.

PANAS

VAS-A

Go to your selected natural area. Once you are there, set a timer for 15 minutes. Put away all electronics and sit in your nature area.

Click continue once you have completed your 15 minutes in the natural area.

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel at this moment (you feel this way right now, that is, at the present moment). Use the following scale to record your answers.

PANAS

VAS-A

You have completed this study. Your help is much appreciated!

Thank you!

Technology Nature Exposure Group

Welcome to part two of the Interaction of stimuli sensitivity and type of nature exposure on mood and anxiety study. The second portion of the study will require 50 consecutive minutes of your time. Thank you for agreeing to participate.

For the second portion of the study, you have been randomly assigned to participate in the Technology Nature Exposure group. This means you will be spending 15 minutes watching a nature video as part of the study. The video has been pre-selected by the researcher and will last 15 minutes. When watching this video, please refrain from using any other forms of technology or speaking with anyone.

You will answer a few questions before and after spending time watching the video of nature. Once you are ready, please continue.

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel at this moment (you feel this way right now, that is, at the present moment). Use the following scale to record your answers.

PANAS

VAS-A

Now you will watch the following video. While you are watching the video, please do not use any other type of technology or speak with anyone.

Nature Video (hyperlinked)

Click continue once you have completed watching the video.

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel at this moment (you feel this way right now, that is, at the present moment). Use the following scale to record your answers.

PANAS

VAS-A

You have completed this study. Your help is much appreciated!

Thank you!

APPENDIX C

Connectedness to Nature Scale (CNS)

Please answer each of these questions in terms of the way you generally feel. There are no right or wrong answers. Using the following scale, in the space provided next to each question simply state as honestly and candidly as you can what you are presently experiencing.

1	2	3	4	5
Strongly Disagree		Neutral		Strongly Agree

____1. I often feel a sense of oneness with the natural world around me.

____2. I think of the natural world as a community to which I belong.

____3. I recognize and appreciate the intelligence of other living organisms.

____4. I often feel disconnected from nature.

____5. When I think of my life, I imagine myself to be part of a larger cyclical process of living.

____6. I often feel a kinship with animals and plants.

____7. I feel as though I belong to the Earth as equally as it belongs to me.

____8. I have a deep understanding of how my actions affect the natural world.

____9. I often feel part of the web of life.

____10. I feel that all inhabitants of Earth, human, and nonhuman, share a common 'life force'.

____11. Like a tree can be part of a forest, I feel embedded within the broader natural world.

____12. When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature.

____13. I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.

____14. My personal welfare is independent of the welfare of the natural world.

APPENDIX D

Disgust Sensitivity Scale (DSS)

Please answer each of these questions in terms of the way you generally feel. There are no right or wrong answers. Using the following scale, in the space provided next to each question simply state as honestly and candidly as you can what you are presently experiencing.

0	1	2	3	4
Not disgusting	A tiny bit disgusting	A little disgusting	Somewhat disgusting	Very disgusting

____1. Getting itchy from bug bites and scrapes

____2. Having to sit on a log in the woods

____3. Having to sit on the ground in the woods

____4. Getting itchy from walking through weeds

____5. Having to sit in wet grass

____6. Getting five or six mosquito bites on my arm

____7. Accidentally stepping in mud around a pond

____8. Getting itchy from dust and sweat on my skin

____9. Finding a tick biting my scalp

____10. Feeling a roach crawling across my hand

____11. Finding a tick crawling up my leg

____12. Accidentally stepping in animal droppings

____13. Having to stick my hand in swamp water

____14. Having to pick through pond algae for a biology class

____15. Feeling flies landing in my hair

APPENDIX E

The Positive Affect and Negative Affect Scale (PANAS)

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel at this moment (you feel this way right now, that is, at the present moment). Use the following scale to record your answers.

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

_ interested	_ irritable
_ distressed	_ alert
_ excited	_ ashamed
_ upset	_ inspired
_ strong	_ nervous
_ guilty	_ determined
_ scared	_ attentive
_ hostile	_ jittery
_ enthusiastic	_ active
_ proud	_ afraid

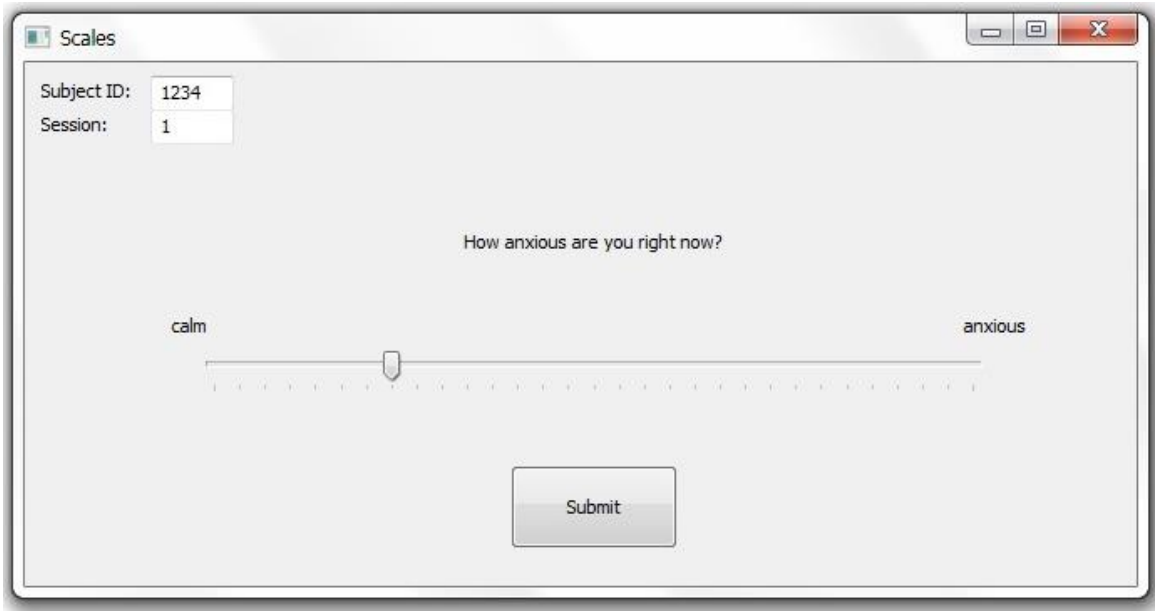
We have used PANAS with the following time instructions:

- Moment (you feel this way right now, that is, at the present moment)
- Today (you have felt this way today)
- Past few days (you have felt this way during the past few days)

- Week (you have felt this way during the past week)
- Past few weeks (you have felt this way during the past few weeks)
- Year (you have felt this way during the past year)
- General (you generally feel this way, that is, how you feel on the average)

APPENDIX F

Visual Analog Scale - Anxiety (VAS-A)


Scales
Subject ID:
1234
Session:
1
How anxious are you right now?
calm
anxious
Submit