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Grief, loss, and climate change: Validation of a solastalgia scale

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

by

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For Koni Steffen, who helped me see that there was a whole world out there,

For Regula Steffen, who helped me find my place in it,

And for Anico and Sarah, who are *my* home.

Acknowledgements

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Abstract

GRIEF, LOSS, AND CLIMATE CHANGE: VALIDATION OF A SOLASTALGIA SCALE

Claire Luce, MSW

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

Virginia Commonwealth University, 2021

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Climate change has been identified as a defining issue of this century (United Nations, n.d.) and has been addressed by many different academic and research disciplines because of that designation. Climate change impacts human wellbeing including mental health. While much research has focused on the way that the effects of climate change cause increases in common mental disorders, mental health is not just the absence of these disorders (World Health Organization, 2014). Non-pathologized mental health responses to climate change, such as the grief and loss that results from climate change impacts, are a growing consideration for researchers. Solastalgia, or the distress experienced in the absence of the solace once provided by the environment in the aftermath of environmental destruction, is one construct in the sub-field of grief and environmental change. Solastalgia has been measured using a scale developed and validated after individual events of environmental degradation or destruction. This study sought to validate the solastalgia scale with a sample of people broadly impacted by climate change using a confirmatory factory analysis, to investigate the relationship between solastalgia and the three common mental disorders most studied in relation to climate change through structural equation models, and to see how demographic factors may have influenced solastalgia scores. The findings support the use of a modified version of the solastalgia scale with a sample of

people broadly impacted by climate change effects. All three structural equation models were a good fit for the data. This study provides important scientific knowledge to expand our understanding of grief and loss that results from climate change.

Keywords: climate change, solastalgia, ecological grief, environmental change

Chapter 1: Introduction

The United Nations (n.d.) calls climate change the "defining issue" of the modern era and argues that we are at an equally defining moment in our history as this global phenomenon continues to have impacts including changes in weather patterns, sea level rise, and flooding. Interdisciplinary research on the development of climate change and the way that it continues to impact the environment has made amazing strides, providing detailed and specific information empirically measuring the impacts of climate change and estimating future climate impact burden. Teams of scientists have found ways to measure the change in the amount of greenhouse gasses in the atmosphere through coring massive glaciers and ice sheets accumulated over thousands of years (Thompson et al., 2003), developed models to predict global temperature increases that may result from the increased amount of gasses like carbon dioxide and methane (Intergovernmental Panel on Climate Change, 2018), and modeled various results of the attendant sea-level rise that is encroaching on coastal areas at ever-increasing rates (Nerem, 2018). Models of summer-season temperature rise can show both the increase in temperature and the change in temperature distribution, as well as provide predictions for ongoing shifts (McKinnon et al., 2016). These worsening present-day and future climate conditions will threaten human health (Watts et al., 2019).

While the investigation into the causes and impacts of climate change has been vast, research on the ways that the effects of climate change may impact the emotional and psychological well-being of people around the world in still emergent even as this phenomenon continues to cause massive changes on both local and global scales. As social scientists, we are primarily concerned with the ways that various phenomena, such as climate change, impact human behavior and well-being. However, in order to compare observable and empirically

measurable impacts of climate change with human experience, we must have a systematic way to understand that experience. While this may be done through qualitative studies, there is much to be gained from having a quantitative approach available, which demands the development and validation of psychometric measures focused on the mental health impacts of climate change. Therefore, this project is an attempt to better understand the ways that current psychometric measures may or may not capture the impact of climate change on mental health and well-being.

History of Climate Change

Scientists have studied the history of global temperature rise and fall over the course of Earth's history by analyzing ice cores from the Arctic and Antarctic regions, tree rings, ocean sediment cores, and other environmental archives of past temperature changes. For example, researchers drill massive cores of glaciers and ice sheets, and by dating the approximate years that the gas was trapped in that layer of ice, they established the content of various gasses in the atmosphere throughout history (Blunier & Brook, 2001; Thompson, 2003). Through the rigorous analysis of these ice cores and the contents of the gas bubbles, clear patterns have emerged. Scientists found that after the industrial revolution, when humans began to burn massive amounts of fossil fuels like coal and petroleum, the quantity of carbon dioxide, one of the most prevalent greenhouse gas in the atmosphere, began to climb at an ever-increasing rate (Keeling, 1960; IPCC, 2007; Scripps Institution of Oceanography, 2021). Studies have now shown that the rate of increase of these heat-trapping gases has exceeded any other natural process of recent geologic history (Zeebe et al., 2016).

It is important to note that a certain amount of carbon dioxide is necessary in the atmosphere. Carbon dioxide serves several important purposes. First, plants use carbon dioxide for photosynthesis, pulling carbon dioxide gas out of the air and turning it into plant forms that

can then be eaten by animals, forming the basis of life on earth. Second, carbon dioxide and other greenhouse gasses keep the heat that is generated by the sun, absorbed by the planet, and re-radiated back into the atmosphere from the Earth's surface from escaping back into space too quickly (Pierrehumbert, 2004). This natural process is called the greenhouse effect and was first linked to global warming potential by Swedish scientist Svente Arrhenius in 1896 (Arrhenius, 1896). However, the amount of carbon dioxide and other greenhouse gasses that are currently being added to the atmosphere is problematic for the sustainability of life on the planet as we know it today. The same greenhouse effect that has allowed the planet to sustain life can trap so much additional heat that global temperatures rise too rapidly for plant and animal species to adjust and adapt in tandem. This phenomenon is known as anthropogenic climate change, or often just climate change.

The first scientific report to draw attention to the phenomenon of rising greenhouse gas levels was called the Keeling Curve (Keeling, 1960). In 1979, The Charney Report predicted an average global rise in temperature of 3 degrees Celsius (+/- 1.5 degrees) if enough carbon dioxide was released to double the atmospheric quantity as a result of human activities (Charney et al., 1979). However, the rise in greenhouse gases was not politicized until the publication of the Bruntland Report (Keeble, 1988), which drew attention to the burning of fossil fuels as the main cause of climate change. From that point on, climate scientists have steadily produced research supporting the argument that the current rise in global temperatures is a result of human activity, namely the burning of fossil fuels. The Intergovernmental Panel on Climate Change was established in 1988 by the United Nations Environment Programme and the World Meteorological Association in order to provide governments with information to create climate policy (IPCC, n.d.). This is achieved by writing reports aimed at policymakers. The IPCC does

not conduct its own research, however relies on scientists from around the world to assist in the writing and publication of the regular reports. As of 2021, the IPCC has 195 members.

IPCC Report

According to a recent report released by the IPCC (2018) and the United Nations (UN; 2018), human emissions of heat trapping gases and other forcing of the climate system has already induced an overall average global temperature increase of 0.85 degrees Celsius (1.53 degrees Fahrenheit). They confirm that this rise in temperature has resulted in an increase in the frequency and intensity of extreme weather events as well as long-term shifts in weather patterns. Additionally, they predict that temperatures will continue to rise to a global average of 1.5 degrees Celsius (2.7 degrees Fahrenheit) if substantial reductions in carbon emissions are not reached in the near future. According to these reports, we know that climate change has and will continue to cause a global temperature increase that has many direct and indirect effects on the environment. Some of the direct effects include melting ice at the poles (IPCC, 2007), rising temperatures in already hot environments in the tropical regions of the world (IPCC, 2007), and warming of oceans (IPCC, 2007). Indirect effects of the global temperature increase include: sea level rise, which results from the melting of the polar ice caps; increased frequency and intensity of extreme weather events, as more water can evaporate into the atmosphere when the air is warmer; and changes in precipitation patterns, causing some regions to become dryer while others flood more often (IPCC, 2007).

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Climate Change and the Impact on People

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Extreme weather events often change the landscape of a place dramatically in a very short period of time. For example, hurricanes can devastate the landscape through high-speed winds, heavy rainfall, and storm surges, as we saw in 2017 with the devastation and loss of life

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Maria wrought in Puerto Rico (Kishore et al., 2018; National Oceanic and Atmospheric Association, 2017). Longer-term shifts in weather patterns may take more time to alter a place but can still make it inhospitable to traditionally native plants and animals that have evolved to that particular climate and can culminate in other extreme events such as mudslides, floods, or wildfires. Additionally, sea level rise threatens cities built along the coast around the world (Clark et al., 2016; IPCC, 2018; UN, 2018), an issue that exacerbates weather events such as hurricanes and also poses long-term problems.

Connection to Social Justice

According to Dominelli (2012), marginalized populations, such as low-income communities, communities of color, women, youth, and older adults, are disproportionately impacted by the effects of climate change. This disparity is complex and deeply structural. It occurs because of limited political, economic, and social power to affect change as well as limited ability to leave regions that are dangerous or no longer hospitable due to shifts in weather patterns or sea-level rise (Bohra-Mishra et al., 2014; Dandy et al., 2019). Although climate change impacts all people to varying degrees, the disproportionately more aggressive impacts on already marginalized populations is what makes this an important social justice issue.

Climate Change and Wellbeing

All of the previously mentioned effects of climate change have a devastating effect on both the natural and built environments. Climate change also impacts people through economic losses, injuries, and deaths due to these events and their aftermath. However, research is just starting to investigate the relationship between extreme weather events, often referred to as natural disasters, and the well-being of people. For example, research has found a link between extreme weather events and mental health diagnoses including the individual diagnoses of and

comorbidity among post-traumatic stress disorder (PTSD), depression, and anxiety (Neria et al., 2008; Obradovich et al., 2018; Tang et al., 2014). However, researchers are just beginning to examine and understand the mental health impacts of climate change outside of these common mental disorders. These less common mental health afflictions may be broadly affecting larger segments of the population in ways more substantial than the narrow definitions of diagnostic mental health disorders.

There are natural disasters that are not confidently tied to climate change, such as earthquakes or tsunamis. These disasters also have impacts on people's mental health, including their rates of anxiety, depression, and PTSD symptoms (Cénat et al., 2020; Luce et al., 2021; Xi et al., 2020; Yokoyama et al., 2014). However, these are not the types of natural disasters I discuss in this study as they are not exacerbated by the rise in global temperatures due to human activity.

Mental Health

Research and scholarship may have focused so narrowly on these three mental disorders due, in part, to the fact that mental health is often operationalized using mental disorders. However, according to the World Health Organization's (2014) definition, mental health is not just the absence of illness or disease but is a state of well-being that allows each individual to realize their own potential, manage normal life stress, and contribute to their community. For the purposes of this paper, I use this definition of mental health which goes beyond the boundaries of diagnostic mental disorders. This more holistic definition of mental health is in line with the ethics that undergird the social work profession. Social workers are taught to advocate for social justice and to use a strengths perspective, which allows practitioners and scholars to examine the way that power structures influence mental health diagnoses (Payne,

2014; Saleeby, 1996). Therefore, social work scholars are ethically bound to research non-pathologized mental health responses that may impact an individual's ability to contribute to their community or otherwise function in their life.

Non-Pathologized Mental Health. One non-pathologized mental health response to changes in the natural environment identified by researchers is solastalgia. Albrecht (2006) defines solastalgia as the mental discomfort or pain caused by an individual's inability to gain solace or comfort from the present state of their home environment. In his original description of the phenomenon, he explains that it is prevalent in any context where there is a direct experience of destruction or negative change in the environment. The ongoing investigation of solastalgia builds on the growing body of research investigating the widespread, pervasive, complex, and dynamic effects that climate change has on human physical and mental health (Berry et al., 2010; Berry et al., 2018; Bourque & Cunsolo Willox, 2014; Costello et al., 2009; Doherty, & Clayton, 2011; Dominelli, 2012; Hsiang et al., 2013; Obradovich et al., 2018; Tschakert et al., 2017). This study seeks to validate an existing measure of solastalgia (Higgenbotham et al., 2006; Eisenman et al., 2015) among a sample of adults impacted by climate change and related stressors to assess how well the measure and related construct relate to indirect experiences of environmental destruction and transformation due to climate change.

Relevance to Social Work Profession

The populations who experience the most devastating impacts of climate change are also those traditionally served by the social work profession. Additionally, the American Academy of Social Work and Social Welfare included "creating social responses to a changing environment" as one of the 12 Grand Challenges guiding the profession (Kemp & Palinkas, 2015). Finding new ways to better understand the mental health impacts of climate change fits squarely into this

Grand Challenge. The International Federation of Social Workers (IFSW; 2012) stated their commitment to working toward sustainable environmental development while maintaining the dignity and worth of persons. Therefore, the issue of climate change is of paramount importance to the social work profession.

Social workers serve in many capacities including as providers of mental health care. Therefore, understanding all of the things that impact mental health is relevant to our clinical work as well as our policy work. Some researchers and clinicians have begun to explore the ways that individual and group counseling can contend with climate change and its related mental health burden (Buzzell, 2017; Hasbach, 2015), with one study finding that clinicians providing mental health treatment did not feel their training prepared them to discuss the psychological responses to climate change (Seaman, 2016). This exposes a gap between the needs of the clients and the ability of our profession to respond to that need, which can only be filled by creating psychometrics to capture the mental health impacts of climate change. Continuing to use research and funding resources to pursue scholarship connecting climate change and mental health will only advance our field and improve the well-being of the populations social workers serve.

<div align="center">**Measurement**</div>

Our understanding of the epidemiology of mental health disorders as well as non-pathologized mental health responses to stimuli relies on the development and validation of psychometric measures (Devellis, 2017). For many of the most common mental health diagnoses, such as depression, we have a plethora of measurement options that allow researchers to assess this construct in a variety of circumstances and populations (Beck et al., 1996; Derogatis, 1974; Lovibond & Lovibond, 1993). If measures are not rigorously tested with

attention to structural power dynamics, we will continue to assume that measures are valid across all populations, possibly missing major differences for populations that are already without power in society.

Because the research on the experiences of grief and loss that result from climate change is still emerging, there is a paucity of measures focused on relevant constructs. One measure that is available is for solastalgia (Higgenbotham et al, 2006), which was developed to assess the experience of loss felt by individuals living in a community recently impacted by significant environmental change. While this measure has been validated in other similar contexts (Eisenman et al., 2015; Warsini et al., 2014a), and there are theoretical arguments that the construct of solastalgia may encompass some of the experience of those impacted by climate change (Albrecht, 2017; Cunsolo & Ellis, 2018; McNamara & Westoby, 2011), this measure has not been validated with a sample of individuals broadly affected by the impacts of climate change. In order to begin to understand the grief and loss resulting from climate change, we must begin by assessing if the current measures we have are valid in this context.

Research Questions

This study seeks to expand scientific knowledge about the relationship between the impacts of climate change and mental health. The primary aim of this study will be broken down into three research questions: 1) is this solastalgia scale valid and reliable with a sample of people broadly impacted by climate change? 2) what is the relationship between symptoms of anxiety, depression, and PTSD and solastalgia? 3) how do demographic factors impact solastalgia scores in this sample?

Chapter 2: Literature Review

The research questions for this study were informed by both theoretical and empirical literature drawn from multiple disciplines. As the theoretical literature provides the foundation for both my research questions and the project as a whole, I will discuss that first. Next, I will provide an overview of empirical literature related to experiences of loss connected to climate change and how those inform the current study.

Theoretical Literature

The research project is grounded in two main theories: place attachment theory, specifically drawn from the work of Manzo and Devine-Wright (2014), and the framework of ambiguous loss (Boss, 2009). These two theoretical perspectives provide structure to understand the complexity inherent in the relationship between people, the places that they call home, and the feelings they experience after those places are irreparably damaged or changed due to climate change stressors.

Place Attachment Theory

Place attachment theory tells us that we become emotionally and psychologically attached to places that have meaning to us and that leaving those places or seeing them destroyed is extremely painful—we actually grieve the loss. This is an important aspect of the painful feelings of loss in the aftermath of extreme weather events or other effects of climate change (Cunsolo & Ellis; 2017; Cunsolo & Landman, 2017). Additionally, Dandy et al. (2014) argue that place attachment may be a large factor in limiting migration due to climate change. Some individuals may choose not to leave in advance of a natural disaster or may stay even as long-term changes in weather patterns make life more difficult, only leaving after daily living has

become intolerable. This research shows how strong human connection is to place, even when that place has become unsafe or has undergone extreme change.

Research has also shown that place attachment is connected to a variety of constructs including pro-environmental behavior (Ramkissoon et al., 2013), acceptance of renewable energy transitions (Devine-Wright, 2011), and the development of a sense of community (Ram et al., 2016). Additionally, one study found that lower-income neighborhoods had lower levels of place attachment due to the higher rates of neighborhood turnover and the lower levels of social cohesion (Bailey et al., 2012). Natural disasters often alter the natural and built environments of a place either temporarily or permanently, and research has found that place attachment impacts people in the aftermath of these disasters. Among children, place attachment increases disaster preparedness in advance of a disaster, and after a disaster, previous or newly formed place attachments increase resilience (Scannell et al., 2016). One study found that perceived risk had a negative impact on place attachment while increased coping had a positive impact on place attachment in the aftermath of a major earthquake (Zheng et al., 2019). Place attachment theory provides an important foundation for the complex impact that climate change has on feelings of grief and loss due to environmental degradation.

Ambiguous Loss

The ambiguous loss framework (Boss, 2009) helps us understand the complex pain associated with certain types of loss that are undefined or do not yet have a culturally significant ceremony to provide closure. The initial ambiguous loss literature explained the experience of the family members of soldiers who went missing during wartime, and it has since been found to capture many other types of loss. Specifically, in her earliest book on the construct, Boss (2009) described how some families had members who were psychologically present but physically

absent, such as those lost during war or the parents of a child who had been kidnapped. Examples of ambiguous losses are widespread and ubiquitous and include but are not limited to having a family member who is Missing in Action (Boss, 1999), experiencing pet loss (Green et al., 2018), experiencing a miscarriage (Mcgee et al., 2018), and losing one's home or homeland (Boss, 1999). Additionally, family members of those lost in the September 11th terrorist attacks identified their experience as ambiguous loss because of the non-normative way their loved ones died and the many bodies that were not recovered from the disaster site (Boss et al., 2003). Ambiguous loss has been identified as an aspect of gender transition for families with a trans-identified member (McGuire et al., 2016; Norwood, 2013). Finally, research has identified an ambiguous loss of homeland among immigrants (Perez, 2016; Solheim et al., 2016). These examples of ambiguous losses, while distinct in their details, all describe the experiences of psychological distress, isolated grief, and difficulty coping after the loss, drawing them together under this framework.

Previous studies of ambiguous loss have almost always used qualitative methods to understand the ongoing experience of ambiguous loss among study participants (Boss, 2003; Robins, 2016) or have used other constructs, like depression (Baraković et al., 2013; O'Brien, 2007; Pagani et al., 2014), anxiety (Baraković et al., 2013; Pagani et al., 2014), complicated grief (Shear & Delaney, 2015), or overwhelming grief and functioning (Boss, 2006) to assess change in participants' experience after an intervention. Ambiguous losses are often addressed with treatments and therapies similar to those used after more culturally-identified and -accepted losses, which fails to account for the unresolved nature of these experiences. The early studies on ambiguous loss took place with the families of military members who were missing in action and then with the families of individuals with dementia or Alzheimer's disease.

Because the effects of climate change are a set of complex phenomena (IPCC, 2018), it can be difficult for people to see how they connect to one another and to understand the way that they cause a place to change over time. Each region has a different set of climate change-related alterations; some may experience more rain while others experience desertification. Also, while these shifts in weather patterns may create the conditions for larger disasters, such as wildfires, the connection between the two may not be immediately obvious. And because climate change has been caused by such large-scale human activities, like the burning of fossil fuels and increased meat consumption worldwide (IPCC, 2018; UN, 2018), individuals may feel as though they have no ability to affect the processes that lead to climate change (Doherty & Clayton, 2011). Discomfort with uncertainty and feelings of powerlessness can combine with grief for a lost place leading to intensified pain.

These two theories help frame our understanding of the grief and loss that result from climate change by explaining the attachment to the world around us and they also explore why losses that are not culturally defined cause such uncertainty and unique pain. They provide an invaluable starting point for our understanding of the grief and loss that result from climate change. However, the connection between these theories may be missing the concrete connection to the everyday lived experiences of loss and mourning. The empirical literature on ecological grief and other experiences of loss and mourning of the natural environment relies on these theories as a foundation for the scientific investigation of this phenomenon. Additionally, these theories provide a basis for understanding the creation of art and other cultural contributions, discussed later in this chapter, that are intended to explore the pain that results from the ambiguous loss of place caused by climate change.

Empirical Literature

The relationship between the framework of ambiguous loss and place attachment theory provides an excellent foundation for our understanding of the grief and loss that results from environmental destruction or degradation, including that which results from climate change impacts. Empirical studies provide additional depth to the connection between the natural environment and the wellbeing of people. The studies discussed in the following sections outline research on varying attitudes toward climate change, mental health disorders and environmental change, and the way that non-pathologized mental health is impacted by climate change and other types of environmental degradation. These areas not only provide humanizing detail to this field but also provide connections to the additional constructs that impact the relationship between climate change and mental health.

Attitudes about Climate Change

While the impacts of climate change are worldwide, individual attitudes and understandings about this phenomenon vary. The majority of studies focus on the variation of attitudes within one single country, such as the United States, even though the global temperature increase and its subsequent impacts are a worldwide problem that requires collaboration across countries. In the United States, studies have investigated the relationship between attitudes toward climate change and news media coverage of climate change (Newman et al., 2018), populist attitudes (Huber, 2020), and wealth redistribution (Panno, 2019). One international study found that environmental values predict attitudes toward climate change policy in Germany, China, and the United States, but political affiliation has a bigger impact on climate attitudes among US residents than those of other countries (Ziegler, 2017). Continuing to

investigate the way that attitudes toward and responses to climate change vary across the world will contribute to our understanding of possible international solutions.

Researchers have also investigated how age influences attitudes toward climate change denial and climate change policies because younger generations (i.e., millennials and Generation Z), have been exposed to the impacts of and discussions about climate change for the majority of their lives. One study found that Republicans from the Millennial generation were less polarized in their ideas about climate change than Republicans from previous generations (Funk & Heffron, 2018). Additionally, Millennial Republicans are more likely to worry about global warming, understand that it is human caused, and understand the agreement among climate scientists about the scientific evidence, than Republicans of older generations (Ballew et al., 2019). That same study found, however, that both Millennial Democrats and Republicans are equally unlikely to hear about climate change in the media at least once per week. Millennials in particular may be any more likely to act on issues of climate change than older generations (Kuppa, 2018). However, there is also research that shows that age and generational cohort have no impact on environmental concern or preventative actions (Gray et al., 2019). These differences in attitudes about climate change informed the development and use of demographic variables for this study including age and location which served as grouping variables for bivariate analyses.

Mental Health

Research has shown that climate change has an impact on the well-being of people (Berry et al., 2010; Bourque & Cunsolo-Willox, 2014, Clayton et al., 2014; Orbradovich et al., 2018). Not only do we know that extreme weather events impact physical health (Costello et al., 2009) and economic growth (Burke et al., 2015), but we know that warmer weather also results in

strained mental and physical health (Parker et al., 2019; IPCC, 2018), and increased conflict (Hsiang et al., 2013). In the aftermath of extreme weather events, people experience increased symptoms of depression, anxiety, and post-traumatic stress disorder (PTSD; Neria et al., 2008; Obradovich et al., 2018; Tang et al., 2014)). Therefore, empirical research indicates that the many effects of climate change have a negative impact on humans in these myriad ways.

Mental Health Disorders

Much of the current social science research on the relationship between mental health and climate change has focused on the way that climate change exacerbates symptoms of common mental health disorders such as depression, anxiety, and PTSD (Beaglehole, 2018; Neria et al., 2008; Obradovichet al., 2018; Tang et al., 2014). One meta-analysis found that the positive relationship between natural disaster exposure and common mental disorders is ubiquitous across studies but that there were methodological limitations among many of these studies which relied on cross-sectional design, univariate analysis, and retrospective measures (Chen et al., 2020). Chen et al. (2020) also found that resilience was more common than diagnosed mental health disorders, highlighting the importance of research on non-pathologized mental health relating to the impacts of climate change.

Research on the relationship between climate change-related natural disasters and common mental disorders was the basis for the second research question in this study. I included measures to capture anxiety, depression, and PTSD in order to situate this study on grief and loss within the more robust literature around climate change and mental disorders. To date, studies of the impacts of climate change on mental health disorders and non-pathologized mental health have largely been separate.

Positive Mental Health

In addition to the robust and well-established research on natural disaster exposure and common mental disorders, there is also research on the relationship between the natural environment and positive mental health. Research has shown that exposure to nature or urban green-space is beneficial to mental and physical health (Bowler et al., 2010; Hartig et al., 2014; Tyrväinen et al., 2014) and is correlated with lower mortality rates (Gascon et al., 2016). It is also important to acknowledge that mental health does not just mean the absence of mental disorders. In fact, the United Nations (2018) defines mental health as an individual's ability to positively contribute to their community and participate in their culture. Understanding the relationship between positive mental health and the natural environment informed the inclusion of the connectivity with nature measure in this study.

Solastalgia and Ecological Grief

One emotional and psychological process that is natural and expected, but still might impact an individual's mental health, is the experience of grief resulting from the impacts of climate change. Emerging research from an interdisciplinary group of scholars has begun to connect the experiences of grief and loss to the phenomenon of climate change and its related stressors (Albrecht et al., 2007; Cunsolo & Ellis, 2017; Cunsolo & Landman, 2017). This field includes the constructs of ecological grief and solastalgia. The construct of solastalgia captures the experience of loss as a result of environmental destruction or degradation and is the compilation of the words solace and nostalgia (Albrecht, 2017). Solastalgia was originally identified in the aftermath of a single event that resulted in environmental degradation and destruction (Albrecht et al., 2007) and has since been connected to the literature on ecological grief (Albrecht, 2020). Albrecht (2020) argues that solastalgia is connected to ecological grief

but unique in its conception of the relationship between people and their concept of "home." Additionally, and possibly most importantly, is that solastalgia is grounded in the Freudian definition of mourning and melancholia (Albrecht, 2017). Pulling from the Freudian understanding of the grief process places a focus on solace or comfort that was once given by the environment that has disappeared due to the degradation or change. This understanding of grief places the focus on the individual doing the grieving.

While the research on solastalgia predates scholarship on ecological grief, there are still notable gaps in the literature. One scoping review of the solastalgia literature found that the research on this construct would benefit from diverse methodologies, more diversity of people and places studied, and more attention to practical applications of research findings (Galway et al., 2019). Additionally, Askland and Bunn (2018) argue that while solastalgia exposes the relationship between environmental destruction and related human distress, it may not be sufficiently complex to encompass the full extent of the relationship between humans and the natural environment. In previous research, solastalgia has been measured using a subscale from the Environmental Distress Scale (EDS) developed by Higgenbothom et al. (2006).

The construct of ecological grief is related to solastalgia but distinct in its scope and grounding theories. Ecological grief is defined as the experience brought on by the anticipated or actual loss of natural environment, physical spaces, ecosystems, species, and weather patterns (Cunsolo & Ellis, 2018b). This definition is not rooted in a Freudian conception of grief and is not connected to melancholy, nostalgia, or the absence of solace due to environmental change. Additionally, themes of ecological grief have been identified across cultures (Cunsolo & Ellis, 2018a). Research has yet to parse apart the specific dimensions of ecological grief; however, previous qualitative research indicates it may be multidimensional (Cunsolo & Ellis, 2018b).

Finally, the broader literature around grief, loss, and mourning resulting from environmental change draws together the constructs of solastalgia and ecological grief by analyzing the history of grief theories and showing how interdependent these constructs are. Namely, Cunsolo and Landman (2017) acknowledge the importance of Freud's contribution to our understanding of grief but then continue to integrate more modern grief scholarship into their definition. They argue that we can experience grief even if we did not have a personal relationship with someone or something because we are able to care for people and places even if they do not directly provide us with solace or comfort. This connection between solastalgia and other types of environmental grief and loss is relevant to this study and the need for valid measures to capture these constructs. While the solastalgia scale (Higgenbotham et al., 2006) has shown validity in the aftermath of individual events of environmental change and degradation (Eisenman et al., 2015; Warsini et al., 2014a), it has not been validated with a sample of people more broadly impacted by the effects of climate change. Additionally, it was developed as a unidimensional scale, which may not be complex enough to capture the full experience of the ambiguous loss of place. Testing the validity of the solastalgia scale with a sample of people impacted by climate change may provide additional insight into the way that solastalgia is related to other aspects of grief, loss, and mourning due to environmental loss.

Orientation to Environmental Grief

Scholarship on the grief and loss resulting from climate change and other types of environmental destruction is relatively young, beginning about 15 years ago and growing ever since. However, expressions of grief, loss, and mourning existed long before scholars identified the constructs of solastalgia or ecological grief. In this section, I will discuss the way that grief and loss due to environmental change have been portrayed throughout our culture as well as the

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ways that modern researchers have used their personal experiences to connect them to their scholarship, further showing how humans are not separate from the world that we inhabit.

Cultural Expressions of Grief

While the scholarly literature discussing the grief and loss that results from environmental change is relatively young in the social sciences, there have been cultural expressions of that grief for many years. In one of the first books highlighting the impact of humans on the natural world, *Silent Spring*, Carson (1962) opens with a moving scene that paints a picture of what the world might look like if there was no intervention to stop the destructive impact of dichlorodiphenyltrichloroethane (DDT) and other similar pesticides. While the book was deeply grounded in complex science, the connection to the human experience of loss made the book a seed that ignited movements for regulations that preserved air and water across the United States (Griswold, 2012). Documentary films, such as *An Inconvenient Truth* (Guggenheim, 2006) and *An Inconvenient Sequel: Truth to Power* (Shenk & Cohen, 2017), directly confront climate change incorporating the emotional connection humans have to the world around them. These are examples of ways in which experts have used their knowledge to create media that harnesses the emotions experienced as a result of climate change, including grief and loss.

More artistic expressions of grief and loss due to environmental degradation also exist. Novels such as *The Book of Joan* (Yuknavitch, 2018), *Flight Behavior* (Kingsolver, 2012), and *The Bone Clocks* (Mitchell, 2014) use stories to delve into the emotional experience of loss that results from environmental change. Both Yuknavitch (2018) and Mitchell (2014) use fantasy and future-casting to create worlds in which climate change has advanced to a dangerous degree, portraying an extreme possibility of what environmental loss and subsequent grief may feel like.

In *Flight Behavior*, Kingsolver explores how the pain of environmental change impacts people no matter how much they understand the scientific causes of those changes. This echoes the work of Cunsolo and Ellis (2018) on ecological grief and its prevalence across cultures.

Films made for children such as *Ferngully: The Last Rainforest* (Kroyer, 1992), *WALL-E* (Stanton, 2008), and *Moana* (Clements & Musker, 2016) have directly incorporated themes of grief and loss resulting from environmental change and destruction due to human action. In fact, *Moana* (Clements & Musker, 2016) clearly portrays solastalgia at the beginning of the film as the villagers experience distress due to the sudden degradation of their island ecosystem, as well as broader themes of ambiguous loss related to environmental destruction throughout the film. Both *Ferngully* (Kroyer, 1992) and *WALL-E* (Stanton, 2008) have story arcs that show the pain of human-caused environmental change and end with messages of hope. Finally, visual artists have creatively depicted grief and loss resulting from climate change in pieces like *TIDE* (Kenyon, 2020) which showcases the loss of homes resulting from climate change related flooding.

Scholar's Experiences

Much of the literature on environmental grief and loss and related constructs includes the author's personal experience with the subject matter, highlighting the connection between the scholarly material and the individual doing the research. This is common in this sub-field of grief and loss work, as Boss (1999) wrote about her family's experiences with ambiguous loss in her first book on the construct. Also, Kessler began the seminal book *On Grief and Grieving* (Kübler-Ross & Kessler, 2005), with a preface about his experience grieving the death of his co-author and longtime mentor, Elizabeth Kübler-Ross. Kessler's most recent book, *Finding Meaning: The Sixth Stage of Grief* (2019), shares his personal experience moving through grief

and loss after the death of his son. The use of the first-person accounts of the experiences described in these texts can help connect the academic theories and research back to the quotidian human pain of losing someone or something beloved.

In the interdisciplinary literature on grief, loss, and climate change, many scholars have also shared their personal experiences in a variety of ways. Cunsolo (2018) opens *Mourning Nature* with an essay articulating her own experiences of connection to the natural environment and the feelings of loss she has experienced as she has seen places she loved permanently altered through global climate change. Albrecht (2018) adds his own experience of distress when he updates his discussion of solastalgia in light of ongoing environmental change and destruction. One glaciologist, Konrad Steffen, worked with NASA to create a short film about the warming in the arctic region of the world (Van Bruggen, 2018). Steffen had nearly 20 years studying the Greenland ice sheet from a semi-permanent encampment called Swiss Camp. He melds his expertise as a glaciologist with his personal experience seeing the Greenland ice sheet melt and be irreparably changed. While he does not mention the words grief or loss, he articulates those themes throughout his narration. In this way, he connects his experience to the grief that the viewer also experiences and provides a starting place to make meaning of those emotions.

Personal Orientation

Like all of the scholars, researchers, and scientists who have come before me and were moved to work on issues related to environmental change, I have my own experience with emotional attachment to the changing world that has resulted in grief, loss, and mourning. I don't remember a time when I was not equally fascinated by the natural world and horrified by human-caused harms to it. However, I do not have a single event that brought about my interest in environmental issues or that highlighted my experience with grief and loss due to environmental

change. I believe that this is why the development of this field, and its move away from Freudian understandings of grief and loss by Cunsolo and Landman (2017), has spoken to me so much as a scholar and a person. The more research I read, the more my own emotional experience living in a climate changing world makes sense to me. Daily, I experience grief for the loss of life due to major natural disasters as well as the slow drip of ice melting in Greenland. And, just as the five-stage model of grief (Kübler-Ross & Kessler, 2005) brought new understanding to an everyday emotional experience, the literature on ecological loss has helped me see that my experiences are the same as that of so many others. So, just like the scholars who have come before me, I bring my own grief with me and I use it to try to make meaning from the loss. This drive to make meaning is what has driven me to create this research project, hoping to draw even more understanding around the relationship between solastalgia and the broader experiences of grief and loss resulting from climate change, and perhaps set the stage for additional projects on the measurement of these constructs.

Chapter 3: Research Methodology

In this chapter, I will outline the methodology of this exploratory research study which included primary data collection, participant recruitment, data cleaning, and finally data analysis. The method was guided by these three research questions: 1) is this solastalgia scale valid and reliable with a sample of people broadly impacted by climate change? 2) what is the relationship between symptoms of anxiety, depression, and PTSD and solastalgia? 3) how do demographic factors impact solastalgia scores in this sample? This chapter will outline the methods followed as well as discuss inherent design limitations and changes to the proposed method that occurred during the implementation of this project.

Study Design

This study was designed to test the validity and reliability of the solastalgia scale with a sample of people who had been impacted by climate change in a broad variety of ways. It is an exploratory study since the field of environmental grief is still emergent. This study was not intended to be generalizable, but to be an initial point of understanding around the measurement of grief and loss resulting from the impacts of climate change through the validation of this solastalgia scale. Therefore, I want to acknowledge the limitations that were inherent based on the study design. First, this study was only available to people who had internet access, and since recruitment was worldwide, there were large swaths of the global population that were unable to participate. Additionally, since recruitment was done using social media and email listservs, recruitment was limited to users of those social media platforms and people who were part of relevant listservs. Because recruitment sought to target individuals who had certain life experiences, I knew that the sample would not be representative and that there would be violations of assumptions of normality due to the study design. Additional limitations to the

study occurred as a result of the COVID-19 pandemic, which had an impact on data collection

and survey response rate, which are discussed in the following section on recruitment.

<center>**Recruitment and Sample**</center>

Because the impacts of climate change are worldwide and experiences of grief and loss

have been found across cultures (Cunsolo & Ellis, 2018; Cunsolo et al., 2020), this study sought

to incorporate as many different individual experiences as possible through maximum sampling

variation. Additionally, I sought to identify if this solastalgia measure was valid with the broad

experience of climate change. Therefore, this study only limited participants by the following

inclusion criteria: ability to respond to all questions in English and over age 18. The literature on

non-pathologized mental health responses to climate change, such as solastalgia and ecological

grief, suggests that there are three distinct categories of individuals, each of which describes their

feelings of loss differently as a result of their lived experience (Cunsolo & Ellis, 2018a). These

groups are: 1) individuals who have directly experienced a climate change related natural

disaster in their hometown/region; 2) individuals who work directly with the land, such as

farmers or fisherpersons; and 3) individuals who experience climate change indirectly or in a less

concentrated manner. A combination of purposive and availability sampling strategies were used

to recruit participants representing all three of these groups.

These three distinct categories that emerged from the research on ecological grief

(Cunsolo & Ellis, 2018a) are closely tied to the theories that this study draws from: place

attachment theory (Manzo & Devine-Wright, 2014) and the framework of ambiguous loss (Boss,

1999). The first category, people who have experienced or survived a natural disaster, have

experienced a disruption to their home, a place they are attached to, that they cannot necessarily

process because the loss is ambiguous. The second group, people who work directly with the

<center>35</center>

land, may experience their attachment to place differently, because they are economically dependent on the natural environment. This may impact their experience of grief or loss that results from climate change and also create additional ambiguity to those losses experienced. Finally, the third group of people, those who experience impacts of climate change less directly, may express their grief and loss differently than the first two groups because they do not witness changes to places they are attached to as intimately. The relationship between these three categories and the theories that guide this study, informed the design of this research project.

Recruitment was conducted using social media and through listserv emails. Recruitment email communications and social media postings are available in Appendix B. I posted a link to the survey on Twitter and Instagram, and the posts were shared by others which allowed me to reach a wider audience for potential recruitment. I identified listservs where the survey could be distributed to individuals who might be willing and able to further distribute the link to their networks in order to try to recruit individuals who had survived climate related natural disasters and who worked closely with the land. These listservs included the Environmental Fellows Program alumni network, which includes interdisciplinary environmental justice professionals from traditionally underrepresented groups; the environmental social work email listserv, which includes social work practitioners and researchers interested in environmental and environmental justice social work; and a listserv for educators who teach climate change and climate justice at the K-12 level. In advance of all data collection this study was reviewed and approved by the VCU IRB as an exempt status study.

Data collection was monitored using the internal REDCap tools to assess how many surveys had been completed. There were a number of factors that impacted the total number of participants in this study. First, this project was designed before there was any knowledge of the

coming COVID-19 pandemic and the ways that it would impact daily life and therefore data

collection, over the duration of this study. Second, because data collection coincided with

hurricane season in the southeastern United States and fire season in the western part of the

United States, some planned recruitment had to be cancelled because of ongoing disaster and

disaster response. While the original goal of this study was to have about 2000 completed

surveys, it was designed so that it could be completed with at least 200 complete surveys (Wolf

et al., 2013). After completed surveys passed 200, and ongoing recruitment efforts were not

successful, data collection was concluded. A total of 363 surveys were begun by participants,

however only 234 were complete. For this study, only complete surveys were included in

analyses.

Originally, I planned to run four CFAs, one with each of the three groups identified by

Cunsolo and Ellis (2018) and one that was a mix of all three groups. However, there were not

sufficient participants in two of the three groups (people who worked directly with the land in

agriculture/farming/fishing/etc.; and people who had not experienced a natural disaster) to

complete these analyses with this sample.

Data Collection

All data were collected using online surveys in REDCap (Grant number UL1TR002649).

Data collection took place between June and September of 2020. In addition to detailed

demographic data and the solastalgia measure, the survey included measures of the three mental

health disorders most commonly included in research on the relationship between climate change

and mental health: post-traumatic stress disorder (PTSD), anxiety, and depression. Additionally,

a measure to capture participant's connection to the natural environment was included.

Collecting data on these constructs allowed me to analyze relationships between solastalgia and

aspects of mental health that have been studied most in relation to climate change. Data were cleaned and examined using SPSS. Confirmatory factor analysis and structural equation modeling were run in MPlus.

Survey

The survey used in this study includes demographic questions that were developed for this study as well as previously validated psychometric measures for solastalgia, anxiety, depression, PTSD, and connectivity with nature.

Demographic Questions

Age

Age was assessed using an open-ended question. This variable was used as a control variable in analyses and to assess for variance across age. To assess measurement invariance, age was collapsed into two categories: those aged 21-39, and those aged 40-81. Participants under 40, those of the millennial and Generation Z groups, have been exposed to discussions about climate change for their entire lifetimes, and are anticipated to have had a distinctly different experience of and relationship to the natural environment. For bivariate testing, age was divided into categories based on generation: Generation Z, Millennials, Generation X, and older generations.

Gender Identity

Participants were asked to indicate their gender identity from this list of options: cisgender man, cisgender woman, transgender man, transgender woman, nonbinary, other identity. If their gender identity was not available on the list, they were asked to self-describe it. In order to test invariance, gender was collapsed into two categories: cis-gender women and

those of other gender identities as cis-gender women made up more than half the sample. Gender identity was also used as a grouping variable for ANOVA analysis.

Race

All participants were asked to disclose their self-identified race and ethnicity from a list of checkboxes, allowing them to select more than one option. During data cleaning, individuals that selected multiple categories were recoded as Multi-racial/Mixed. Race was used as a grouping variable for ANOVA tests.

Region

Participants were asked to select a major region where they live from the following options: North America, South America, Africa, Europe, and Asia/Australia. After selecting a region, participants were asked to write in the name of the country where they live, followed by the postal code. For the current analysis, region was included as a grouping variable for ANOVA analysis.

Spirituality

Participants were asked if they identified with a particular spiritual or religious tradition. Responses were collected categorically from the following options: none or no identification, atheist, agnostic, Buddhist, Christian, Jewish, Muslim, Hindu, Spiritual, Indigenous or nature-based religion, and other (with option to specify). If participants selected more than one option, they were recoded into the best fitting category. For example, if they selected Christian and other, and specified 'progressive Christian' they were recoded as Christian. If they selected multiple denominations or traditions, they were recoded as other. Spirituality was used as a grouping variable for ANOVA analysis.

Relative Income

Participants were asked their income relative to the community they live in. They were

asked what quartile they fell into (i.e. I make more than at least 75% of the people in my city or

town, I make more than about half of the people in my city or town.) This allowed me to assess

relative wealth and poverty, which is more useful than empirical income given the broad

sampling strategy of this study. Relative income was used as a grouping variable for ANOVA

analysis.

Employment Status

Participants were asked if they were employed full time, part time, working as an

entrepreneur/self-employed, unemployed, or acting as an unpaid caregiver. If participants

indicated they were unemployed, they were asked if they were unemployed as a result of the

COVID-19 pandemic. Employment status was used as a descriptive statistic.

Occupation

Participants who indicated that they were employed full or part time were asked to

indicate their occupation categorically. Participants were asked to select from the following

options: hospitality or food service, healthcare professional, social services/NGOs/non-profit,

agriculture/farming/fishing, legal/law/policy, education, engineering/construction/public works,

manufacturing/production, government, or other. Occupation was used as a grouping variable for

ANOVA analysis.

Natural Disaster Exposure

Participants were asked if they had been exposed to a natural disaster. If they reported

that they had been exposed to at least one disaster, they were asked to describe that disaster

categorically using the following options: hurricane, tornado, wildfire, mudslide, earthquake,

tsunami, flood, blizzard, drought, or other. Disasters, such as earthquake and tsunami, that are

not confidently or directly tied to climate change were included for subsequent analysis.

Participants who indicated they had experienced a natural disaster and indicated other, were

asked to specify the type of disaster. Those who indicated the COVID-19 pandemic as a natural

disaster were recoded as never having experienced a natural disaster. Those with disaster

exposure were asked to indicate how much they felt that the natural disaster impacted their life

with choices ranging from not at all impacted (=1) through extremely impacted (=4). Finally,

participants were asked to indicate how many years ago the disaster had occurred and to identify

the specific disaster by name or descriptor. Natural disaster exposure and type of disaster were

both used as grouping variables in bivariate analysis. All variables are summarized in table 1.

Table 1

Descriptions

Variable	Description	Response Categories	Scoring Range
Age	Continuous	Open	
Age invariance	For invariance testing, binary	0=Generation Z +Millennial 1=Generation X + Greatest Generations	
Age Categories	For ANOVA tests, categorical	0=Generation Z 1=Millennial 2=Generation X 3=Baby Boomer and Greatest Generations	
Gender identity	Categorical	0=Cisgender man 1=Cisgender woman 3=Transgender man 4=Transgender woman 5=Nonbinary 6=Other gender identity	
Gender invariance	For invariance testing, binary	0=Cisgender woman 1=Other gender identities	
Race	Categorical	1=Arab/Arab American 2=Asian/Asian American 3=Black/African American 4=Indigenous/Native American 5=Latino/Latina/Latinx 6=Mixed race 7=South Asian/Pacific Islander 8=White 9=Other Race	
Income	Categorical	0=At least 75% of people in my city or town make more than I do 1=About half of people in my city or town make more than I do 2=I make more than about half of the people in my city or town	

		3=I make more than at least 75% of the people in my city or town.
Region	Categorical	0=North America 1=South America 2=Asia/Australia 3=Europe 4=Africa
Country*	Categorical	Open ended/write in
Zip/Postal Code*	Categorical	Open ended/write in
Spirituality	Categorical	1=None/no identification 2=Atheist 3=Agnostic 4=Buddhist 5=Christian 6=Jewish 7=Muslim 8=Hindu 9=Spiritual 10=Nature based 11=Other
Employment Status	Categorical	0=Employed full time 1=Employed part time 2=Self-employed/entrepreneur 3=Providing unpaid labor or caregiving 4=Unemployed
Occupation	Categorical	0=Hospitality or food service 1=Healthcare professional 2=Social services/NGOs/ Non-profit 3=Agriculture/Farming/Fishing 4=Legal/Law/Policy 5=Education 6=Engineering/Construction 7=Manufacturing/Production 8=Government 9=Other
Experienced Natural Disaster	Binary	0=No 1=Yes
Type of Disaster	Categorical	0=Hurricane

		1=Tornado 2=Wildfire 3=Mudslide 4=Earthquake 5=Tsunami 6=Flood 7=Blizzard 8=Drought 9=Other	
Impact of Disaster	Ordinal	1=Not at all impacted 2=A little bit impacted 3=Somewhat impacted 4=Extremely impacted	
Time Since Disaster*	Continuous		
Name of Disaster*	Qualitative	Open ended	
Describe Disaster Impact*	Qualitative	Open ended	
Solastalgia	10 item scale, continuous	0=Strongly disagree 1=Disagree 2=Neither agree nor disagree 3=Agree 4=Strongly agree	0-40
PTSD	20 item scale, continuous	0=Not at all 1=A little bit 2=Moderately 3=Quite a bit 4=Extremely	0-80
Depression	7 item subscale, continuous	0=Did not apply to me at all 1=Applied to me to some degree 2=Applied to me a considerable amount of time 3=Applied to me very much or most of the time	0-21
Anxiety	7 item subscale, continuous	0=Did not apply to me at all 1=Applied to me to some degree 2=Applied to me a considerable amount of time 3=Applied to me very much or most of the time	0-21

Connectivity with Nature	7 item scale, continuous	For questions 1-6: 1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree For question seven: See Appendix A	7-33
COVID Cause of Unemployment *	Categorical	0=No 1=Yes	
Tested for COVID-19*	Categorical	0=No 1=Yes 2=Prefer not to say	
Positive for COVID-19*	Categorical	0=No 1=Yes 2=Prefer not to say	
Suspected COVID-19*	Categorical	0=No 1=Yes 2=Prefer not to say	
Concern for own welfare*	Categorical	0=No 1=Maybe 2=Yes 3=Prefer not to say	
Concern for family welfare*	Categorical	0=No 1=Maybe 2=Yes 3=Prefer not to say	
Concern for community welfare*	Categorical	0=No 1=Maybe 2=Yes 3=Prefer not to say	

Note: * indicates questions that were asked but not included in analyses

Measures

The following measures were utilized in this study. Copies of all measures are provided in Appendix B.

Solastalgia

Solastalgia was measured using the Environmental Distress Scale (EDS; Higginbotham et al., 2006). The EDS was developed with populations who experienced environmental change and degradation as a result of mining activity in Australia. This scale has previously been used to measure the feelings loss associated with solastalgia in the aftermath of specific events that caused environmental change or destruction (Albrecht et al., 2007). The EDS includes a sub-scale that measures solastalgia using ten items with possible scores ranging from 0-40. The solastalgia subscale has been used in prior research to assess solastalgia in the aftermath of environmental damage (Eisenman et al, 2015). Prior studies suggest the subscale has adequate internal reliability with Cronbach's alpha values ranging from 0.85 (Eisenman et al., 2015) to 0.93 (Higgenbotham et al., 2006). For this study, the full ten-item scale had adequate internal reliability with a Cronbach's alpha value of 0.8.

PTSD

I used the PTSD Checklist-V (PCL-V) to measure PTSD in this sample. The PCL-V is a self-report measure based on the clinical PTSD criteria in the DSM-5 (Blevins et al., 2015). The first version of the PCL was developed at the National Center for PTSD in 1990, and was updated 2015 to incorporate the changes made to the DSM-V. The PCL-V contains 20 items intended to capture the diagnostic criteria in the DSM-V. For each item, respondents are asked to score how much each symptom has bothered them in the previous two weeks. Responses range from 0 (not at all) to 4 (extremely), and summed scores range from 0 to 80. The PCL-V

has been used to assess PTSD symptoms in the aftermath of natural disasters (e.g., Cao et al., 2015, Gruebner et al., 2015; Lowe et al., 2015). For this study, the PCL-V had good internal reliability with a Cronbach's alpha of 0.960.

Depression and Anxiety

For this study, I measured depression and anxiety using the short-form Depression, Anxiety, and Stress Scale (DASS-21; Lovibond & Lovibond, 1993). The DASS-21 is made up of three subscales made up of seven questions each which assess depression, anxiety, and stress symptoms. Each question has responses ranging from 0 (did not apply to me at all) to 3 (applied to me very much, or most of the time), and higher scores indicate more frequent symptomatology. The DASS-21 has been validated with both clinical and community samples of adolescents and adults (Henry & Crawford, 2005, Osman et. al, 2012; Ronk et al., 2013; Shaw et al., 2017). The DASS-21 has also been used and validated with samples exposed to environmental disasters (Drescher et al., 2014, Helton et al., 2011) and showed adequate internal reliability in these contexts with alphas above 0.89 (Drescher et. al, 2014). The DASS-21 is not intended to be used as a diagnostic measure for either anxiety or depression, as it assesses dimensional components of these two disorders (Psychology Foundation of Australia, 2011). The DASS-21 is intended to assess for shared causes and experiences across depression, anxiety, and stress (Psychology Foundation of Australia, 2011). For this study, the full DASS-21 had good internal reliability with a Cronbach's alpha score of 0.942. The depression subscale had adequate internal reliability with a Cronbach's alpha of 0.899 and the anxiety subscale also had adequate reliability with a Cronbach's alpha of 0.840.

Connectivity with Nature

In order to assess environmental values, I used the connectivity to nature scale (Dutcher et al., 2007). This was developed to measure individuals' empathy and compassion with the natural environment. The original scale consists of six statements with responses ranging from 1 (strongly disagree) to 5 (strongly agree). The seventh question is a series of three Venn-diagrams, scored from 1 to 3, that represent the participant's relationship to nature (see Appendix A). The seven items are summed for a total score ranging from 0 to 33. This scale showed adequate internal consistency with a Cronbach's alpha score of 0.72 in an earlier study (Dutcher et al., 2007). The connectivity with nature scale had a Cronbach's alpha score of 0.62 for this study.

Additional Variables

There were several variables that were collected but were not included in the analyses for this study. These variables were all collected because they may be useful for future research and were relevant to the context under which this study was conducted.

Time Since Disaster

Participants that had experienced a natural disaster were asked to indicate how long it had been since that disaster. This was a short answer question so participants could indicate the time as well as the unit of measurement (i.e., two months, 25 years).

Disaster Name

Participants who had experienced a natural disaster were given the opportunity to share the name of the disaster in a short answer.

Describe Disaster Impact

Participants who had experienced a natural disaster were asked to describe the impact that the disaster had on their life in a qualitative format.

COVID-19 Cause of Unemployment

For participants who indicated that they were not employed at the time of the survey, they were asked if they were unemployed because of the COVID-19 pandemic with a binary response of yes or no.

COVID-19 Testing and Diagnosis

Participants were asked if they had been tested for, diagnosed with, or suspected they had contracted but not been tested for or diagnosed with COVID-19 and were given the following response options: yes, no, prefer not to say.

Impact of COVID-19

Participants were asked three questions about the impact of COVID-19. They were asked if they worried about their own welfare, the welfare of their family, and the welfare of their community as a result of the pandemic.

Analysis

To begin, data were cleaned and examined descriptively using SPSS. Additionally, Pearson's correlations between total scores of the modified solastalgia model, PTSD, anxiety, depression, and connectivity with nature were run.

Confirmatory Factor Analysis

The first research question for this study asks: 1) is this solastalgia scale valid and reliable with a sample of people broadly impacted by climate change? To answer this question, I conducted a confirmatory factor analysis (CFA) using MPlus to validate the solastalgia scale

with this sample of people broadly impacted by climate change. All models were run using the WLSMV estimator. I hypothesized that all items would load significantly onto solastalgia in a unidimensional model (see figure 1). Due to the size of the sample, I conducted a single CFA with the original solastalgia scale. Three items (1, 9, and 10) had factor loadings below 0.6 and were removed from the model. Factor loadings for the full 10-item scale are presented in table 2. Then, models based on recommendations by van de Schoot et al. (2012) testing configural, metric, and scalar invariance across age and gender with the 7-item scale. Measurement invariance was not established across these groups, which was considered before running additional bivariate tests with this sample. A Pearson's correlation was run with the connectivity to nature scale to establish convergent validity.

Figure 1

Unidimensional Model for Solastalgia
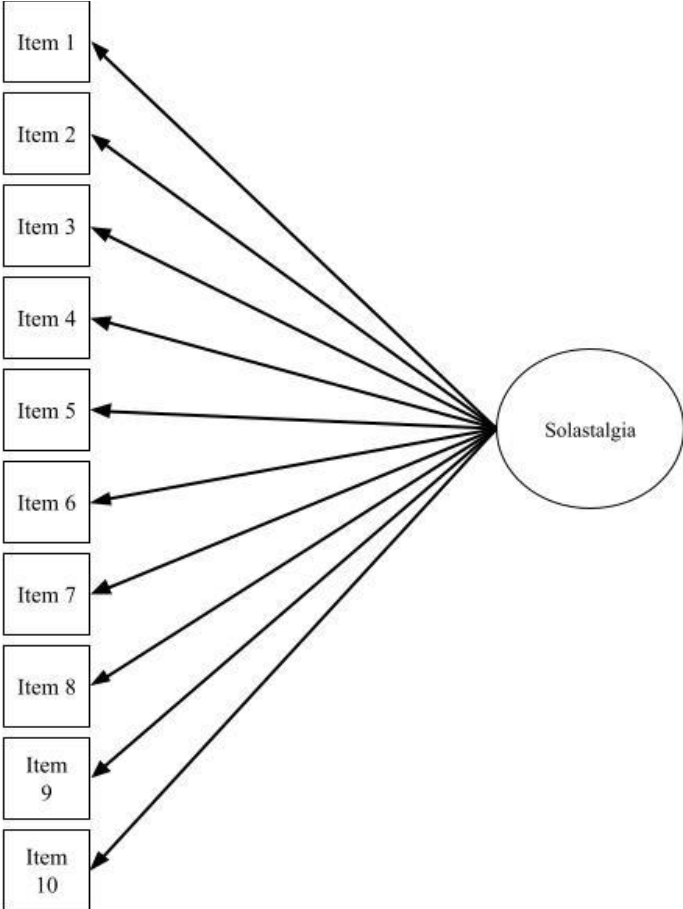
Figure 2

Modified Model for Solastalgia
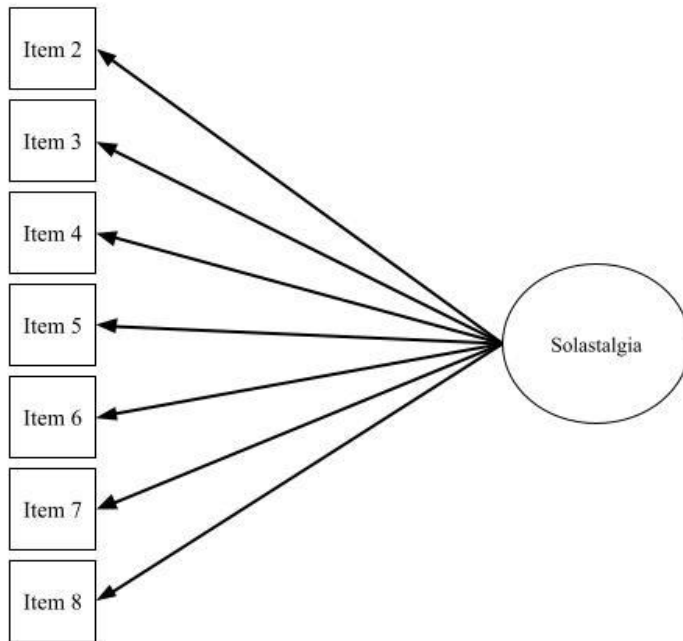
Structural Equation Models

The second research question in this study asks: 2) what is the relationship between symptoms of anxiety, depression, and PTSD and solastalgia? In order to answer this question, I ran three structural equation models where the measured mental disorders predicted the 7-item solastalgia scale (see figures 3-5). These models were all run using the WLSMV estimator. Based on modification indices, two items (sol4 and sol5) were correlated in all three models.

Figure 3

Model 1: Anxiety with Solastalgia
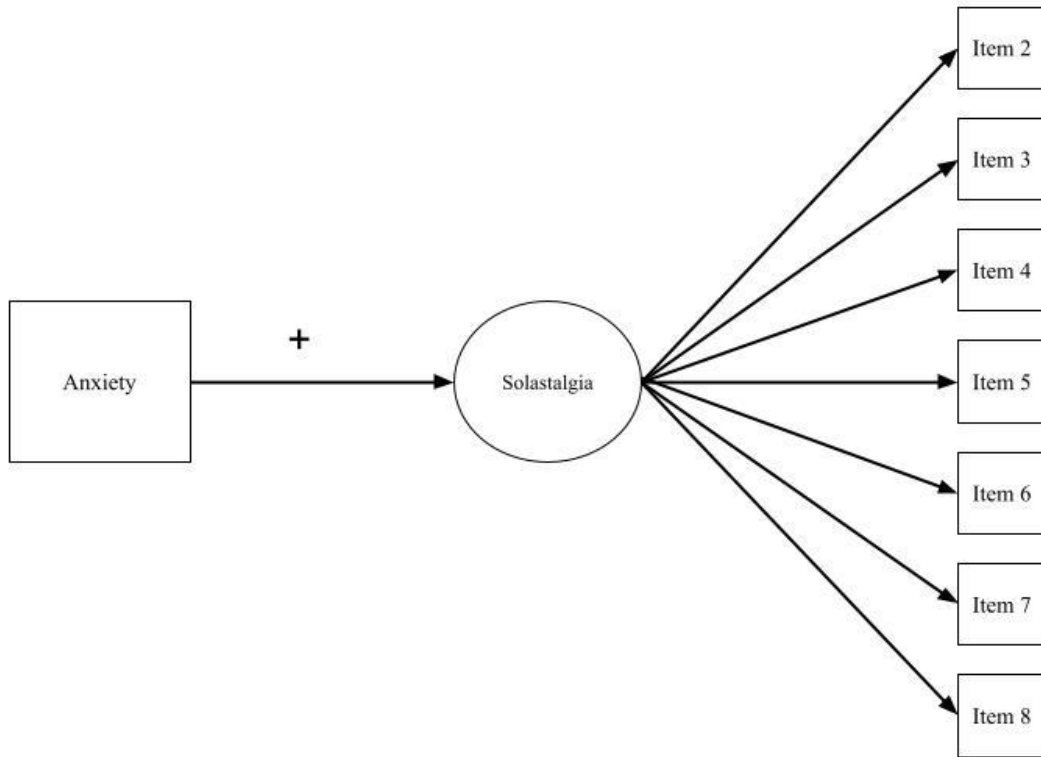
Figure 4

Model 2: Depression with Solastalgia
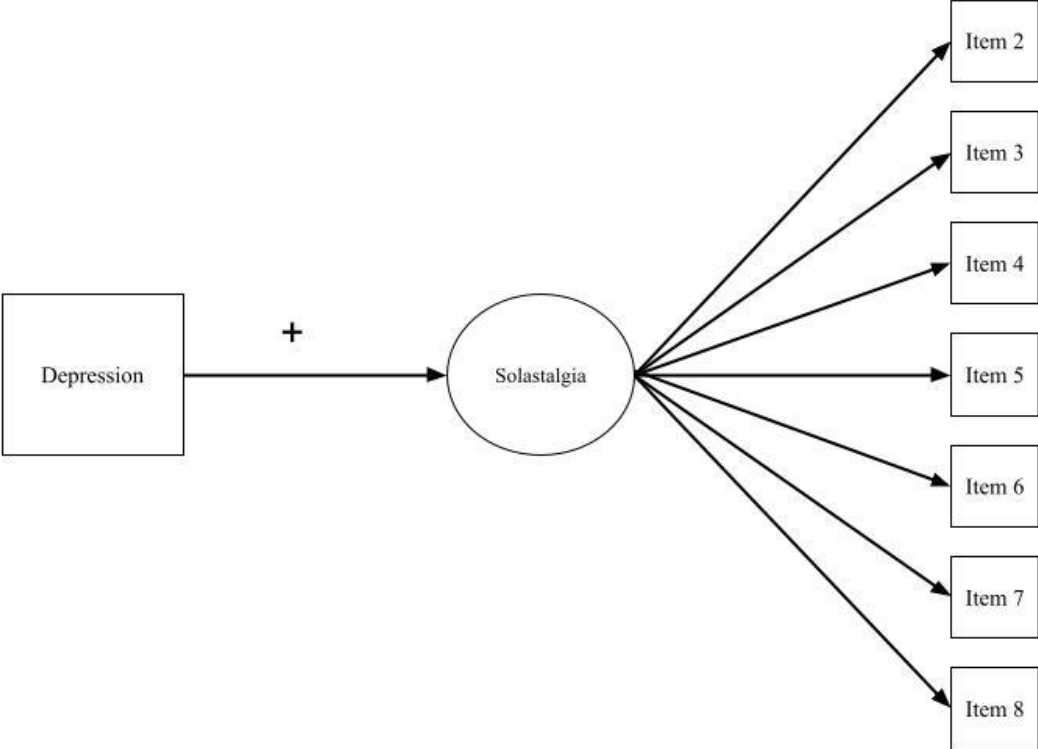
Figure 5

Model 3: PTSD with Solastalgia
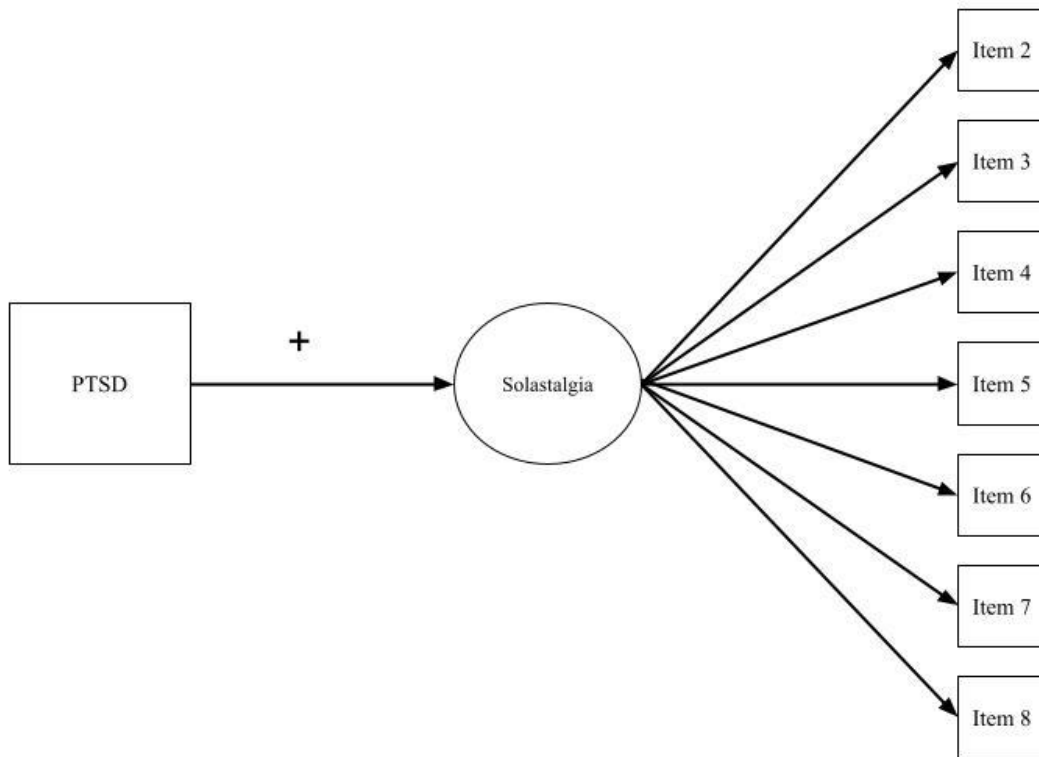
Bivariate Analyses

Question three asks: 3) how do demographic factors impact solastalgia scores in this

sample? In order to analyze how solastalgia scores may be impacted by different demographic

factors, I ran ANOVA and *t*-tests using SPSS. I ran an independent samples *t*-test to examine the

difference between those exposed to a natural disaster and those with no exposure. I ran one-way

ANOVAs to examine how solastalgia scores vary across groups for gender identity, race, region,

relative income, spirituality, occupation, and type of disaster exposure. The purpose of running these bivariate analyses, without including multivariate analysis at this time, is to see if there is any mathematical support for future study around the difference in solastalgia among groups. Since this entire study is exploratory, these bivariate analyses provide a useful springboard for ongoing investigation in this area.

Chapter 4: Results

In this section, I will describe the results of the study described and outlined in the previous chapter. I will begin by detailing the results of descriptive statistical analyses, followed by the results of the CFA, SEM, and bivariate analyses that were run to answer the three research questions in this study. Taken together, these analyses provide new insights into the use of a solastalgia scale with a sample of people broadly impacted by climate change and that measure's relationship with the three mental health disorders most commonly related to climate change.

Demographics

This sample of 234 participants had a mean age of 44.3 with a standard deviation of 15.1 and a range of 21 to 81 years old. The sample is mostly made up of cisgender women (77.4%), followed by cisgender men (17.1%), non-binary people (3.8%), and those who identified as other gender (1.7%). The majority of participants identified as white (86.8%) followed by Arab (2.6%), other or not identified (2.4%), Black (1.7%), Latinx (1.7%), mixed race (1.7%), Indigenous (1.4%), South Asian (1.4%), and Asian (0.9%). Participants were mostly located in North America (86.3%), with 5.1% located in Africa, 4.3% in Europe, 3.8% in Asia/Australia, and 0.4% in South America. Relative income was more evenly distributed across groups, with 15.8% of participants identifying as being in the top 25% income bracket of their community, 29.1% of participants identified that they make more than about half of their community, 33.8% identified that about half of the community makes more than they did, and 21.4% identifying as being in the bottom 25% income bracket. Regarding spirituality or religious affiliation, 35% of the sample identified as Christian.

Table 2

Demographics (N=234)

Variable	Frequency	%	M (SD)
Age			44.3 (15.1)
Gender			
Cis-Man	40	17.1	
Cis-Woman	181	77.4	
Non-Binary	9	3.8	
Other	4	1.7	
Race			
Arab	6	2.6	
Asian	2	0.9	
Black	4	1.7	
Indigenous	3	1.4	
Latinx	4	1.7	
Mixed	4	1.7	
South-Asian	3	1.4	
White	203	86.8	
Other/Not identified	5	2.1	
Income			
Top 25%	50	15.8	
Top 50%	79	29.1	
Bottom 50%	68	33.8	
Bottom 25%	37	21.4	
Location			
North America	202	86.3	

South America	1	0.4
Asia/Australia	9	3.8
Europe	10	4.3
Africa	12	5.1
Spirituality/Religion		
None	51	21.8
Atheist	16	6.8
Agnostic	12	5.1
Buddhist	5	2.1
Christian	82	35.0
Hindu	1	0.4
Jewish	5	2.1
Muslim	10	4.3
Nature-based	3	1.3
Spiritual	34	14.5
Other	15	6.4
Employment Status		
Full-Time	147	62.8
Part-Time	22	9.4
Self-Employed	23	9.8
Unpaid labor/Caregiving	8	3.4
Unemployed	32	13.7
Chose not to answer	2	.8
Occupation		
Hospitality/Food-Service	1	.5
Healthcare	10	5
Social Service/NGO	32	15.8

Agriculture/Farming/Fishing	1	.5
Legal/Law/Policy	6	3
Education	66	32.7
Engineering/Construction	9	4.5
Government	8	4
Other	36	17.8
Chose not to answer	33	16.3

The second largest group were participants who did not identify with any spiritual label (21.8%), followed by those who identified as spiritual (14.5%), atheist (6.8%), other (6.4%), agnostic (5.1%), Muslim (4.3%), Buddhist (2.1%), Jewish (2.1%), nature-based (1.3%), and Hindu (0.4%). The majority of participants were employed full time (62.8%), while 13.7% were unemployed, 9.8% were self-employed, 9.4% were employed part time, 3.4% were engaged in unpaid care giving, and 0.4% were missing/chose not to answer. Of those who indicated they were unemployed, 71.9% indicated that unemployment was the cause of the COVID-19 pandemic. For those that marked that they were employed, they indicated the following sectors for their employment: 32.7% were in education, 17.8% were in other fields of work, 16.3% chose not to answer/were missing, 15.8% were in social services/NGOs, 5% were in healthcare, 3% were in law/policy, 4% were in government, 4.5% were in engineering/construction, 0.5% were in hospitality/food service, and 0.5% were in agriculture/farming/fishing. The results of demographic descriptive analyses are also summarized in table 2.

Of the 234 participants who completed the full survey, 142 (60.7%) had experienced a natural disaster at some point during their lifetime. The most common disaster experienced was a hurricane (45.8%) followed by flood (14.1%), tornado (12.7%), wildfire (12.7%), earthquake (6.3%), drought (3.5%), and blizzard (2.1%). Participants indicated that they had been impacted

by the disaster a little bit (44.4%) or somewhat (41.5%). 11.3% of participants marked that they had been severely impacted by the disaster and only 2.8% marked that the disaster had no impact on them. Table 3 shows the results of natural disaster demographics from this sample.

Table 3

Disaster Questions

	Number	%
Experienced a Natural Disaster (*n=234*)		
Yes	142	60.7
No	92	39.3
Type of Disaster (*n=142*)		
Hurricane	65	45.8
Tornado	18	12.7
Wildfire	18	12.7
Earthquake	9	6.3
Flood	20	14.1
Blizzard	3	2.1
Drought	5	3.5
Other	4	2.8
Impact of Disaster (N=142)		
Not at all	4	2.8
A little bit	63	44.4
Somewhat	59	41.5
Extremely	16	11.3

Several demographic questions regarding the COVID-19 were asked that were not included in further analysis for this project. In this sample, 20.5% of the respondents indicated

they had been tested for COVID-19, while only 0.9% had been diagnosed with COVID-19. However, 15.4% suspected that they had contracted COVID-19, although they had not been tested/diagnosed with the virus. The majority of respondents were worried about their own welfare due to the pandemic (50.5%), while 26.5% were not worried, 22.2% marked that they were maybe worried about their welfare, and 0.4% indicated that they preferred not to answer. Regarding their family welfare, 72.6% indicated that they were worried, 14.5% were maybe worried, and 12.8% were not worried about their family due to the pandemic. Finally, 83.3% of respondents indicated that they were worried about the welfare of their community due to the pandemic, 11.1% were maybe worried, 5.1% were not worried, and 0.4% of respondents preferred not to answer. Table 4 shows the results of these COVID-19 demographic questions.

Table 4

COVID Questions

	Number	%
Tested for COVID (Yes)	48	20.5
Diagnosed with COVID (Yes)	2	.9
Suspected without test (Yes)	36	15.4
Worry about your welfare		
No	62	26.5
Maybe	52	22.2
Yes	119	50.9
Prefer not to say	1	0.4
Worry about family welfare		
No	30	12.8
Maybe	34	14.5
Yes	170	72.6
Worry about community welfare		
No	12	5.1
Maybe	26	11.1
Yes	195	83.3
Prefer not to say	1	0.4

The mean score for solastalgia was 25.5 with a standard deviation of 6.64. For the full

DASS-21, this sample had a mean score of 17.4 with a standard deviation of 12.4. The

depression subscale had a mean score of 5.9 with a standard deviation of 4.8 and the anxiety

subscale had a mean of 3.7 and a standard deviation of 4. The stress subscale had a mean score

of 7.9 with a standard deviation of 4.9. The PCL-V had a mean of 20.7 with a standard deviation of 18.8 in this sample. Finally, the connectivity with nature scale had a mean score of 21.0 with a standard deviation of 3.9. Descriptive statistics for all measures are available in table 5.

Table 5

Measure Descriptive Statistics

	M (SD)	α
Solastalgia	25.53 (6.64)	0.817
DASS-21	17.40 (12.39)	0.942
Depression subscale	5.88 (4.84)	0.899
Anxiety subscale	3.66 (4.00)	0.840
Stress subscale	7.88 (4.93)	0.885
PCL-V	20.73 (18.83)	0.960
Connectivity with Nature	30.63 (2.5)	0.62

Solastalgia was significantly correlated with all three mental health disorders as well as connectivity with nature. Results of Pearson's correlations are displayed in table 6.

Table 6

Pearson's Correlations

	Depression		Anxiety		PTSD		Connectivity with Nature	
	Pearson	sig.	Pearson	sig.	Pearson	sig.	Pearson	sig.
Solastalgia 7 Item	0.288	<0.000	0.252	<0.000	0.291	<0.000	0.269	<0.000

*Note: correlations were run with the modified seven-item scale

Confirmatory Factor Analysis

In order to answer my first research question, I conducted a CFA to assess the validity of the solastalgia scale with a sample of adults who had been broadly impacted by climate change. CFA results are shown in table 7. The original ten item scale was not a good fit for the data as RMSEA was over the suggested cutoff ($\chi^2[35] = 105.308$, $p < 0.001$; CFI $= 0.966$, TLI $= 0.956$; RMSEA $= 0.093$ [90% CI: 0.073, 0.113]). After three items were removed because they fell below the 0.6 factor loading cutoff, I ran a modified seven-item unidimensional model. With the exception of the significant chi-square loading, the modified model was a good fit for the data ($\chi^2[14] = 34.65$, $p=0.002$; CFI $= 0.989$, TLI $= 0.983$; RMSEA $= 0.079$ [90% CI: 0.046, 0.113]).

Table 7

CFA Model Fit Statistics

Model	$\chi 2$	Sig.	*df*	CFI	TLI	RMSEA
Full 10 Item	105.308	<0.001	35	0.966	0.956	0.093
Modified 7 Item	34.655	0.002	14	0.989	0.983	0.079

All factors loaded above the a priori cutoff of 0.6, and factor loadings for the seven-item model are available in table 8.

Table 8

Factor Loadings for Seven-Item Scale

Item Name	STD Factor Loading
Sol2	0.786
Sol3	0.901
Sol4	0.746
Sol5	0.637
Sol6	0.627
Sol7	0.818
Sol8	0.692

Invariance

Next, I conducted multiple-group analyses to examine measurement invariance based on the recommendations of van de Schoot et al. (2012). I tested invariance across age and gender using the seven-item unidimensional model. I tested the model separately for age group 21-39 ($\chi^2[14] = 22.813$, $p=0.0634$; CFI = 0.986, TLI = 0.978; RMSEA = 0.077 [90% CI: 0.000, 0.132]) and 40-81 ($\chi^2[14] = 14.128$, $p=0.0442$; CFI = 0.993, TLI = 0.989; RMSEA = 0.075 [90% CI: 0.012, 0.125]) and found that the model was a reasonable fit for both age groups. Results of configural invariance testing can be found in table 9. The multigroup models run to test metric invariance across age found that the model was a good fit between age groups ($\chi^2[49] = 50.697$, $p=0.4065$; CFI = 0.999, TLI = 0.999; RMSEA = 0.017 [90% CI: 0.000, 0.063]). Finally, scalar invariance was tested and the model was a good fit for the data across all fit indices ($\chi^2[56] = 70.095$, $p=0.0843$; CFI = 0.993, TLI = 0.995; RMSEA = 0.048 [90% CI: 0.000, 0.079]). I tested the seven-item model separately for cisgender women ($\chi^2[14] = 43.633$, $p=0.0000$; CFI = 0.973,

TLI = 0.959; RMSEA = 0.113 [90% CI: 0.078, 0.150]) and other gender identities (χ^2[14] =

13.125, p=0.5167; CFI = 1.000, TLI = 1.002; RMSEA = 0.000 [90% CI: 0.000, 0.126]) which

found that the model was not a good fit for cisgender women. For gender identity groups, the

multigroup model run to test metric invariance found that the model was not a good fit for the

data with a RMSEA score above the recommended cutoff of 0.8 (Browne & Cudeck, 1993;

Jöreskog & Sörbom, 1993) (χ^2[49] = 87.719, p=0.0006; CFI = 0.981, TLI = 0.984; RMSEA =

0.082 [90% CI:0.053, 0.110]) and scalar invariance found further evidence of variance across

groups (χ^2[56] = 101.896, p=0.0002; CFI = 0.977, TLI = 0.983; RMSEA = 0.084 [90% CI:0.057,

0.109]). This concluded my invariance testing for this model.

Table 9

Invariance Testing

Model	χ^2	Sig.	*df*	CFI	TLI	RMSEA
Modified 7 Item	34.655	0.002	14	0.989	0.983	0.079
Age						
21-39	22.813	0.063	14	0.986	0.978	0.077
40-81	24.128	0.044	14	0.993	0.989	0.075
Metric	50.697	0.407	49	0.999	0.999	0.017
Scalar	71.095	0.084	56	0.993	0.995	0.048
Gender						
Cis-woman	46.633	0.000	14	0.973	0.959	0.113
Other gender	13.125	0.517	14	1.000	1.002	0.000
Metric	87.719	0.001	49	0.981	0.984	0.082
Scalar	101.896	0.000	56	0.977	0.983	0.084

Convergent Validity

Additionally, results of my validity analysis, which examined the relationship between the seven-item solastalgia scale and the connectivity with nature scale, provided evidence of convergent validity (see table 6) with results in expected directions.

Structural Equation Models

In order to explore the relationship between the three mental disorders most commonly studied in relation to climate change and solastalgia, I ran three structural equation models. In these models, anxiety, depression, and PTSD were predictors of the seven-item solastalgia scale. The first model, where anxiety predicted the seven-item solastalgia scale, was a good fit for the data (χ^2[19] = 21.049, p=0.3341; CFI = 0.999, TLI = 0.998; RMSEA = 0.021 [90% CI: 0.000, 0.063]). The second model, where depression predicted the seven-item solastalgia scale, was a good fit for the data (χ^2[19] = 19.519, p=0.4240; CFI = 1.000, TLI = 1.000; RMSEA = 0.011 [90% CI: 0.000, 0.059]). In the third model, PTSD predicted the seven-item solastalgia scale. This model was a good fit for the data (χ^2[19] = 21.147, p=0.3287; CFI = 0.999, TLI = 0.998; RMSEA = 0.022 [90% CI: 0.000, 0.063]). Results of SEM analyses are presented in table 10.

Table 10

SEM Model Fit Statistics

Model	χ2	Sig.	*df*	CFI	TLI	RMSEA
Anxiety on Solastalgia	21.049	0.334	19	0.999	0.998	0.021
Depression on Solastalgia	19.519	0.424	19	1.000	1.000	0.011
PTSD on Solastalgia	21.147	0.329	19	0.999	0.998	0.022

Bivariate Tests

In order to answer my third research question, I ran bivariate tests to assess the differences in solastalgia scores based on demographic factors. One-way ANOVAs were run to

compare means of solastalgia using the seven-item unidimensional model for the following variables: gender identity, race, religion, spirituality, relative income, occupation, and type of disaster. There was a significant effect of gender identity on solastalgia score [F= (3, 230) = 5.028, p=0.002]. There were also significant effects of occupation [F= (8, 160) = 3.581, p<0.001] and type of disaster [F= (7, 134) = 2.599, p=0.015] on solastalgia score.

Table 11

Results of ANOVA Tests

	Sum of Squares	df	Mean Square	F	sig.
Gender Identity	428.359	3	142.786	5.028	0.002*
Age	40.097	3	13.366	0.444	0.722
Race	371.350	8	46.419	1.585	0.130
Region	237.158	4	59.289	2.020	0.093
Spirituality	425.897	10	42.590	1.454	0.158
Relative Income	30.885	3	10.295	0.342	0.795
Occupation (N=169)	645.288	8	80.661	3.581	0.001*
Type of Disaster (N=142)	499.130	7	71.304	2.599	0.015*

Results of independent samples *t*-tests (shown in table 13) indicated that there was not a significant difference between those exposed to a natural disaster and those who were not exposed.

Table 12

Results of t-tests

Variable	*t* statistic	df	sig

Disaster Exposure	1.089	193.030	0.277

*Note: results are for equal variances not assumed

These bivariate results concluded my analyses for this exploratory study. In the next chapter I will discuss the results of this study within the context of the existing literature on grief, loss, and climate change.

Chapter 5: Discussion

This study sought to explore the validity of the solastalgia scale with a sample of people who had experienced varied effects of climate change, and to place this validation study in the context of the previous research on climate change and mental health. This study had inherent and expected limitations, as well as limitations that were not anticipated. It also had strengths that provide unique contributions to the scientific literature from the data gathered. Taken together, the findings provide more information about the construct of solastalgia, the use of a modified version of this solastalgia measure for samples broadly impacted by climate change, and the relationship between the solastalgia measure and anxiety, depression, and PTSD. In turn, this allows me to place these findings within the broader context of the literature of the grief and loss caused by the impacts of climate change and sets the stage for continued scientific inquiry in this field.

Confirmatory Factor Analysis

My first research question asked: is this solastalgia scale valid and reliable with a sample of people broadly impacted by climate change? This research question began the investigation into the way that the experience of solastalgia may be or may not be captured across landscapes, cultures, and experiences of climate change's effects. Answering this research question provides additional insight into the construct of solastalgia and its relevance to our understanding of the mental health impact of climate change on a global scale. Previous research has shown that this scale is valid with samples of people who had experienced the same environmental disaster or degradation (Eisenman et al., 2015; Higgenbotham et al., 2006; Warsini et al., 2014a). All of three of these studies were conducted in the aftermath of different instances of environmental damage. This study found some support for the use of a modified version of the original

solastalgia scale. Taken together, these results show that there is evidence that a single measure may be able to capture diverse experiences of grief and loss related to environmental change, which is relevant because climate change impacts every area of the globe in varied ways.

This is further supported by examining the three items that were removed to improve the fit of the model. The three items that were removed from the original model were items number 1 (my sense of belonging to this place has been undermined by unwelcome change), 9 (the thought of my family being forced to leave this place upsets me), and 10 (I feel good about the restoration of the environment [e.g. mine site rehabilitation]). These three items were the ones that most specifically referenced the individual's local environment rather than using language that discussed nature in slightly more broad terms. Because this sample was made up of people living in very different locations, it makes sense that these three items did not work well with this sample of people broadly impacted by climate change. Additionally, this provides some evidence that it is necessary to consider the wording of items and the way that they reference the natural environment. Because this solastalgia scale has been used in the aftermath of specific events of environmental degradation, the

For this study, I did not consider or test any multidimensional models because previous studies of this scale have used it as a unidimensional measure (Eisenman et al., 2015; Higgenbotham et al., 2006; Warsini et al., 2014a; Warsini et al., 2014b) and there was no strong theoretical reason to believe that this construct is multidimensional. The construct is narrowly focused on the absence of solace or distress that is the result of environmental distress or degradation and all of the questions on this scale focus squarely on that. As Glenn Albrecht, who first identified and named the construct of solastalgia, was involved in the development of the Environmental Distress Scale (Higgenbothom et al., 2010), from which the solastalgia scale was

taken, it is reasonable to believe that he approved of the uni-dimensional model for this scale. The literature on solastalgia does not argue that this is a multidimensional construct, and therefore there was no evidence for the investigation of any other models for this solastalgia scale through exploratory factor analysis.

While the seven-item model was a reasonable fit for the data, it did not show gender invariance between cisgender women and other gender identities. This is particularly important to consider since this sample was mostly made up of people who identified as cisgender women and this model was not a good fit for that group. Further investigation of this scale and the way that it captures solastalgia across gender groups may benefit from different types of study recruitment that targets cisgender men, binary, and gender non-conforming people. Therefore, additional studies exploring invariance with a more diverse sample is warranted.

<center>**Structural Equation Models**</center>

The second research question asked: 2) what is the relationship between symptoms of anxiety, depression, and PTSD and solastalgia? I asked this question because using measures for anxiety, depression, and PTSD related to natural disasters and climate change are common among research studies on climate change and mental health (Beaglehole, 2018). Additionally, these mental health disorders focus on mental health pathology, with the understanding that there is something abnormal about experiencing symptoms of a mental health disorder after witnessing major environmental destruction. Therefore, I wanted to explore the relationship between these three mental health disorders and the non-pathologized emotional response of solastalgia. All three of the models tested were a good fit for the data, which was expected.

Anxiety and Solastalgia

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The SEM exploring the relationship between anxiety and solastalgia, with anxiety serving as the predictor variable, was a good fit for the data. This means that higher rates of anxiety are associated with higher rates of solastalgia. Research shows that anxiety symptoms are common in the aftermath of natural disasters (Chen et al., 2020) and that there is a specific type of anxiety related to climate change (Clayton, 2020; Panu, 2020; Wu et al., 2020) called climate anxiety. Climate anxiety has gained traction among scholars over the past two years. Clayton and Karazsia (2020) developed a measure of climate anxiety and found that this phenomenon was not uncommon among adults, particularly among young adults. That same study also found that climate anxiety was related to emotional responses to climate change. Therefore, it is not surprising that anxiety influences solastalgia rates for a sample of people who are broadly impacted by climate change.

The interesting thing about this connection is the connection between anxiety and the construct of solastalgia itself. Solastalgia, with its roots in Freudian understandings of grief and mourning, focuses on the absence of solace that was once given by the natural environment (Albrecht, 2020). For people that live in areas that have experienced a lot of environmental changes due to climate change, they are possibly experiencing climate anxiety and also not able to gain the solace or comfort that they once received from their relationship with the environment around them. This raises questions about the interrelatedness of these two emotional responses to environmental degradation over time. This study only looked at the impact of anxiety on solastalgia, but future studies may want to explore the way that climate anxiety and solastalgia impact each other, which I will discuss in more detail later in this chapter.

Depression and Solastalgia

The second SEM, which explored the relationship between depression and the seven-item solastalgia scale, was also a good fit for the data. This means that higher rates of depression predict higher rates of solastalgia in this sample. In fact, both the TLI and CFI scores were a perfect 1.000. In fact, this result may suggest that these constructs are indistinguishable from one another using the measures from this study. While research has found that depression is common in the aftermath of natural disasters (Arnberg et al., 2013; Beaglehole, 2018), there has been minimal investigation into the nuance of that mental health response and its causes. This study used a subscale of the DASS-21 to capture depression, which is not used to capture clinical levels of depression. This difference may be important to consider given how well this model fit the data. This finding suggests that depression and solastalgia may be so closely related that these two measures are in fact capturing the same latent construct.

In order to better understand how closely related depression and solastalgia are, it is useful to turn to the theoretical literature on the relationship between grief and depression, as solastalgia has been rooted in the Freudian definition of grief and mourning (Albrecht, 2020). According to Kübler-Ross and Kessler (2005), the initial five stages of grief, taken from the five stages of death and dying, include the depression stage, which comes just before acceptance. This stage of the grief process is where people feel hopeless and extremely distressed because there does not seem to be anything they can do to change what has happened (or will happen in the case of those who are confronted with their impending death). Because we understand the grief process to be a normal, albeit painful, reaction to loss, this type of depression is not pathologized in the same way that Major Depressive Disorder or Dysthymia are. These feelings of depression, related to loss or mourning, are considered normal as long as they do not last too

long. The particular type of distress that is captured by this solastalgia scale may be closely related to the depression stage of the Kübler-Ross model of grief. This may provide additional insight as to the reason this model fit the data so well. Further study of the relationship between depression and solastalgia using different measures for depression, may help parse apart the nuances between these constructs.

Finally, because solastalgia is both defined as the distress caused by environmental degradation and the absence of solace due to environmental change, I wonder how depression and solastalgia may reinforce one another. As with climate anxiety, there is the possibility that people who experience symptoms of depression may have relied on the natural environment around them to help them through the painful feelings and to find some solace, comfort, or healing. When that environment has changed or is destroyed, those same people may lose one of their most important coping mechanisms, leaving them without a way to move through the depression. Therefore, it is interesting to consider the way that depression and solastalgia may simultaneously act upon one another, creating a more complex relationship between these two constructs than was investigated in this study.

PTSD and Solastalgia

The third SEM, exploring the relationship between PTSD and the seven-item solastalgia scale, was a good fit for the data. This means that higher rates of PTSD predict higher rates of solastalgia in this sample. Rates of PTSD are commonly studied in the aftermath of natural disasters and have been found to increase after these events (Beaglehole, 2018; Parker, 2016). Additionally, studies have found a relationship between PTSD and grief in the aftermath of traumatic events among adults (Stroebe et al., 1998; Sveen et al., 2018) and children (Dyregrov et al, 2015; Salloum et al., 2009; Salloum & Overstreet, 2012). Therefore, this study supports

previous scholarship on the relationship between PTSD and grief related to environmental distress.

Because PTSD is the mental disorder most commonly associated with the aftermath of traumatic events, its positive relationship with solastalgia is expected. Solastalgia has most often been discussed in the aftermath of single events that resulted in environmental degradation or destruction (Eisenman et al., 2015; Higgenbotham et al., 2006; Warsini et al., 2014a; Warsini et al., 2014b), which could easily be described as traumatic events. The impacts of climate change are varied and include many things other than natural disasters. The work of Cunsolo and Ellis (2018a) argues that people experience grief and loss due to environmental change even if they have not experienced a natural disaster and would not normally be eligible for a PTSD diagnosis. For example, PTSD as a construct may not be able to capture the way that repeated exposure to news about natural disasters, loss of beloved species, environmental degradation, sea level rise, and ice melt may cause a different type of traumatic response. There is some theoretical support and research to help frame the limitations of PTSD as a measure for the traumatic effects of climate change through a focus on complex trauma and holistic mental health interventions that do not rely solely on mental health disorder diagnosis. White (2015) makes the connection between the trauma of climate change and the subsequent effects on the human brain and body. He focuses on how important it is for practitioners to have a cogent understanding of trauma when working with people in a world beset by climate change. Additionally, Hayes et al. (2018) provide an overview of the current literature on climate change trauma and the relationship to mental health arguing that the impacts of climate change are so wide reaching and varied that they will require a holistic approach that is not rooted in mental health disorder diagnosis but instead in supporting resilience and recovery for people.

Bivariate Analyses

My third research question asked: 3) how do demographic factors impact solastalgia scores in this sample? The majority of the demographic factors tested (age, race, region, spirituality, relative income, and disaster exposure) did not have statistically significant differences. Disaster exposure was one of the categories explored in the ecological grief literature (Cunsolo & Ellis, 2018a) and therefore the statistically insignificant result was particularly interesting. The other category discussed by Cunsolo and Ellis (2018a) was occupation, which did show a statistically significant difference between groups. Additionally, while gender did show statistically significant difference between groups, tests for measurement invariance found that the seven-item scale was not a good fit for cisgender women. Since cisgender women made up the majority of the sample, this is important to consider. These results provide mathematical support for continued investigation on the way that solastalgia impacts people based on identities and life experiences they have had.

Because there was already justification for exploring the way that occupation may impact the experience of grief and loss that results from climate change (Cunsolo & Ellis, 2018a), and this study found that there was a statistically significant difference between occupation groups, continued investigation about the way that occupation may influence solastalgia is warranted. In order to do that, recruitment would have to focus on targeting a diverse sample of people with varied occupations. Because the main occupation group that was identified by Cunsolo and Ellis (2018a) was not represented in this sample, it would be very important to ensure that future studies included people who worked directly with the land such as farmers, fisherpersons, and state and federal park employees.

The other results, when taken together, that I would like to see explored in further detail are the impact of disaster exposure and type of disaster on solastalgia. While natural disaster exposure did not have a statistically significant impact on solastalgia score, and this was unexpected, the type of disaster that a person experienced did have an impact on their solastalgia score. This is particularly interesting because solastalgia, as a construct, focuses on environmental degradation or distress. In fact, it was developed to assess the impact of coal mining on a community (Higgenbothom et al., 2010) and has since been used to assess the impacts of natural disasters (Eisenman, 2015; Warsini et al., 2014a; Warsini et al., 2014b) on people. Therefore, deeper investigation into what type of natural disasters illicit higher levels of solastalgia and why would be a very interesting thing to explore.

Grief and Loss Literature

Solastalgia is a construct that was created to explain the distress experienced by people in the aftermath of environmental degradation or destruction because that environment can no longer offer the solace it once did (Albrecht, 2007). Of the constructs in this study, solastalgia is most closely related to depression, and this was upheld by the results of the second structural equation model. I have already discussed the possibility that these two constructs may not be distinct from one another, at least not in a way that can be captured with the measures used, in some detail in earlier sections of this chapter. However, the connection between depression and grief is important to consider when framing these findings within the broader context of the grief and loss field. The Kübler-Ross model of grief marks depression as a distinct phase in this psychological process (Kübler-Ross & Kessler, 2005). This leads me to wonder if solastalgia may be a phase of a larger process of grieving environmental changes, the way depression is a stage of death and dying, and grief and grieving. Continued inquiry into these constructs will

future illuminate their relationship with one another. The apparent similarity between depression and solastalgia that shows up in the second SEM analysis may be an important piece of information when considering how solastalgia is related to and also distinct from the other constructs in the literature on grief, loss, and mourning due to environmental change.

Previous research on the grief and loss related to environmental change and degradation, including climate change, has connected solastalgia to ecological grief (Albrecht, 2020). Ecological grief may capture more of the full process of grief and loss that occurs after environmental destruction or degradation as it encompasses existing and anticipated losses (Cunsolo & Ellis, 2018a). Connecting these two constructs also frames them within their respective theoretical groundings in the grief and loss literature. Solastalgia, rooted in the Freudian tradition of grief and mourning (Albrecht, 2017), does not encompass the full experience of grief and loss that is described by ecological grief, grounded in modern understanding of the grief process (Cunsolo & Landman, 2017). Therefore, the modified version of the solastalgia scale was a reasonable fit for this sample, yet this scale does not capture the complexity of the grief and loss experienced by people as they live through climate change on a daily basis. Using this study to begin the development of an ecological grief scale would help us better understand the way that these constructs are related as we continue to expand our understanding of the non-pathologized mental health responses to climate change.

Unintended Interesting Findings

There were several other findings from this study that were interesting but were not directly related to the three research questions that guided the inquiry. First, these data were gathered during the summer just after the start of the Covid-19 pandemic, and when they were asked if they were worried about the welfare of their family or their community, the vast

majority answered yes or maybe. This is an important piece of information for the context of this study. It is also important to note the significance of potential mental health impact that the pandemic has had on people. Research is beginning to explore the way that the pandemic has impacted mental health (Cullen et al., 2020; Pfefferbaum, B., & North, 2020; Vindegaard & Benros, 2020), including the complicated grief that is likely on the way as the pandemic slowly dies down (Gesi et al., 2020).

In this study, I did not get any direct feedback from participants or the people who assisted me with recruitment about the content of my study and its impact on their experience. However, I did collect qualitative data on the way that people felt that they'd been impacted by natural disasters that they had experienced. People who indicated "yes" they had experienced a natural disaster and then discussed Covid-19 were recoded as "no." However, I do have qualitative data on the six respondents who shared their experiences with Covid-19. One participant wrote "safety is an illusion and I worry constantly" when describing the impact of Covid-19 on their life. The other participants spoke about changes in their work situations, either about job loss or working from home, and about the weakening of their social relationships. While these data are not enough to conduct any formal analysis of the experiences of participants in reaction to Covid-19, it is interesting to note their own words and the way they relate the pandemic to the subject of this study.

In order to begin to explore the possible impact that Covid-19 had on the mental health of the participants of this study quantitatively, I ran one-way ANOVAs using the three Covid-19 impact questions as grouping variables for anxiety, depression, and PTSD. The results are available in table 14.

Table 13

Results of ANOVA Tests

	Sum of Squares	df	Mean Square	F	sig.
Anxiety					
Worry about own welfare	185.066	3	61.689	4.003	0.008*
Worry about family welfare	239.036	2	119.518	7.910	0.000*
Worry about community welfare	96.225	3	32.075	2.030	0.110
Depression					
Worry about own welfare	230.519	3	76.840	3.379	0.019*
Worry about family welfare	255.865	2	127.933	5.678	0.004*
Worry about community welfare	280.010	3	93.337	4.144	0.007*
PTSD					
Worry about own welfare	4935.379	3	1645.126	4.869	0.003*
Worry about family welfare	4336.947	2	2168.473	6.396	0.008*
Worry about community welfare	1791.119	3	597.040	1.698	0.168

The results of this analysis found that there was a statistically significant difference between groups for all but two of these groupings. Being worried about the welfare of the community did not impact the anxiety or PTSD scores for this sample. However, every other grouping variable did have a statistically significant effect on anxiety, depression, and PTSD scores for this sample. Further investigation into the mental health impact of the pandemic would help parse apart the influence that the Covid-19 pandemic may have had on the participants of this study. In order to further explore this relationship with this sample, it would be useful to examine how someone's worry for their own welfare, their family's welfare, and the community's welfare interact together to impact mental health symptoms. This would be

additionally useful in framing any future studies on this solastalgia scale with a sample of people broadly impacted by climate change that occur after the end of the Covid-19 pandemic. This is an interesting future direction for research with these data. I have included a table of subsequent analyses to be conducted with this data set in Appendix C.

Limitations

There were several limitations to this study that are important to consider. First, this study was designed with a combination of purposive and random sampling in order to try to capture data from the three categories described by Cunsolo and Ellis (2018a) in their discussion of ecological grief which created some inherent limitations. The goal of this study was not to get a full representative sample, and therefore it was not intended to be generalizable. I expected there to be violations of normality among demographic variables due to the sampling strategy, which did occur. However, I was not able to capture sufficient subsamples of these three groups due to unrelated challenges that came up during data collection.

The process of collecting data was impacted by the Covid-19 and that impact resulted in a much smaller sample size than originally planned. This study was planned in the fall and winter of 2019, before Covid-19 was on the horizon. The study design and recruitment plan was based on previous studies I had done using social media recruitment as well as contacting groups using email listservs to assist with distribution of my survey links. My final sample size for this study included the 234 participants who completed the full survey. Based on my previous experience, I expected to collect a much larger sample based on the recruitment tools that I used. I was unable to conduct CFAs with the three groups identified by Cunsolo and Ellis (2018a) because I did not have a sufficient number of participants in each of those groups to run a CFA analysis. Instead, I was limited to running a single CFA with the full sample and focusing instead

on the way that varied experiences of climate change may or may not have been captured by the solastalgia scale.

One way that I adapted my initial recruitment strategy was to send more follow up emails to the listservs that I originally intended. I also did more social media posts, spread apart by several weeks or months, than I had planned to do before the pandemic began. When I did not see the expected number of responses after each of these posts or emails went out, I had to consider the research questions for this study and how I would best address them given the lower response rate. I decided that focusing on the single CFA, and its validity, would still provide important scientific insight into solastalgia and the utility of this scale with a sample of people impacted by climate change in a variety of ways. The sample I ended to have would have allowed me to run separate CFAs for groups of people who had experienced a natural disaster, those who worked directly with the land, and those who fell into neither of these groups but had experienced climate change more indirectly. This would have given me more insight into the way that the research on ecological grief relates to solastalgia. However, I had intentionally crafted research questions that would allow me to make adjustments to this plan and focus on a single CFA instead.

While the Covid-19 pandemic is not a climate related natural disaster, it did cause major changes to daily life. These changes included: many people working from home who had previously gone in to offices, many people losing jobs due to changes in the economy, essential workers going into work in spite of potential exposure to Covid-19, the inability to see friends and family due to social distancing recommendations, and the grief and loss caused by the major loss of life due to the Covid-19 virus. These changes may have impacted the responses to the

mental health measures, which may have influenced the relationship between solastalgia and the three common mental disorders explored in the second research question.

The Covid-19 pandemic coincided with major protests about racial violence and structural inequalities that have persisted in the United States for hundreds of years. Many of the protests that occurred in the aftermath of George Floyd's murder were organized online using social media. This meant that people who had previously worked in offices were not only working from home and spending many more hours on video calls, but were also confronted with pressing calls to action through their various social media feeds. I hypothesize that a survey on the relationship between the natural environment and mental health was difficult to notice or prioritize among the onslaught of information during the summer of 2020. Additionally, it is very possible that the protests and the police violence that sprung up in response to those protests, may have impacted the mental health of participants in the survey, particularly when looking at their anxiety, depression, stress, and PTSD scores. For this study, I do not have any way to parse apart the impact of these events on my results. For future studies, I would like to consider ways to capture the impact of acts of violence, racism, or injustice in order to account for those when considering mental health symptoms, or aspects of grief and other non-pathologized mental health responses to major global events.

The other major structural issue that impacted my data collection was the number of natural disasters that coincided with my recruitment period. I had planned to work with several practitioners and researchers who are based in California to recruit people who had been impacted by various fires there including the Campfire disaster in 2018. However, the fire season in 2020 caused massive outbreaks of fires up and down the west coast, and those same researchers and practitioners were focused on supporting their communities through a new round

of environmental devastation. I was also planning to work with an organization based in Texas that provides support to people affected by hurricanes in Texas and Louisiana. That organization was planning to help me distribute my survey to the communities they serve, however that same week was when Hurricane Laura swept through the region, causing new environmental damage and loss. Because of the time constraint for this project, I was unable to wait and continue data collection with these groups after their communities had returned to equilibrium in the aftermath of these major disasters. In future studies, I hope to learn from the timing issue that I encountered in this study, where my data collection period fell during the height of various disaster seasons in the United States. I would try to arrange my data collection so it fell over the winter months or over a full year, for a global study, so I could target different regions of the globe during the time that they are least susceptible to disasters and subsequent recovery.

The practical and mathematical limitations are also joined by implications to theory given the makeup of my sample. My intended sample would have incorporated diverse experiences of place attachment and ambiguous loss due to environmental change which would have allowed me to assess the way that those experiences impacted the validity and reliability of the solastalgia scale. However, most of my sample was from one region, North America, identified as cis-gender women, and identified as white. This meant that the culture represented in my sample was much more uniform than I had hoped for and could not really assess the way that the broad impact of climate change might have been prevalent across regions, gender identity, and race.

Finally, I want to acknowledge the limitations that were inherent in the use of my chosen measures. First, the solastalgia measure was developed for use in the aftermath of a single event of environmental degradation or destruction (Higgenbothom et al., 2010). It was not developed for use in a sample like the one used in this study. This limitation was known, intended, and was

part of the study design, allowing me to draw more connection between solastalgia and other literature on experiences of loss in the aftermath of environmental change. The use of the DASS-21 measure also has inherent limitations. Namely, it is not intended as a diagnostic tool, but instead captures the three constructs (depression, anxiety, and stress) and also allows for the researcher to assess shared causes of these three constructs (Psychology Foundation of Australia, 2011). This limitation in measurement may have contributed to the fit indices for the second structural equation model, which was such a good fit for the data. Perhaps a diagnostic measure would be able to parse apart the unique aspects of depression and solastalgia and illuminate more about their relationship. Finally, the PCL-V is most often used in the aftermath of traumatic events and is intended as a diagnostic tool (Blevins et al., 2015). While its use is common in the aftermath of natural disasters (Cao et al., 2015, Gruebner et al., 2015; Lowe et al., 2015), some of this sample had either never experienced a disaster or had not experienced one for many years. This characteristic of the sample may have impacted PTSD scores.

Overall, I was not able to conduct the exact study that I intended due to a variety of factors. The structural issues in particular may have had a major impact on the study findings, as it would be nearly impossible to replicate the interaction between the Covid-19 pandemic, the protests in the aftermath of George Floyd's murder and the police violence that followed, and the sheer number of natural disasters that occurred in the summer of 2020. However, this study still provides useful insight into the way that this solastalgia may or may not be the best measure to capture the grief and loss that result from a sample broadly impacted by the effects of climate change. I will discuss the strengths of this study in the next section.

Strengths

While the limitations discussed above are important to consider, it is also relevant to discuss the strengths of this study and its contribution to scientific knowledge. One major strength of this study is its grounding in a breadth of theoretical literature including the framework of ambiguous loss (Boss, 1999) and place attachment theory (Manzo & Devine-Wright, 2014). These two theories provided the theoretical justification for the research questions, however, throughout the development and implementation of the study as well as the data analysis, literature on grief and loss was incorporated at all times. Because solastalgia is rooted in a particular orientation to grief and mourning, one that is drawn from Freud (Albrecht, 2020), it is essential to consider how that theory of grief impacts the construct and the subsequent measure used for this study. By considering that, I have been able to orient this study to other constructs in this subfield, like ecological grief, that are drawn from other theoretical foundations (Cunsolo & Landman, 2017). This allows me to situate this study within the theoretical literature and the differences and similarities among the various constructs that are a part of the way that we seek to better understand the experience of grief and loss due to environmental change.

Another strength of this study was its study design. Due to the emergent nature of the study of grief and loss resulting from climate change, it was very important to craft research questions that would allow for exploration and would result in information to guide future inquiry on this topic. The questions asked in this study allowed me to add to our scientific knowledge about the relationship between climate change and grief even though my study encountered many barriers to the plan. The study design allowed me to explore the validity of the solastalgia scale with a sample of people who had experienced climate change in very different

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ways from one another. It also allowed me to do an initial exploration of the relationships among the three common mental disorders most commonly studied in relation to climate change and solastalgia. This examination helps to situate the studies on solastalgia and other types of grief resulting from environmental change among the broader literature surrounding climate change and its mental health impacts. Finally, the bivariate analyses provided me with an excellent place to start asking new questions about how solastalgia impacts different groups. This is a wonderful place to end an exploration of a construct: with many more exciting questions to study going forward.

Future Directions

This study provides interesting information to inform future directions of social work research, practice, policy, and my future development as a scholar. As researchers continue to explore the way that climate change causes feelings of grief and loss, it will be important to have psychometric measures to assess the efficacy of interventions as well as the epidemiology of grief in the aftermath of climate related disasters. The validation of this measure is a good starting point for this work. This study has provided an initial starting point for the development of measures that capture the grief and loss that results from broad experiences of climate change that would allow practitioners and researchers focused on social work practice to assess the efficacy of interventions in this area. In order to continue this investigation, I posit the three following research questions: 1) what are the dimensions of ecological grief? 2) how do the identified dimensions of ecological grief differ from the construct of solastalgia? 3) how valid and reliable is a developed measure of ecological grief with samples of people with varied experiences of climate change based on the work of Cunsolo and Ellis (2018a)? Questions one and two direct the development of a measure of ecological grief that would be unique from one

for solastalgia in a way that honors the connection between these two constructs. Question three focuses on the validation of the developed measure and provides a direct connection to the previous scholarship on ecological grief. I believe that these three questions would best be tackled as one research project, allowing each to build on the question before. The final result would hopefully be a new measure for grief and loss that could more fully capture this experience in relation to the impacts of climate change.

Additionally, there is research on the treatment of the mental health responses to climate change through talk therapy (Hasbach, 2015), music therapy (Seabrook, 2020), and ecotherapy (Doherty, 2016). Social work practitioners are on the front lines, working with clients who are managing their mental health response to climate change in addition to the other challenges and stresses that they experience in their lives. This research project has provided insight into the connections between solastalgia and mental disorders that are commonly the focus of mental health social workers. Providing social work practitioners with the language they need to help their clients identify and process through specific types of grief is an important first step in helping social work practice confront the realities of climate change in our profession. Secondly, connecting the constructs of solastalgia or ecological grief to more traditional aspects of social work practice, like the Kübler-Ross model of grief (2005) or Freud's work on mourning (1924) helps practitioners build on the skills they already possess, making the integration of environmental loss into their practice more seamless.

As policymakers continue to wrestle with climate change policy at the local, national, and international levels, it will be important for them to consider the mental health impacts of climate change on the population. This includes the non-pathologized mental health responses, such as grief and loss, to climate change and its effects. One of the main ways that public policy can

incorporate aspects of this study is to conduct educational campaigns about the mental health responses to climate change, including grief and loss. This may be modeled after the work done by former US Surgeon General Vivek Murthy and his focus on the loneliness epidemic (2020). In his work, Murthy has encouraged people to take their mental health, emotions, and experiences of loneliness seriously and treat them like they would treat something in their physical body. Second, state and local governments should begin to implement studies about the ways in which their communities are experiencing grief and loss due to environmental degradation and change. By conducting localized studies, these governments could work to find localized solutions that empower the people living there to work toward solutions and make meaning from their feelings of loss (Kessler, 2019). Because the process of finding meaning is so individual, it would be difficult to implement projects like this on a larger scale, and therefore keeping them at the state or local level would be ideal.

Finally, this project has inextricably altered my journey as a social worker, researcher, and scholar. My passion has been climate change mitigation for nearly 15 years, yet it was only through this project that I could fully integrate that passion with my deep commitment to the study of trauma and non-pathologized mental health. As I move into the next phase of my career, I plan to use the findings from this study to support the development of a more comprehensive measure of the grief and loss caused by the impacts of climate change. Armed with this tool, I plan to gather data on the epidemiology of this type of grief and use that to advocate for policy changes to mitigate the effects of climate change as quickly as possible. Additionally, I hope to find ways to use this knowledge outside of the academy. Whether through policy work like the public health interventions described above, or by writing a non-academic text, I hope to normalize the attachment, love, and care that people experience for the natural world and to help

improve our understanding of the ways that love and care can result in feelings of loss, grief, or pain. In short, I hope to be part of the process to move these feelings of loss out of a state of ambiguity. Through this work, I hope to use my expertise and my personal experience, just as the scientists before me have, to tip the scale a little further away from the dystopian possibilities I have seen in *WALL-E* (Stanton, 2008) or read about in *The Book of Joan* (Yuknavitch, 2018).

Conclusion

Climate change is the single greatest existential threat to humanity at this time, and therefore it is unsurprising that it impacts many aspects of human wellbeing. Over the course of this study, I have discussed the way that climate change impacts human mental health with a focus on the resultant experiences of grief and loss. Through the development of three research questions, a discussion of the existing literature that informed this project, the implementation of a survey designed for this study, statistical analyses, and the discussion of the results of those analysis I have sought to position the current measure of solastalgia within the broader literature on the grief and loss that results from environmental change.

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Solastalgia

Directions: Do you agree or disagree with the following statements about your local environment.

The rating scale is as follows:
0=Strongly disagree
1=Disagree
2=Neither agree or disagree
3=Agree
4=Strongly agree

Number	Question
1	My sense of belonging to this place has been undermined by unwelcome change.
2	I am sad that familiar animals, plants and fish are disappearing from this place.
3	I am worried that aspects of this place that I value are being lost (e.g., clean air and water, beautiful scenery).
4	I miss having the sense of peace and quiet I once enjoyed in this place.
5	I am ashamed of the way this area looks now.
6	A farming lifestyle that depends on good land and water is being threatened by environmental change.
7	Unique aspects of nature that made this place special are being lost forever.
8	I am saddened when I look at degraded landscapes.
9	The thought of my family being forced to leave this place upsets me.
10	I feel good about the restoration of the environment (e.g., mine-site rehabilitation).

DASS-21

Directions: Please read each statement and indicate how much the statement applied to you over the past week.

There are no right or wrong answers, Do not spend too much time on any one statement.

The rating scale is as follows:
0=Did not apply to me at all
1=Applied to me to some degree or some of the time
2=Applied to me a considerable degree or a good part of the time
3=Applied to me very much or most of the time

Number	Domain	Question
1	S	I found it hard to wind down
2	A	I was aware of dryness of my mouth
3	D	I couldn't seem to experience any positive feeling at all
4	A	I experienced breathing difficulty (e.g. excessively rapid breathing, breathlessness in the absence of physical exertion)
5	D	I found it difficult to work up the initiative to do things
6	S	I tended to over-react to situations
7	A	I experienced trembling (e.g. in the hands)
8	S	I felt that I was using a lot of nervous energy
9	A	I was worried about situations in which I might panic and make a fool of myself
10	D	I felt that I had nothing to look forward to
11	S	I found myself getting agitated
12	S	I found it difficult to relax
13	D	I felt down-hearted and blue
14	S	I was intolerant of anything that kept me from getting on with what I was doing
15	A	I felt I was close to panic
16	D	I was unable to become enthusiastic about anything
17	D	I felt I wasn't worth much as a person
18	S	I felt that I was rather touchy
19	A	I was aware of the action of my heart in the absence of physical exertion (e.g. sense of heart rate increase, heart missing a beat)
20	A	I felt scared without any good reason
21	D	I felt that life was meaningless

PCL-V

Directions: Below is a list of problems people sometimes have in response to a very stressful experience.

Please read each problem carefully and choose one of the buttons to indicate how much you have been bothered by that problem in the past month.

The rating scale is as follows:
0=Not at all
1=A little bit
2=Moderately
3=Quite a bit
4=Extremely

Number	Question
1	Repeated, disturbing, and unwanted memories of the stressful experience?
2	Repeated, disturbing dreams of the stressful experience?
3	Suddenly feeling or acting as if the stressful experience were actually happening again (as if you were actually back there reliving it)?
4	Feeling very upset when something reminded you of the stressful experience?
5	Having strong physical reactions when something reminded you of the stressful experience (for example, heart pounding, trouble breathing, sweating)?
6	Avoiding memories, thoughts, or feelings related to the stressful experience?
7	Avoiding external reminders of the stressful experience (for example, people, places, conversations, activities, objects, or situations)?
8	Trouble remembering important parts of the stressful experience?
9	Having strong negative beliefs about yourself, other people, or the world (for example, having thoughts such as: I am bad, there is something seriously wrong with me, no one can be trusted, the world is completely dangerous)?
10	Blaming yourself or someone else for the stressful experience or what happened after it?
11	Having strong negative feelings such as fear, horror, anger, guilt, or shame?
12	Loss of interest in activities that you used to enjoy?
13	Feeling distant or cut off from other people?
14	Trouble experiencing positive feelings (for example, being unable to feel happiness or have loving feelings for people close to you)?
15	Irritable behavior, angry outbursts, or acting aggressively?
16	Taking too many risks or doing things that could cause you harm?
17	Being "super alert" or watchful or on guard?
18	Feeling jumpy or easily startled?
19	Having difficulty concentrating?
20	Trouble falling or staying asleep?

Connectivity with Nature

Directions: Please indicate how much you agree with each of the following statements

The rating scale is as follows for questions 1-6 (question 7 is scored separately):
0=Strongly disagree
1=Disagree
2=Neither agree nor disagree
3=Agree
4=Strongly agree

| 1	I see myself as part of a larger whole, in which everything is connected by a common essence.
2	I feel a sense of oneness with nature.
3	I have never had an experience in which all things seemed unified into a single whole.
4	The world is not merely around us but within us.
5	I never feel a personal bond with things in my natural surroundings, like trees, a stream, wildlife, or the view on the horizon.
6	While in the outdoors, I have experienced a lessened sense of the distinction between myself and my natural surroundings.
7	In the following diagrams, one circle represents yourself and the other circle represents the natural world which includes animate objects (like plants and animals) and inanimate objects (like streams, the atmosphere, and landscapes). [Scoring: Diagram 1=1, Diagram 2=2, Diagram3=3]
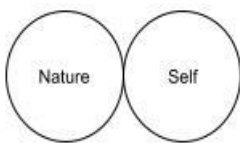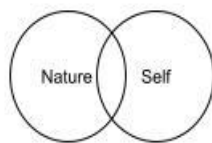
Diagram 1   Diagram 2   Diagram 3

Appendix B: Social Media Recruitment Graphics

Graphic 1: Instagram and Facebook

Do you live on Earth? Are you over 18 & Proficient in English?

WE ARE DOING A STUDY TO BETTER UNDERSTAND THE WAY THAT NATURE AFFECTS (OR DOESN'T AFFECT) MENTAL HEALTH

PLEASE TAKE OUR SURVEY!!!

Graphic 2: Twitter

DO YOU LIVE ON EARTH?
ARE YOU OVER 18 &
PROFICIENT IN ENGLISH?

WE ARE DOING A STUDY TO BETTER UNDERSTAND THE WAY NATURE AFFECTS OUR MENTAL HEALTH

Please take our survey, it takes less than 20 minutes!

Appendix C: Future Multivariate Research Models

Independent Variables	Moderating Variable	Mediating Variables	Dependent Variables	Covariates
Depression Anxiety PTSD	Gender identity		Solastalgia	Age, race, region, disaster exposure, employment status
Depression Anxiety PTSD	Race		Solastalgia	Age, gender identity, region, disaster exposure, employment status
Depression Anxiety PTSD	Covid-19 Impact		Solastalgia	Age, race, gender identity, region, disaster exposure, employment status
Depression Anxiety PTSD		Disaster exposure	Solastalgia	Age, race, gender identity, region, disaster exposure, employment status
Depression Anxiety PTSD		Type of disaster (all)	Solastalgia	Age, race, gender identity, region, disaster exposure, employment status
Depression Anxiety PTSD		Type of disaster (climate change related vs. non-related)	Solastalgia	Age, race, gender identity, region, disaster exposure, employment status
Depression Anxiety PTSD		Time since disaster	Solastalgia	Age, race, gender identity, region, disaster exposure, employment status
Connectivity to Nature	Spirituality		Solastalgia	Age, race, gender identity, region, disaster exposure, employment status