Climate Change and Student Stress: The Impact of Climate Change on the Mental Health of University Students

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Abstract

The prevalence of climate change in our world today has provoked immense fear and panic among members of society. As young people who are navigating the world during this unprecedented time, university students are especially impacted by environmental changes. Utilizing a mixed-methods approach, this study explores how university students' mental well-being is impacted by climate change. To understand this relationship, environmental identity, climate anxiety, and negative feelings towards climate change were studied. Additionally, students' program of study was investigated as a moderator of this relationship, to determine whether students in science-based programs were more strongly impacted by climate change. This study was conducted through the use of an anonymous online survey consisting of both quantitative and qualitative questions distributed to the McMaster University undergraduate population. This survey accumulated a total of 40 complete responses that underwent statistical and thematic analysis. Findings revealed that the mental health of undergraduate students was strongly impacted by climate change. Additionally, those in science-based programs identified more strongly with the environment and experienced greater anxiety and overall negative feelings towards climate change than those in non-science-based programs. While this topic is still in need of additional research, this study provides insight into the social implications of climate change by understanding how impacts the mental health of university students.

Introduction

Climate change is a highly prevalent issue that individuals across the world continue to face (NASA, 2023). Our current behaviours are creating immense and irreversible changes to the climate, resulting in various environmentally and socially negative consequences (Cianconi et al., 2021). Beyond the biological and somatic impacts of climate change, this issue also creates more social concerns pertaining to the well-being of individuals (Clayton et al., 2017). Narratives of climate change are ever-so present in empirical research, yet there is a lack of focus when it comes to societal implications and influences on mental well-being. With respect to this neglect in the

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research field, the goal of our research was to understand how the issue of climate change impacted the mental well-being of undergraduate students. Throughout the research process, we applied our research findings to existing theoretical perspectives to establish a relationship between environmental identity, climate anxiety, and students' well-being. Our research was approved by the McMaster Research Ethics Board (MREB#: 0327).

Social Psychological Context

Our research team selected three existing social psychological theories to further understand the relationship between well-being and climate change. We ultimately focused on social identity theory, environmental identity theory, and terror management theory to analyze and further interpret our findings. We explored the concept of social identity and the impacts that social groups have on individuals' self-concept, which can influence beliefs surrounding climate change (Islam, 2014). We also examined environmental identity theory, a subset of social identity theory, which focuses on individuals' beliefs and behaviours in relation to the environment (Clayton, 2004). Finally, we analyzed terror management theory to understand the relationship between climate change and negative emotions. Terror management theory investigates how humans manage the negative emotions associated with feelings of risk and mortality (Van Lange et al., 2012). Regarding climate change, appropriate terror management can help alleviate some of the negative emotions that relate to climate crises and the associated risks.

Purpose

Current research surrounding climate change often takes an environmental perspective. To expand on this naturalistic focus, it is important to examine the implications of climate change from a more humanistic perspective by exploring the correlation between climate change and the mental well-being of individuals. Using this objective, we explored these research questions: *How does climate change affect the mental well-being of undergraduate students*? *How do these effects differ between programs of study*?

We sought to answer these questions by distributing an online anonymous survey using scales pertaining to participants' feelings toward climate change. After further analysis of our selected theories and included scales, we took a particular interest in environmental identity and how individuals' feelings are influenced by climate change through this lens.

Overview of Paper

To establish an appropriate foundation for understanding our research topic, we conducted a literature review and explored three social psychological theories that we then applied to our research questions. Subsequently, we outlined our research process, methodology, and described how we performed our data analyses. We then shared both our quantitative and qualitative findings through various figures and tables, which were further analyzed in the discussion section. Finally, we concluded by conveying the limitations and significant insights found throughout our research process.

Literature Review

Climate change has been rapidly occurring over the last few centuries which has caused detrimental impacts to the planet and extreme weather events like floods, droughts, fires, and earthquakes (Cuijpers et al., 2023). These occurrences have had direct impacts on the physical health of individuals; however, climate change has also had a major impact on individuals' mental health. Climate events have increased the prevalence of several mental health disorders including post-traumatic stress disorder (PTSD), depression, and anxiety (Cuijpers et al., 2023). Climate change has also increased stress levels and substance abuse and caused emotional distress and feelings of frustration and grief (Clayton et al., 2017; Stanley et al., 2021). Canadians are particularly vulnerable to these impacts, considering Canada is "warming twice as fast as the global average" (Hayes et al., 2019, p. 2). Young people are also particularly at risk for eco-anxiety and post-traumatic stress in relation to climate change, given the effects it will have on their future (Patrick et al., 2022). The following literature review will summarise current research on the effects that climate change has on mental health. Three key themes were extracted from the literature: direct effects, indirect effects, and the effects on young people. These themes highlight the importance of understanding how climate change influences mental health and therefore, the importance of our topic of study and the population we chose to examine. After this discussion, the major limitations of the literature will be examined.

Prior to analyzing the current literature regarding climate change and mental health, it is necessary to define key terms that will be used throughout the review. 'Climate events' refer to "discrete episodes of extreme weather or unusual climate conditions, often associated with deleterious impacts on society or natural systems" (Cuijpers et al., 2023, p. 639). 'Mental health' is defined as the psychological and social well-being of individuals (Hayes et al., 2019). 'Young people' refers to individuals under the age of 35, given this encompasses the age of most university students (Schwartz et al., 2023). Several new terms have been introduced in reference to the effects of climate change on mental health, one of which will be used in this review: 'eco-anxiety' (Stanley et al., 2021). 'Eco-anxiety' is defined as the "anxiety experienced in response to the ecological crisis" (Stanley et al., 2021, p. 1). The creation of this term highlights the extreme mental health effects individuals have been experiencing as a result of climate events.

Direct Effects

Direct climate events cause "trauma associated with extreme weather events" (Patrick et al., 2022, p. 711). Some examples of these events are storms, heatwaves, and wildfires (Clayton et al., 2017). Consequently, these events directly impact mental health by increasing levels of PTSD, depression, suicidal thoughts, and substance use disorders (Cuijpers et al., 2023). Patrick et al., (2022) performed a study to understand how climate change affected the mental health of over 5000 Australian citizens. Most of these individuals had experienced direct effects of a climate change-related event. Of these individuals, one in four had met the criteria of post-traumatic stress disorder (Patrick et al., 2022). Further, Clayton et al., (2017) found that climate events increase levels of suicide and suicidal ideation in response to the increasing temperatures occurring due to climate change. Additionally, it has been shown that heat levels increase aggression, negative thoughts, decreased cognitive functioning, and lack of

problem-solving (Berry et al., 2010; Clayton et al., 2017). Similarly, Yoo et al., (2021) conducted a study in New York looking at hospital visits in relation to climate change. They found an association between higher temperatures and hospital visits for mental health-related concerns such as mood and internalizing disorders (Yoo et al., 2021). Palinkas & Wong (2020) explain potential reasons as to why this may be occurring, given that increased heat leads to body dehydration, which can cause decreased cognitive functioning. Higher temperatures also suppress thyroid hormones which can lead to cognitive impairments such as low mood and lethargy (Palinkas & Wong, 2020).

Indirect Effects

Among the direct effects of climate change, indirect effects are also prevalent causing environmental, social, and economic disruptions (Patrick et al., 2022). Some examples of these effects include economic uncertainties and migration (Cuijpers et al., 2023). Along with the direct physical effects of climate change, occupational structures and agricultural conditions can also be destroyed, leading to economic difficulties for individuals (Cuijpers et al., 2023). Additionally, other areas around the world are becoming less habitable or destroyed completely, causing individuals to forcefully migrate to other locations (Cuijpers et al., 2023). Decreasing food security and weakened infrastructure also contribute to the indirect effects of climate change (Clayton et al., 2017). These effects can create a sense of lost autonomy because individuals no longer feel like they are in control of their environment, leading to poorer mental health (Clayton et al., 2017). Clayton (2021) discussed how these changes, food, and economic insecurity, are particularly impactful on the Inuit in Northern Canada. As a result, there is an increased prevalence of substance abuse and mental health concerns (Clayton, 2021). Climate change also has a major influence on communities that rely on agricultural production, due to reduced productivity and viability of produce (Berry et al., 2010). The rising heat also reduces the amount that agricultural labourers can physically work. These losses contribute to socioeconomic hardships and declining mental health (Berry et al., 2010).

Effects on Young People

Young people are particularly at risk for being affected by climate change (Patrick et al., 2022). Patrick et al., (2022) found that young people are more susceptible to eco-anxiety and PTSD. Similar results were found by Hickman et al., (2021) who conducted surveys on young people among 10 different countries on their opinions on climate change. They found that the majority of young people were concerned about climate change, and “59% were very or extremely worried” (Hickman et al., 2021, p. 863). Young people feel betrayed because despite not having done most of the damage to the planet, they must deal with the consequences (Hickman et al., 2021). This betrayal manifests itself in negative thoughts and mental health conditions (Hickman et al., 2021). To further explain this phenomenon, Hickman et al., (2021) referred to the stress-vulnerability model of health, which explains that exposure to chronic stress in childhood can cause lasting impacts and increase the risk of mental health struggles.

Furthermore, we see patterns of concern amongst young people regarding procreation due to fears about the future and the impact climate change may have (Clayton, 2021). A study by Schwartz et al., (2023) analyzed the effects of climate

change anxiety on adult students in the United States. In their study, they included several qualitative questions that allowed young people to express their concerns about climate change. One individual conveyed that “Even going to college and thinking of my future at times feels misguided and naïve when facing the reality that there is a large chance that I won’t be able to have children, a future or a stable career in a world that is devastated by climate change” (Schwartz et al., 2023, p. 16717). Others explained feeling like they should not bring children into the world as to not contribute to population growth (Schwartz et al., 2023). Despite the numerous stressors for young people in relation to climate change, protective factors are present as well. Hickman et al., (2021) explained that psychosocial resources such as friend and family support, coping skills, and the ability to handle stressors can mitigate the effects of climate change on the mental health of young people. The extreme worries and stress that young people experience due to climate change highlights the need for our study and its focus on students’ mental health.

Limitations

Despite current literature providing important insights into climate change and mental health, they do pose a variety of limitations. Patrick et al., (2022) and Schwartz et al., (2023) collected data during the COVID-19 pandemic in 2020, which could have contributed to increased rumination and feelings of anxiety. Due to limited distractions, individuals may also have been more exposed to negative news surrounding climate change, which could have influenced the results of the study. Individuals in Australia had also recently experienced severe bushfires, therefore, increasing the likelihood of experiencing a direct climate event and mental health symptoms (Patrick et al., 2022). Cuijpers et al., (2023) explained how it is challenging to study how climate events impact mental health, as measurements would have to occur before and after the events to determine causality. Confounding variables are also important to consider as they may have influenced the levels of mental health symptoms (Cuijpers et al., 2023). Furthermore, Hickman et al., (2021) developed a study that utilized an online polling company that required Internet access and in most cases the ability to speak English. This limits the generalisability of the study given its exclusion of non-English speaking countries. Other research studies found similar trends and difficulties in determining directional relationships, as it is not always clear whether climate change influences mental health (Schwartz et al., 2023; Stanley et al., 2023). Another possible explanation could be that poor mental health makes individuals more susceptible to having negative reactions toward climate change (Schwartz et al., 2023; Stanley et al., 2023). Despite these limitations, the discussed literature is important as it recognizes the implications of climate change and the prevalent effects on the mental well-being of young people.

Summary

The literature review provided demonstrates the immense impact of climate change on the mental health of individuals, through both direct and indirect effects. Mental health can be directly affected by experiencing extreme weather events, which can cause increased stress levels and decreased cognitive functioning (Clayton et al., 2017; Patrick et al., 2022). Climate change also negatively influences social and economic structures by making areas less habitable and decreasing food security, demonstrating

its indirect effects (Cuijpers et al., 2023). Additionally, it emphasises empirical evidence highlighting young people as a vulnerable population to the effects of climate change. Young people experience feelings of worry and powerlessness about the future and fear the potential of not having a stable career or family (Clayton, 2021; Schwartz et al., 2023). This evidence guided our research as we sought to gain a greater understanding of how students feel about climate change and whether it distracts from their studies. It also aimed to build on existing literature and push for more mental health resources to support those who are struggling with the effects of climate change.

Theoretical Frameworks

Social Identity Theory

According to Stets and Biga (2003), identity is defined as "a set of meanings attached to the self that serves as a standard or reference that guides behaviour in situations" (p. 401). Identity provides a basis for an individual's attitudes and behaviours, playing a significant role in everyday situations and social interactions. Theorists have highlighted the influence of social groups on individual identities (Stets & Biga, 2003). This has led to the conclusion that individuals define their personal identities based upon the groups they are a part of, which is the foundation of social identity theory (Islam, 2014). Social identity theory provides a foundation for environmental identity theory, which forms a basis for the study of how identities surrounding the environment can be influenced by several factors including social groups (Islam, 2014).

Social identity theory was first developed by Henri Tajfel (1970) through his work on social groups (Islam, 2014). This early work involved the use of cognitive grouping to explain how social groups differ in their biases and perceptions (Islam, 2014). Tajfel (1970) found that individuals formed psychological bonds within their groups, by having more positive evaluations of one's own group and more negative evaluations of the out-group (Islam, 2014). When one forms an identity within a group, it becomes part of their self-concept, meaning they are more emotionally tied to the values of the group (Islam, 2014). Therefore, comparisons between groups can lead members to have a positive bias towards their group to feel good about themselves and their identity (Islam, 2014).

Stets and Biga (2003) highlighted the importance of how identities are formed through the identity model. This model permits that once an identity is used within a specific situation, a feedback loop has been secured (Stets & Biga, 2003). Since individuals are composed of multiple identities due to the social groups they are a part of, each interaction involves its own feedback loop for these separate identities (Stets & Biga, 2003). A feedback loop includes three components (Stets & Biga, 2003). The first component is one's standard "self-meanings tied to their identity" (Stets & Biga, 2003, p. 402). The second component is one's reflected appraisals, in which individuals use the perceptions of others to derive a view of themselves (Stets & Biga, 2003). The third component is called a comparator and compares the standard and perceptual inputs to determine differences between them (Stets & Biga, 2003). In cases where these components are similar, individuals feel more positive emotions and confidence since others are reaffirming their standard beliefs (Stets & Biga, 2003). Therefore, they tend to

perform the behaviour that is most aligned with these positive emotions (Stets & Biga, 2003).

Social identity theory plays a vital role in understanding social groups and how individuals develop their identities based on the groups they are a part of. This theory has been applied to a variety of situations and contexts throughout the years. For example, social identity theory has been used to address concerns regarding the environment, which has led to the development of environmental identity theory (Stets & Biga, 2003).

Within our study, social identity theory has allowed us to understand how beliefs regarding climate change can be strongly influenced by one's social identity. Specifically, we argued that students' affiliation with their program of study would play a role in how they feel about climate change. Social identity theory has also provided us with a sufficient basis to understand the development of environmental identity theory, which delves into one's social understanding of the environment.

Environmental Identity Theory

Environmental identity pertains to how an individual's self-meanings are related to their interactions with the environment (Stets & Biga, 2003). An environmental identity can be considered a collective identity that provides a sense of connection and influences one's self-concept (Clayton, 2004). Environmental identities can be classified as either products or forces. They are products when they are developed from interactions with nature and social understandings of it (Clayton, 2004). On the other hand, environmental identity can be a motivating force by leading an individual to partake in behaviour relevant to the environment (Clayton, 2004). For example, having a strong environmental identity may propel an individual to understand the importance of environmental issues and take personal, social, or political action to promote more healthy behaviours (Clayton, 2004). Given that an individual's identity may be tied to the environment, this explains why an individual's mental health may be impacted when the environment is threatened.

When looking at environmental identity, it is important to consider the process by which this identity is developed. Theorists Kempton and Holland (2003) identified a three-stage process involved in environmental identity development, which includes salience, identification, and knowledge (Stapleton, 2015). Firstly, salience occurs when an individual becomes personally aware of environmental issues. Identification occurs when an individual becomes more concerned with the environment and begins taking action toward environmental concerns. Lastly, knowledge occurs when an individual becomes more knowledgeable about environmental work and an advocate for environmental issues (Stapleton, 2015).

Stapleton (2015) also identified five key aspects of identity that are important to consider when studying environmental identity. The first aspect suggests that identity is malleable over time (Stapleton, 2015). This means that individuals' identification with the environment can change throughout their lifetime. The second aspect argues that identity is tightly connected to practice (Stapleton, 2015). In the context of environmental identity, individuals must engage in environmental work to consider the environment as part of their identity. The third aspect states that identity is significantly impacted by social interactions (Stapleton, 2015). Since we are extremely influenced by

others, social interactions play a role in both environmental identity formation and maintenance. The fourth aspect indicates that identity exists on multiple levels (i.e., micro/macro) (Stapleton, 2015). Therefore, it is important to consider individual contexts which have a strong influence on how environmental identity is expressed. The fifth aspect suggests that education and schooling can heavily impact identity (Stapleton, 2015). The strength of an individual's environmental identity is immensely influenced by their knowledge of the topic (Stapleton, 2015). This speaks to the importance of including environmental issues in school curriculum.

Environmental identity was extremely important to our study since it allowed for greater insight into how individuals feel about climate change. We were able to understand how dedicated one is to the practice of environmental work and better understand their concerns within the topic. Since many of these beliefs and actions arise from one's social identity, we hypothesized that those in science-based programs would have a stronger environmental identity. This reflects our findings that students in science-based programs engage in larger amounts of environmental work, therefore, demonstrating that their identities are more strongly linked to the environment. Utilizing this theory also allowed us to delve deeper into environmental identity and sparked our interest in researching the link between environmental identity and mental well-being. This led to a shift in our study towards a greater focus on environmental identity overall.

Terror Management Theory

An additional social psychological theory that can be utilised to understand the relationships between mental well-being and our changing climate is terror management theory (TMT). TMT was developed by university students Jeff Greenberg, Sheldon Solomon, and Tom Pyszczynski (1986), who formulated the theory in attempts to outline the interrelatedness between social psychological concepts such as self-esteem, aggression, the self-concept, etc. (Van Lange et al., 2012). They emphasized that the theory was constructed to provide an integrated perspective of these concepts, and additionally wished to investigate how these concepts impacted factors such as social influence and relationships (Van Lange et al., 2012). TMT conceptualizes the impacts of our unconscious perceptions regarding our own mortality, as well as how these perceptions are integrated within our daily lives (Van Lange et al., 2012). To add, TMT explains that our behaviours and methods of coping are dictated by our perceptions and fears of our mortality.

The theory is broken down into two observations that exemplify the significance of these perceptions (Van Lange et al., 2012). The first being that individuals are embedded with a fight-or-flight system that protects them from external threats. Second, the cognitive capacity of individuals maintains that ideas surrounding mortality are present and personal, and that death may be brought upon us at any time (Van Lange et al., 2012). TMT predicts that this evolutionary fight-or-flight response predisposes us to thoughts of anxiety and distress that we must maintain the management of. More specifically, we must endure the management of feelings of anxiety, or terror, brought on by our perceptions of risk and mortality (Van Lange et al., 2012). Thus, the management of our terror is impacted by our perceptions of the state of the world and the position of our existence within it. Further, effective and positive terror management is exemplified through individuals' perspectives maintaining that one provides benefit towards the

society in which they live (Van Lange et al., 2012). One significant component of TMT is defined as Mortality Salience (MS). The concept of MS is outlined as being our perceptual awareness regarding our own future mortality, and the reality of our own death (Naidu et al., 2022). MS is an important component within terror management theory as its presence within the individual demonstrates the salience behind cognitive structures that protect us from anxiety regarding mortality (Naidu et al., 2022).

TMT and its conceptualization are built upon the hypothesis that psychological distress and functioning is a significant mediator between cultural worldviews and our self-esteem. Moreover, our abilities to manage our psychological anxieties plays a critical role in how we interpret external world occurrences, and additionally this perception impacts our self-esteem and distress (Van Lange et al., 2012). The cognitions analyzed through TMT are emphasized to act as a resilience factor within our self-esteem and well-being. Thus, perceptions of mortality are rather explained to reinforce positive self-esteem and well-being due to the protective nature of terror management (Van Lange et al., 2012). Additionally, interfering with these cognitive structures will negatively impact one's terror management, and further bolster anxiety and distress regarding perceptions of risk and mortality (Van Lange et al., 2012). Negative terror management may propel individuals to use maladaptive cognitive strategies to separate themselves from perceptions of death, and further adopt unhelpful perspectives such as minimization of the threat, avoidance, or denial (Naidu et al., 2022). To reiterate, adequate terror management is dictated through our perceptions of the world and our position within it, and this impacts the intensity of anxiety and distress within perceptions of future mortality (Van Lange et al., 2012).

Terror management theory can be utilized to understand the feelings that climate change brings upon us as humans. Occurrences of climate change have brought ideas regarding future death and mortality due to risks towards health and death, and other vulnerabilities (Naidu et al., 2022). The concept of climate change has proposed the probable consequences of intense and persistent extremities of dangerous weather events such as wildfires, floods, droughts, and more (Naidu et al., 2022). The recent and prevalent exposure to this knowledge emphasizes the presence of MS and other psychological stressors regarding thoughts of future and near mortality. This anxiety is further reinforced by portrayals from media outlets, whose content is highly influenced by marketing pressures to sell emotional and powerful stories (Naidu et al., 2022). Further, this constant exposure to information on the climate crisis may amplify thoughts of death and MS, due to the individual's thoughts regarding the inability to fix the problem themselves.

To reiterate, TMT discloses the significance behind our perceptions of the world and further how the individual plays a role within it, and that this impacts our abilities to manage feelings of anxiety and terror (Naidu et al., 2022). Naidu et al., (2022) states that events of climate change have brought feelings of powerlessness and a loss of individual control within the situation. Moreover, this sense of powerlessness brought by the external factor of climate change impacts our abilities to manage terror and anxiety. Societal reactions to events such as climate change are essential dictators of how we manage ideas regarding mortality (Naidu et al., 2022). Further, our capabilities within terror management influence means of external response (i.e., attempts of climate change mitigation) as well as the internal processes (i.e., avoidance, minimization, or

distress) (Naidu et al., 2022). To reiterate, the tenets of TMT lay some of the theoretical groundwork that may be utilized to understand relationships between climate change and mental well-being. It is clear through TMT that we can understand events of climate change as salient factors within how we manage aspects of mental well-being such as anxiety and distress (Naidu et al., 2022).

TMT was valuable to our study because it allowed us to understand the impacts of climate change on mental health and well-being. The overall premise of TMT has been used to understand how climate change plays a critical role in individuals' mental well-being, as our changing climate reinforces ideas regarding future mortality as well as overbearing feelings of powerlessness (Naidu et al., 2022). This provoked our interest in seeking to understand the feelings that may be brought to the surface when thinking about climate change. To measure participants' emotions in regard to climate change, we asked them how they felt about climate change in association to many of the feelings that arise in TMT. Specifically, we looked at how much control participants felt in regards to climate change, with many reporting that they often felt powerless and few reporting regular feelings of optimism.

Summary of Theoretical Frameworks

These theoretical frameworks have provided us with a foundation to understand how climate change influences mental well-being. This has allowed us to gain a deeper understanding of our results and the implications of climate change on university students. Social identity theory was used to understand how participants' identity with their program influences their identity regarding the environment. This in turn provided us with a basis to understand environmental identity theory. Participants' strength of environmental identity allowed us to explore their social relationship with the environment and revealed how they interact with the environment by choosing to take action to eliminate the effects of climate change. Our strong interest in this theory led to a shift in our research towards the link between environmental identity and mental well-being. Lastly, terror management theory provided us with a baseline idea of the feelings that may arise for people when thinking about climate change. This led to our interest in studying how participants felt about climate change, by asking them to report their emotions and level of anxiety associated with this global event.

Methodology

Development of Survey

Our research team consisted of six fourth-year undergraduate students in the Honours Social Psychology Program at McMaster University. This study was conducted as a part of our thesis requirement. All aspects were overseen by Dr. Sarah Clancy, the professor of our SOCPSY 4ZZ6 thesis course. Climate change and its relation to mental well-being was selected as our topic in reaction to the increasing importance of environmental protection and its social implications within recent years. Based on this topic, we were able to select two key research questions. The research questions we aimed to answer were: *How does climate change affect the mental well-being of undergraduate students*? *How do these effects differ between programs of study*?

To answer these questions, we thoroughly analyzed current academic literature on the topics of climate change, mental health, and relevant social psychological theories.

More specifically, we looked at social identity theory, environmental identity theory, and terror management theory. We utilized two existing scales designed to measure environmental identity and anxiety related to climate change. One scale was the Environmental Identity Scale (EID-R) developed by Susan Clayton, a conservation psychologist at the College of Wooster (Clayton, 2023). We additionally used the Climate Change Anxiety Scale (CCA), also created by Clayton (2023) and her collaborator, Brian Karazsia. Both scales (EID-R, CCA) were obtained from Dr. Clayton's personal website, where a statement to use the scales for free for research purposes appears (Clayton, 2023). The third scale used was the Emotions Scale, consisting of questions asked about the persistence of specific emotions and their association with climate change. Questions included in the Emotions Scale were inspired by research conducted by Hickman et al., (2021). We chose to exclude the emotions 'Helpless', 'Afraid', and 'Despair', to shorten the scale items. Additionally, three open-ended questions and six demographic questions were included in our survey.

Our research was approved by Dr. Sarah Clancy, who acted as the McMaster Research Ethics Board (MREB#: 0327) reviewer, on November 8, 2023. Research on our chosen topic was carried out through an anonymous, online survey on LimeSurvey. LimeSurvey was approved by the McMaster Research Ethics Board for survey research in our class, SOCPSY 4ZZ6. This program was ideal as their platform allows participants to remain anonymous and protects participant data behind encrypted, password-protected software. Participants were encouraged to complete our survey in a safe, secure location, to maintain their privacy. This survey included both open and closed-ended questions.

Ethical Concerns

As per the MREB, participants may have experienced social and/or psychological risks as a result of participating in our study. However, we introduced mitigation strategies to ensure that these risks did not exceed any that may be encountered in everyday life. One possible psychological risk present in our survey revolved around the disclosure of sensitive information. The questions used in our survey assessed negative emotions, overall mental well-being, and personal experiences. Disclosing this type of information may have made participants feel embarrassed, uncomfortable, worried, or upset. To reduce this risk, we included wellness resources in the letter of information in the case that any negative feelings were to arise. The content of our survey was also disclosed in the letter of information. This way, participants were immediately informed of the risks they may face when disclosing sensitive information. Additionally, participants had the right to skip questions and/or exit the survey, for any reason, at any point before completion. All these precautions limited the development of negative psychological risks to survey respondents by offering transparency and relevant support.

Additionally, it is important to acknowledge that there may have been social risks to participants. It is possible that if the survey was completed in a public space, their answers may have been visible to others, resulting in a potential loss of privacy. To add, identity may have been revealed if participants liked or responded to a social media recruitment post about our survey. To maintain the privacy and anonymity of our

participants we used an online anonymous survey which ensured that data was only accessible to members of our research team. Additionally, data was stored on the MREB-approved program LimeSurvey, whose software is secure, encrypted, and password-protected. Another mitigation strategy we implemented was suggesting, in the letter of information, that participants complete the survey in a place where they feel most comfortable. This allowed participants to choose their own space to share their answers, ultimately promoting privacy. Moreover, after completing the write-up of our study, we deleted all participant data. Overall, the social and psychological risks in disclosing sensitive information posed no greater risk than issues faced in everyday life.

Another potential ethical concern was that the six researchers involved in this project are of the same demographic as the participant group; both consist of undergraduate students at McMaster University. Furthermore, four of our researchers were employed by the university as Teaching Assistants at the time of recruitment. To reduce conflict of interest, researchers did not ask any individual they have a personal relationship with to complete the survey or post the survey on any personal social media accounts. Additionally, the researchers did not personally contact any MSU clubs or societies they are a member of, past or present. Researchers who were Teaching Assistants at the time of recruitment did not ask any of their students to complete the survey. The survey was solely distributed through McMaster academic societies, MSU clubs, and MSU bulletin boards located on the university's campus. This limited researchers' influence on survey results by using third-parties to distribute the survey.

Recruitment

Participants were recruited through email contact with McMaster Students Union (MSU) clubs by Abby Pomeroy, student-led academic societies by Vishmini Jayatunge, and through MSU-approved physical posters posted on MSU bulletin boards. We asked both MSU clubs and student-led societies to distribute our survey to their members, through either email communication or posting on social media. Posters located on MSU bulletin boards were distributed across a variety of buildings on McMaster University's campus by the McMaster Underground Media. Participants who found our study through physical posters were recruited using convenience sampling.

We selected clubs on the MSU website by choosing every 8th club listed on the clubs' directory through randomized sampling. The list of clubs contacted is as follows: Amnesty International McMaster, Assyrian Chaldean Syriac Student Union (ACSSU), Black Aspiring Physicians of McMaster Association, Canadian Obesity Network Students and New Professionals (CON SNP McMaster), Cornerstone Adventist Christian Fellowship (Cornerstone ACF), Financial Marauder, Health Equity and Advocacy in Science (HEAS), Indus Development Foundation McMaster (IDF McMaster), Korean Culture and Language Club (KCLC), Mac ProcrastiKnitters, MacDonates, McMaster Advanced Space Systems (MASS), McMaster Artificial Intelligence Society, McMaster Brain Injury Association (MBIA), McMaster Champions of Change (Champions of Change Mac), McMaster Culture Connect (MCC), McMaster Extra Life, McMaster German Cultural Club, McMaster Gujarati Students Association, McMaster Indigenous Health Movement, McMaster Japanese Connection (MJC), McMaster Malayalee Student Association (MMalSA), McMaster MOOD FM, McMaster Out of Province Association (MOPA), McMaster Pre-Dental Club, McMaster Rare

Disease Review, McMaster Somali Society, McMaster Students Cooking on a Budget, McMaster Turkish Students Association (MTSA), McMaster Women in Pre-Law Society (WIPS), Midnight Association, North American Young Generation in Nuclear McMaster Chapter, Pediatric Mental Health Initiative (PMHI), RUYA McMaster, Society of Off-Campus Students (SOCS), Students for Wishes McMaster, The Citizens Foundation, The Lift Club, Trek for Teens McMaster, and World University Service of Canada (WUSC) McMaster.

We also selected all student-led academic societies running at McMaster University through convenience sampling. The list of societies contacted is as follows: Bachelor of Health Sciences Society, Bachelor of Technology Association, Bio-Psych Society, Biology Society, BioPharm Society, Chemical Engineering Club, Civil Engineering Society, Communications & Media Arts Society, Computer Science Society, DeGroote Commerce Society, Electrical and Computer Engineering Society, Engineering and Society Students Association, Health, Aging & Society Student Association, iBioMed Society, iSci Student Society, Justice, Political Philosophy and Law (JPPL) Society, Kinesiology Society, Life Sciences Student Society, Math & Stats Society, McMaster Actuarial Society, McMaster Anthropology Society, McMaster Biochemistry and Biomedical Sciences Society, McMaster Economics Society, McMaster Engineering and Management Society, McMaster Engineering Society, McMaster Human Behaviour Society, McMaster Humanities Society, McMaster Labour Studies Student Association, McMaster Materials Science & Engineering Society, McMaster Mechatronics Society, McMaster Neuroscience Society, McMaster Philosophers' Society, McMaster Political Science Students Association, McMaster Science Society, McMaster Social Sciences Society, McMaster Society of Mechanical Engineering, McMaster Sociology Student Society, McMaster Undergraduate History Society, McMaster Undergraduate Physics Society, McMaster Undergraduate Society for the Chemical Sciences, Psych Society, School Of Earth, Environment, & Society Student Association, Social Psychology Society, Social Work Students Collective, Society of Arts & Science, Students Society Culture and Religion Scholars, Software Engineering Society, and StratComm.

Email communication with clubs and societies included the letter of information, relevant recruitment scripts, and the link to our survey. Physical posters were designed in consideration of the supervisor-approved poster template. Posters also included a summary of our study and a QR code linked to our survey.

Communication with clubs and societies were conducted by one of the student investigators on the project, provided that the student investigator had no relationship with the club or society they were contacting. All participants in our study were undergraduate students at McMaster University, over the age of 18 years.

Survey Procedure

Upon clicking the link and entering the survey, participants first saw the letter of information, which included an outline of the purpose of our study, disclosure of the estimated 10-15 minutes required for full completion, examples of a few of our included questions, and any ethical concerns related to survey completion. After reading the letter of information, participants could then decide if they wanted to participate in our study. By agreeing to participate, we received implied consent. All participants had the right to withdraw from completing the survey at any point up until they pressed submit.

The first page of the survey consisted of the Environmental Identity Scale (EID-R), developed by Dr. Clayton (Clayton, 2023). This scale consisted of 14 elements which assessed participants' feelings and connections to the natural environment. Next, participants completed the Climate Change Anxiety Scale (CCA), also created by Clayton and her collaborator, Bryan Karazsia (Clayton, 2023). This scale had 13 elements that evaluated feelings of anxiety in relation to climate change. After this, participants completed the Emotions Scale, where they were asked about the persistence of specific emotions and their association to climate change. The 11 elements included in the Emotions Scale were inspired by research conducted by Hickman et al., (2021). The next page had 3 open-ended questions, giving participants the opportunity to state their opinions in their own words. An example of an open-ended question that was used in our survey is "If any, what kind of actions do you take to address climate change?" Lastly, participants were asked 6 demographic questions. Upon completion of the survey, participants were invited to our poster session, where we presented our findings. Data was collected anonymously and was stored on the LimeSurvey platform website and was only accessible to members of our research team.

Data Collection

Our survey opened on November 13, 2023, after receiving MREB approval from Dr. Sarah Clancy, and closed on February 16, 2024. Our target number of responses from participants was 100. The total number of responses ended up being 231. However, of these responses, 191 were incomplete. Therefore, we received a total of 37 complete responses. 1 of these responses came from a graduate student, therefore, was ineligible for inclusion in this study. Additionally, 4 students filled out over three-quarters of the survey, which made their responses eligible for analysis. Therefore, the total number of eligible responses was 40 (n = 40).

A major challenge that arose during our data collection was survey completion. The questions we included in our survey may have felt long in duration to participants. This may have reduced their motivation to complete the survey, leading to incomplete responses. Out of the 231 received responses, 191 of these responses were incomplete. Almost all of these incomplete responses did not respond to any questions that were past the consent to participate. Additionally, the vast majority of MSU clubs and student-led societies did not respond to our emails, which significantly hindered distribution and student participation. One of the only societies that posted our study on their social media accounts was the Social Psychology Society. This may have affected the variety of programs of study that our participating students came from. Another challenge was the number of participants. We hoped to reach our goal of 100 participants, however, this was difficult as our sample consists of undergraduate students, who may not have enough time and/or incentive to complete our survey. Undergraduate students have busy schedules and this may have affected the number of students that participated in our study. We reached out to many clubs to increase the possibility of prospective participants and full completion of the survey. Lastly, our survey was only active for a three-month period. It was not possible to have it active for longer due to time constraints for the completion of our thesis. This may have affected the total number of participants.

Data Analysis

Quantitative data was inputted and analyzed using Jamovi software. Both descriptive and inferential statistics were used. Descriptive statistics provided a description of various features of the data through generating a summary. We then re-labelled this data for computational purposes. Additionally, some of the data was re-coded in order to properly conduct certain tests. The output of descriptive statistics were frequency tables that listed the quantity of each response set. Means were then computed for each variable to conduct inferential statistical tests. Inferential statistical tests that were utilized were correlations, t-tests, and chi-squares. Correlational matrices were used to identify statistical significance, and whether this correlation was positive or negative. Statistical significance was found when the p-value was less than 0.05. T-tests were used to identify the means of participants across various programs of study. Chi-square tests (contingency tables) were used to identify statistical significance between two variables.

Qualitative data from LimeSurvey was exported into a Microsoft Excel spreadsheet. Thematic analysis was used to analyze our three open-ended survey questions, and we used an inductive codebook approach to code this data. This was done by going through the first 10 individual responses to the open-ended questions, identifying themes based on the content, and applying these themes to the remaining responses. We then utilized axial coding by developing major themes through the themes identified through the inductive codebook approach. Lastly, we created a chart that included the three open-ended questions, major themes for each question, and the frequency of each theme.

Data Collection and Analysis Timeline

Task	Start Date	End Date
Proposal submission	October 19, 2023	October 19, 2023
Working on proposal revisions	November 1, 2023	November 8, 2023
Ethics approval received	November 8, 2023	November 8, 2023
Recruitment of participants	November 13th, 2023	February 16, 2024

Data collection	November 13th, 2023	February 16, 2024
One-to-two-page overview of the research project	November 17, 2023	November 17, 2023
Data analysis	February 17, 2024	March 2, 2024
Draft poster submission	March 4, 2024	March 4, 2024
Poster revisions	March 4, 2024	March 7, 2024
Final poster submission	March 7, 2024	March 7, 2024
Final paper preparation	March 10, 2024	March 27, 2024
Poster presentation	March 20, 2024	March 20, 2024
Final paper submission	March 28, 2024	March 28, 2024

Summary

Research was conducted by six undergraduate students at McMaster University. Randomized and convenience sampling methods were used. The survey was distributed through email communication to academic societies and MSU clubs, and through physical posters on MSU bulletin boards. The survey opened on November 13, 2023, and closed on February 16, 2023.

Ethical concerns were minimal. We disclosed any psychological risks in our letter of information, prior to the commencement of the survey. Supportive resources were also included, in case any negative feelings emerged during completion. As the researchers

involved in this study are of the same demographic as the participants, researchers did not contact any persons, clubs, or societies they may have a relationship with. All participants had the right to withdraw from completing the survey, at any point, up until they press submit. Participants were encouraged to complete our survey in a safe location, to maintain their privacy.

The research process included designing a survey in consideration of current efforts in conservation psychology and a thorough review of existing literature on social psychology, climate change, and mental well-being. We then carried out our survey through the MREB-approved platform, LimeSurvey. We used both closed-ended, quantitative scales and open-ended questions to gather data. To uphold the privacy and anonymity of our participants, data was only accessible to members of our research team, and stored behind password-protected technology. The total number of eligible responses was 40. Data was analyzed using Microsoft Excel and Jamovi.

Results

Sociodemographics

A total of 40 McMaster University Undergraduate students participated in our study (*n* = 40). The final 6 items in our survey consisted of a variety of demographic questions including gender, age, ethnicity, year of study, faculty, and program of study. It is important to mention that not all participants responded to these items, but their responses were included if they responded to at least 75% of the survey. These questions were all open-ended, allowing participants to freely type in their answer of choice. To improve organization, responses were grouped together into appropriate categories (e.g. ‘Woman’ was grouped with ‘Female’). For gender, 25 participants self-identified as female (78.1%), 6 participants self-identified as male (18.8%), and 1 participant self-identified as non-binary (3.1%). The mean age of our participants was 20.7, with 9 reporting the age of 22 (27.3%), 8 reporting the age of 21 (24.2%), 5 reporting the age of 20 (15.2%), 4 reporting the age of 19 (12.1%), 4 reporting the age of 18 (12.1%), and 3 reporting the age of 23 (9.1%). For ethnicity, 18 participants self-identified as White/Caucasian/European (58.1%), 6 participants self-identified as Multiethnic (19.4%), 2 participants self-identified as South Asian (6.5%), 2 participants self-identified as Canadian (6.5%), 1 participant self-identified as Indian (3.2%), 1 participant self-identified as Asian (3.2%), and 1 participant self-identified as Chinese (3.2%).

With regards to year of study, there were 15 participants in their 4th year (44.1%), 6 participants in their 3rd year (17.6%), 6 participants in their 1st year (17.6%), 5 participants in their 2nd year (14.7%), and 2 participants in their 5th year (5.9%). 13 of our participants were from the Faculty of Social Sciences (38.2%), 12 were from the Faculty of Science (35.3%), 4 were from the Faculty of Engineering (11.8%), 2 were from the DeGroote School of Business (5.9%), 2 were from the Faculty of Health Sciences (5.9%), and 1 was from the Faculty of Humanities (2.9%). Participants came from a variety of programs, which we decided to organize into the categories ‘science-based’ and ‘non-science-based’. This was done to conduct calculations to determine the influence of our moderator ‘program of study’, which hypothesized that participants in more science-based programs would have a stronger identity with the environment and more negative feelings about climate change. We determined that

programs in the Faculty of Social Sciences, the Faculty of Sciences, and the Faculty of Health Sciences were considered to be ‘science-based’, and programs in the Faculty of Engineering, the Faculty of Humanities, and DeGroote School of Business were considered to be ‘non-science-based’. There were a total of 27 participants in science-based programs (79.4%), and 7 participants in non-science-based programs (20.6%).

Feelings Towards Climate Change

Table 1 demonstrates the average amount respondents felt different emotions towards climate change. The emotion that respondents experienced the most was powerless with a mean score of 3.75.

Table 1

Means and Standard Deviations for Feelings Towards Climate Change

	Mean	Median	SD
Sad	2.95	3.00	1.06
Powerless	3.75	4.00	1.06
Anxious	2.88	3.00	1.34
Optimistic	2.15	2.00	0.92
Angry	2.88	3.00	1.28
Guilty	2.73	3.00	1.15
Ashamed	2.05	2.00	1.06
Hurt	2.27	2.00	1.32
Depressed	2.23	2.00	1.17
Grief	2.27	2.00	1.26
Indifferent	2.17	2.00	1.22

Lack of Control

Tables 2 and 3 illustrate the frequencies of respondents feeling powerlessness and optimism towards climate change. Figure 1 highlights how 40% (*n* = 16) of respondents often felt powerless towards climate change in comparison to 10% (*n* = 4) of respondents who often felt optimistic.

Table 2

Frequencies of Feelings of Powerlessness

	Counts	% of Total	Cumulative %
Never	2	5.0	5.0
Rarely	2	5.0	10.0
Sometimes	10	25.0	35.0
Often	16	40.0	75.0
Always	10	25.0	100.0

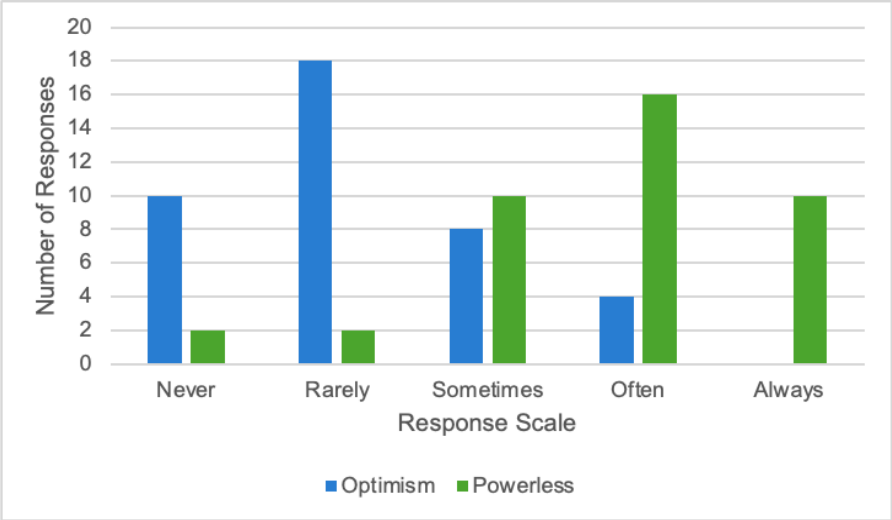
Table 3

Frequencies of Feelings of Optimism

	Counts	% of Total	Cumulative %
Never	10	25.0	25.0
Rarely	18	45.0	70.0
Sometimes	8	20.0	90.0
Often	4	10.0	100.0
Always	0	0.0	0.0

Figure 1

Frequencies of Feelings of Optimism and Powerlessness



For the remainder of our calculations, we chose to exclude feelings of optimism and indifference, and primarily focus on negative feelings towards climate change. This is because the key focus throughout our thesis was to look at whether climate change negatively influences mental well-being. Feelings of optimism and indifference do not accurately represent this and therefore were excluded from these calculations.

Re-coded Means and Frequencies

The means for negative feelings towards climate change, climate anxiety, and environmental identity were all re-coded and separated based on extreme opinions (low, average, strong). This allowed us to transform this data into categorical variables to analyse whether this data was moderated by program of study. This was done by forming contingency tables in Jamovi. Table 4 demonstrates the means and frequencies found based on these groupings. These values demonstrate that most respondents experience average amounts of negative feelings towards climate change (42.5%), strong environmental identity (65.0%), and low amounts of climate anxiety (87.5%).

How does climate anxiety influence negative mental well-being surrounding climate change?

Table 5 demonstrates the correlation between climate anxiety and negative feelings towards climate change. Climate anxiety was positively correlated with negative feelings

towards climate change (r = .68, p <.001). The p-value was less than .05, indicating this is a significant correlation. This demonstrates that increased climate anxiety significantly influences negative feelings toward climate change. Figure 2 displays this significant positive correlation. This finding supports our hypothesis since it demonstrates that

Table 4

Re-coded Frequencies and Means

	Counts	% of Total	Cumulative %	Mean
Negative Feelings				2.55
Low	16	40.0	40.0	
Average	17	42.5	82.5	
Strong	7	17.5	100.0	
Environmental Identity				4.30
Low	0	0.0	0.0	
Average	14	35.0	35.0	
Strong	26	65.0	100.0	
Climate Anxiety				1.30
Low	35	87.5	87.5	
Average	4	10.0	97.5	
Strong	1	2.5	100.0	

Table 5

Climate Anxiety x Negative Feelings Correlation Matrix

		Climate anxiety	Negative feelings
Climate Anxiety	Pearson's r	—	
	p-value	—	
Negative Feelings	Pearson's r	0.680	—
	p-value	<.001	—
Mean		1.68	2.67
SD		0.67	0.93

increased anxiety towards climate change is associated with poorer mental well-being or increased amounts of negative feelings towards climate change.

How is environmental identity related to negative mental well-being surrounding climate change?

The correlation matrix shown in Table 6 measures the correlation between environmental identity and climate anxiety. Environmental identity was positively correlated with climate anxiety (r = .42, p = .007). The p-value was less than .05, indicating that this was a significant correlation. This demonstrates that increased environmental identity has a positive effect on climate anxiety. Figure 3 displays this significant positive correlation.

Figure 2

Climate Anxiety x Negative Feelings Correlation

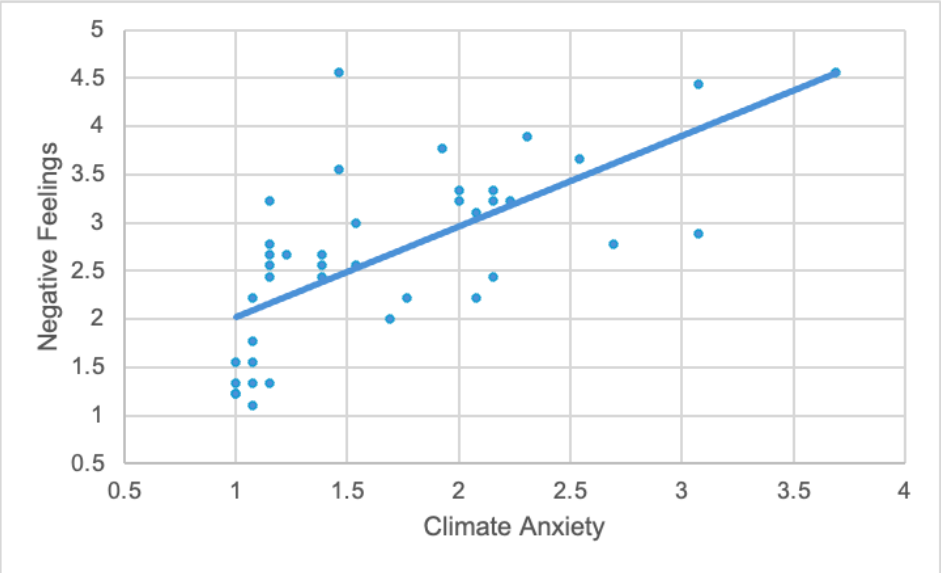


Table 6

Environmental Identity x Climate Anxiety Correlation Matrix

		Environmental Identity	Climate Anxiety
Environmental Identity	Pearson's r	—	
	p-value	—	
Climate Anxiety	Pearson's r	0.418	—
	p-value	0.007	—
Mean		5.62	1.68
SD		0.92	0.67

The correlation matrix shown in Table 7 measures the correlation between environmental identity and negative feelings toward climate change. Environmental identity was positively correlated with negative feelings towards climate change (r = .64, p < .001). The p-value was less than .05, indicating that this was a significant correlation. This demonstrates that environmental identity has a positive effect on negative feelings towards climate change. Figure 4 clearly displays this significant positive correlation.

Figure 3

Environmental Identity x Climate Anxiety Correlation

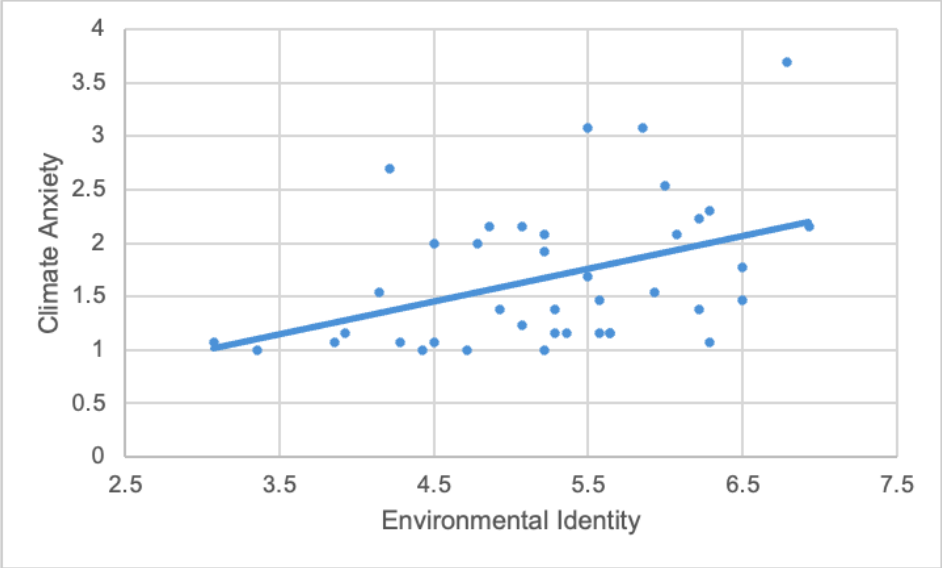


Table 7

Environment Identity x Negative Feelings Correlation Matrix

		Environmental Identity	Negative Feelings
Environmental Identity	Pearson's r	—	
	p-value	—	
Negative Feelings	Pearson's r	0.642	—
	p-value	<.001	—
Mean		5.62	2.67
SD		0.92	0.93

How is program of study associated with mental well-being surrounding climate change?

Table 8 demonstrates the results of a t-test performed to compare the climate anxiety of students in science-based programs to those in non-science-based programs. Students in science-based programs were higher in climate anxiety (M = 1.69, SD = .60) than students in non-science-based programs (M = 1.29, SD = .27), $t(32)$ = 1.71. However, these results were not significant (p = .096).

Figure 4

Environmental Identity x Negative Feelings Correlation

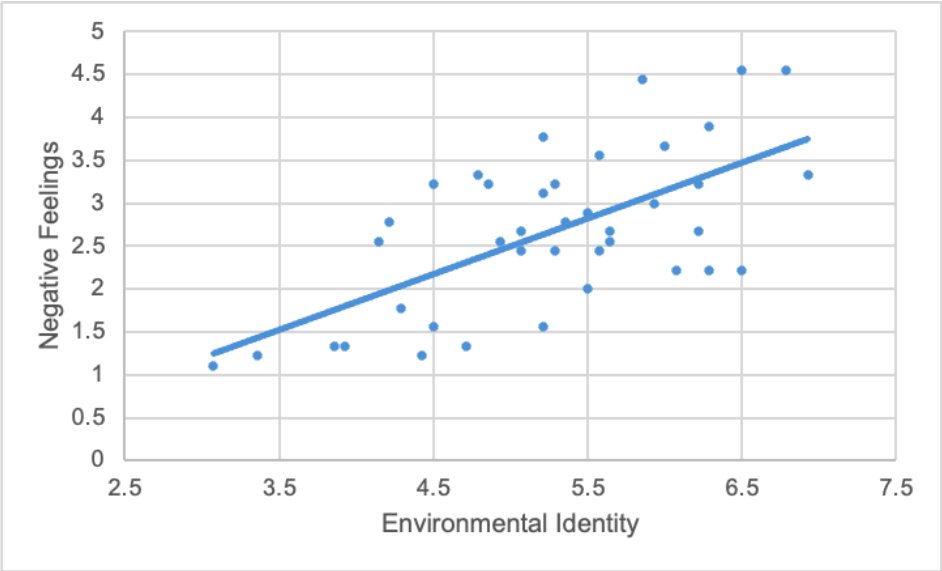


Table 8

Program-Specific Results of the T-Test

	Statistic	df	p-value	Program	Mean	SD	SE
Climate Anxiety	1.71	32.0	0.096	–	–	–	–
				Science-based Programs	1.69	0.599	0.115
				Non-science-based Programs	1.29	0.265	0.100

Table 9 demonstrates the results of a t-test performed to compare the negative feelings toward climate change of students in science-based programs to those in non-science-based programs. Students in science-based programs were higher in negative feelings towards climate change (M = 2.77, SD = .94) than students in non-science-based programs (M = 2.10, SD = .62), $t(32)$ = 1.80. However, these results were not significant (p = .081).

The following table (Table 10) is a contingency table highlighting whether the observed frequencies of negative feelings towards climate change based on program type differed from expected frequencies. We hypothesized that students in science-based programs would experience higher levels of negative feelings toward climate change compared to those in non-science-based programs. Students in a science-based program were more likely to experience strong amounts of negative feelings towards climate change than students in a non-science-based program (100% vs 0%, respectively), $X^2(2) = 2.11$ (refer to Table 10 & 11). However, these results were not significant ($p = .349$).

How is program of study associated with environmental identity?

Table 12 demonstrates the results of a t-test performed to compare the environmental identity of students in science-based programs to those in non-science-based programs. Students in science-based programs were higher in environmental identity (*M* = 5.27, *SD*

Table 9

Program-Specific Results of the T-Test

	Statistic	df	p-value	Program	Mean	SD	SE
Negative Feelings	1.80	32.0	0.081	-	-	-	-
				Science-based Programs	2.77	0.939	0.181
				Non-science-based Programs	2.10	0.623	0.236

Table 10

Science Program x Negative Feelings Contingency Table

Negative Feelings – Extreme Opinions		Science Program: Yes	Science Program: No	Total
Low	Observed	10	4	14
	% within row	71.4%	28.6%	100.0%
	% within column	37.0%	57.1%	41.2%
	% of total	29.4%	11.8%	41.2%
Average	Observed	11	3	14
	% within row	78.6%	21.4%	100.0%
	% within column	40.7%	42.9%	41.2%
	% of total	32.4%	8.8%	41.2%

Strong	Observed	6	0	6
	% within row	100.0%	0.0%	100.0%
	% within column	22.2%	0.0%	17.6%
	% of total	17.6%	0.0%	17.6%
Total	Observed	27	7	34
	% within row	79.4%	20.6%	100.0%
	% within column	100.0%	100.0%	100.0%
	% of total	79.4%	20.6%	100.0%

= .76) than students in non-science-based programs (*M* = 4.95, *SD* = 1.28), *t*(32) = 0.86. However, these results were not significant (*p* = .394).

The following table (Table 13) is a contingency table highlighting whether the observed frequencies of environmental identity based on program type differed from expected frequencies. Students in a science-based program were more likely to experience stronger amounts of environmental identity than students in a non-science-based

Table 11
X^2 Tests

	Value	df	p
X^2	2.11	2	0.349
N	34		

Table 12
Program-Specific Results of the T-Test

	Statistic	df	p-value	Program	Mean	SD	SE
Environmental Identity	0.864	32.0	0.394	–	–	–	–
				Science-based Programs	5.27	0.761	0.146
				Non-science-based Programs	4.95	1.28	0.486

program (81.8% vs 18.2%, respectively), $X^2(1) = 0.221$ (refer to Tables 13 & 14). However, these results were not significant (*p* = .638).

Qualitative Results

The qualitative portion of our survey included three open-ended questions that inquired about personal attitudes, behaviours, and program implications based on feelings toward climate change. These questions were: “Which aspects of climate change worry you the most?”, “If any, what kind of actions do you take to address climate change?”, and “How does your program of study reflect your feelings towards climate change?”. Responses

Table 13

Science Program x Environmental Identity Contingency Table

Environmental Identity – Extreme Opinions		Science Program		
		Yes	No	Total
Average	Observed	9	3	12
	% within row	75.0%	25.0%	100.0%
	% within column	33.3%	42.9%	35.3%
	% of total	26.5%	8.8%	35.3%
Strong	Observed	18	4	22
	% within row	81.8%	18.2%	100.0%
	% within column	66.7%	57.1%	64.7%
	% of total	52.9%	11.8%	64.7%
Total	Observed	27	7	34
	% within row	79.4%	20.6%	100.0%
	% within column	100.0%	100.0%	100.0%
	% of total	79.4%	20.6%	100.0%

Table 14

X^2 Tests

	Value	df	p
X^2	0.221	1	0.638
N	34		

were coded utilizing an inductive codebook approach, and axial coding was used to interpret and extract themes from these responses. For each question, we analyzed the first 10 responses to develop subordinate themes, and then used these themes to apply them to subsequent responses. It is important to note that frequencies of subordinate themes do not add up to our total sample size, as responses were often coded within multiple themes.

1. "Which aspects of climate change worry you the most?"

For our first qualitative question, "Which aspects of climate change worry you the most?", we analyzed and interpreted 30 responses (*n* = 30). Ultimately, we identified two major themes: 1) *Individualised Concerns*, and 2) *Systemic Concerns*. These themes and corresponding subordinate themes are outlined in Table 15 below.

Individualized Concerns

Environmental Anxiety

Many participants explained their anxiety with climate and the natural environment to be the most salient aspect of their worries regarding climate change. One participant explained:

> "I worry that the natural places that I enjoy and have connections to (like forests, provincial parks) will not survive climate change … More broadly, I worry about the suffering that climate change has/will have around the world and the global conflict that it may create."

Table 15

Major and subordinate themes identified

Major Themes	Subordinate Themes	Responses (*n* = 30)
Individualised Concerns	• Environmental anxiety	*n* = 16 (53.3%)
	• Future generations	*n* = 13 (43.3%)
	• Quality of life	*n* = 10 (33.3%)
Systemic Concerns	• Power imbalances	*n* = 8 (26.7%)
	• Economic prioritisation	*n* = 5 (16.7%)
	• Urgency	*n* = 2 (6.7%)
	• Communal guilt	*n* = 2 (6.7%)
	• Limited resources	*n* = 1 (3.3%)

Future Family and Generations

Another prominent concern that was revealed by participants was the implications of climate change on future family members and generations to come after.

Quality of Life

Participants also expressed that they held an overall concern regarding the ambiguity of quality of life in the future. One participant explained a major concern of theirs being:

> "The fact that it feels like it is our responsibility to fix this problem that has been created for us. We experience a quality of life brought to us by high emissions."

Systemic Concerns

Power Imbalances

An additional aspect that concerned many participants were feelings of powerlessness and perspectives of systemic imbalances of power between system and the individual. One participant's concern revolved around:

"The idea that in order to make effective change the government must be involved but it always seems like governments don't want to commit to solutions."

Economic Prioritisation

Some participants also expressed concerns regarding the prioritising of higher systems, and their worry was facilitated by their choices to prioritise economic gains over environmental interventions.

2. "If any, what kind of actions do you take to address climate change?"

We identified two major themes for our second question, "If any, what kind of actions do you take to address climate change", using the 29 (n = 29) complete responses received. These themes were: 1) *Individual Lifestyle Changes*, and 2) *Awareness and Accountability*. Themes and their corresponding subordinate themes are outlined in Table 16.

Table 16

Major and subordinate themes identified

Major Themes	Subordinate Themes	Responses (n = 29)
Individual Lifestyle Changes	● Altering transportation	n = 13 (44.8%)
	● Responsible disposal practices	n = 10 (34.5%)
	● Sustainable consumerism	n = 8 (27.6%)
	● General lifestyle alterations	n = 4 (13.8%)
	● Dietary changes	n = 3 (10.3%)
		n = 4 (13.8%)
Awareness and Accountability	● Spreading awareness	n = 2 (6.9%)
	● Policy change	n = 1 (3.4%
	● Holding others accountable	n = 1 (3.4%)
	● Educating Oneself	

Individual Lifestyle Changes

Altering Transportation

Many participants expressed that the actions they took in respect to climate change involved altering their personal behaviours around sustainable transportation practices. One participant explained:

"[I am] trying to reduce carbon emission by walking/carpooling."

Responsible Disposal Practices

Additionally, participants explained their personal attempts towards mitigating climate change as adopting more sustainable and responsible practices regarding recycling and amounts of garbage waste.

Awareness and Accountability

Spreading Awareness

Some students expressed that their efforts in the climate change crisis revolved more around educational and system barriers that coincide with the issue. One participant explained:

> "Sometimes attending protests, understanding and reading about climate change in relation to decolonization."

Policy Change

A few participants mentioned that they make efforts in attending protests, and engage in other activities targeted to adjust and push policy changes.

3. "How does your program of study reflect your feelings towards climate change?"

We had 29 (*n* = 29) adequate responses for our third qualitative question. These responses provided us with 2 overarching themes, which were: 1) *Educational Implementation*, and 2) *Program Implications on Emotions*. Major themes for this question, as well as corresponding subordinate themes, are outlined in Table 17.

Table 17

Major and subordinate themes identified

Major Themes	Subordinate Themes	Responses (*n* = 29)
Educational Implementation	• Educational recognition	*n* = 16 (55.2%)
	• Educational neglect	*n* = 11 (37.9%)
Program Implications on Emotions	• Guilt	*n* = 3 (10.3%)
	• Environmental anxiety	*n* = 2 (6.9%)
	• Feelings of economic prioritisation	*n* = 2 (6.9%)
	• Resentment	*n* = 1 (3.4%)

Educational Implementation

Educational Recognition

Many participants claimed that their programs of study reflected their feelings regarding climate change, and were adequate in acknowledging the implications of the matter. One participant claimed:

> "[My program] heavily reflects it. I study environmental sciences which has allowed me to learn a lot more about climate change, what the problems are, and what possible solutions can be."

Educational Neglect

Contrasting to the previous theme, participants additionally explained that their program's portrayals of climate change and adjacent topics are contradicting their personal perspectives regarding climate change. One participant mentioned:

> "Computer Science does not reflect my stance on climate change very well, as computer science culture can be very consumerist and wasteful."

Program Implications on Emotions

Guilt

Some participants explained that their studies enhanced their awareness regarding personal and societal guilt. One participant mentioned:

> "... An aspect that would be explored is the guilt we feel with the part we play in climate change and if we as a population are willing to make changes that might cause us discomfort in order to help alleviate the effects of climate change."

Environmental Anxiety

Other participants expressed that discussions of the climate crisis in their studies amplified their thoughts of anxiety regarding the state of the environment and the implications of climate change. One participant claimed:

> "I take a lot of environment and society courses and life sciences courses focused on the environment I reflect about this often."

Feelings of Economic Prioritisation

Similar to findings reflected in the first question, overall worry regarding governments and how choices consistently prioritize economic gains reappeared as a concern to some participants.

Discussion

Feelings Towards Climate Change

Our overall research supported previous literature regarding emotional well-being, and how climate change brought negative implications on students' well-being. This was initially found through our quantitative data, which emphasized that most participants experienced average levels of negative feelings toward climate change. However, when reporting specific emotions, 35% of participants reported feelings of powerlessness "often" compared to 45% of participants that reported "rarely" feeling optimistic (refer to Tables 2 & 3). This finding was expected as it aligns with the literature from Naidu et al., (2022) which stated that climate change events can elicit feelings of powerlessness. We also observed this theme of powerlessness within our qualitative data, specifically relating to power imbalances. While observing the systemic-based worries of our participants, power imbalances between government and public were the most frequently emphasized systemic worry. Participants also reported fear for future

generations, expressing worry that climate change issues will impact future generations (refer to Table 15).

These findings regarding feelings of powerlessness among participants can be supported by terror management theory and existing research (Clayton et al., 2017; Hickman et al., 2021). Firstly, our findings align with TMT, as feelings of powerlessness regarding climate change issues can bolster fears of mortality (Van Lange et al., 2012). Since individuals are concerned about the lack of attention from powerful systems, this can promote feelings of powerlessness. This negative impact on one's terror management can then increase anxiety and distress regarding perceptions of mortality (Van Lange et al., 2012). This theme of powerlessness can be further understood through existing literature. Clayton et al., (2017) suggest that feelings of powerlessness could be attributed to the lack of control that individuals may perceive concerning the future of the environment. The perception of climate change issues being out of one's control can be observed in our participants' responses concerning the lack of initiative that those in power are taking to address this significant environmental issue (refer to Table 15). This theme also aligns with existing literature from Hickman et al., (2021) which indicates that young people feel betrayed as they must deal with environmental consequences despite not contributing to the problem as greatly. Overall, the frequency of powerlessness in undergraduate students could be attributed to the burdens they face regarding the current state of the environment.

Climate Anxiety

To measure climate anxiety we included a scale in our survey which examined both cognitive and functional impairment. Although we found that most respondents experienced low amounts of climate anxiety, we were able to find a significant positive correlation between climate anxiety and negative feelings toward climate change (r = .68, p <.001). This suggests that increased anxiety towards climate change is associated with increased negative feelings and poorer well-being, as predicted in our hypothesis.

Students also reported experiencing climate anxiety within our qualitative results. When participants were asked to voice which aspects of climate change they found most worrying, more than half of individuals expressed concerns regarding the overall state of the environment and the preservation of natural resources (refer to Table 15). This aligns with the research performed by Hickman et al., (2021) who also found that the majority of their respondents expressed significant worry about climate change. Our results surrounding climate anxiety also support the findings of Patrick et al., (2022) which indicated that young people are at higher risk for being influenced by eco-anxiety due to perceived effects on their future. Despite low reports of climate anxiety based on our quantitative scale, qualitative results highlighted significant experiences of climate anxiety. This emphasizes a dissonance between the climate anxiety scale items and participants' subjective experiences, demonstrating a limitation of our study design.

Environmental Identity

Environmental identity and its impact on well-being became a significant point of interest throughout our research process, differing from our original main focus. First, we were able to determine a statistically significant positive correlation between

environmental identity and climate anxiety (r = .42, p = .007). This positive correlation suggests that the more an individual incorporates the environment into their self-identity, the more anxiety they will experience in response to environmental crises. Another statistically significant finding we found was a positive correlation between environmental identity and negative feelings toward climate change (r = .64, p < .001). This indicates that greater identification with the environment is associated with more negative feelings and poorer well-being.

These two correlations can be further understood by examining environmental identity theory. Based on this theory, we can understand environmental identity as individuals' understanding of themselves in relation to their interactions with the environment (Stets & Biga, 2003). In relation to our findings, we deduced that a stronger identification with the environment can lead to poorer well-being through increased climate anxiety and negative feelings regarding environmental issues.

An additional finding surrounding environmental identity pertains to individuals' actions when addressing climate change. When participants were asked about the ways in which they have attempted to tackle the problem of climate change, the majority reported engaging in individual lifestyle changes (i.e. altering transportation methods and more sustainable disposal practices). This theme can be applied to Clayton's (2004) work regarding environmental identity theory. Clayton (2004) suggested that a strong environmental identity can motivate individuals to participate in behaviours that benefit the environment. Considering Clayton's (2004) narrative of environmental identity in addition to our research findings, we can predict that participants who reported making lifestyle changes have a stronger identification with the environment.

Program of Study

In accordance with our hypothesis, we found that students in science-based programs were higher in climate anxiety and reported more negative feelings towards climate change in comparison to other students. When respondents were asked how their program of study reflects their feelings around climate change, more than half felt their program accurately represented their feelings towards climate change. Moreover, students in science-based programs reported recognition of environmental issues as well as participating in more class discussions regarding climate change.

This difference between programs of studies can be supported using social identity theory. This theoretical framework revolves around the formation of individual identity based on group membership (Islam, 2014). Furthermore, when forming an identity within a group, one's values become more emotionally tied to the group (Islam, 2014). In the context of a program of study, social identity theory can help explain how one's association with a specific program at McMaster University can influence their values and emotions relating to climate change. This is especially evident since certain programs discuss climate change issues more often, as reflected in our qualitative results by students in science-based programs.

We also found that students in science-based programs were higher in environmental identity. This relation can be further understood through Stapleton's (2015) work in relation to environmental identity theory. Stapleton (2015) suggested that environmental identity is developed through awareness, concern, and knowledge about environmental issues. In the same literature, it is noted that education can heavily impact one's identity

(Stapleton, 2015). Considering this perspective of environmental identity in relation to our qualitative results, we can predict that the heightened environmental identity in science programs can be related to increased awareness and knowledge within these programs.

Broader Significance

Climate change is inevitable in today's society, but the impacts expand beyond environmental implications. Our study found that climate change has significant social implications through its impact on students' anxiety and negative feelings towards climate change. Mental well-being should be included in discussions surrounding the impacts of climate change. As the environment shifts in patterns of weather, natural disasters, and climate, so do individuals' emotions and reactions (Clayton et al., 2017). Mitigating the impacts of climate change should go beyond preserving ecosystems by protecting the mental well-being of individuals amidst these challenges. Our qualitative results demonstrated that individuals are willing to take action to lessen the effects of climate change but more support is needed from higher systems such as governments to enact more systematic changes. Identifying the underlying factors of environmental identity and climate anxiety has helped us to understand the psychological and theoretical mechanisms behind it. This highlights the need to enhance our understanding of individuals' vulnerability to various influences and their coping methods. Furthering education and research concerning the impacts of climate change on the mental well-being of individuals is necessary.

Conclusion

Summary of Findings

Through our data analysis, we found that climate change affects mental well-being through the increase in climate anxiety and negative feelings towards climate change. Several participants indicated prominent feelings of powerlessness towards climate change, which is consistent with TMT (Greenberg et al., 1986). It was also found that participants who had higher levels of environmental identity experienced higher levels of climate anxiety. This finding coincides with environmental identity theory since we found that individuals who perceive the natural environment to be a large part of their personal identity experience more anxiety towards climate change (Clayton, 2004). Additionally, participants who had higher levels of climate anxiety experienced more frequent negative feelings toward climate change. When looking at programs of study, we found that students in science-based programs experienced higher levels of environmental identity, climate anxiety, and negative feelings towards climate change, when compared to students in non-science-based programs.

When asked about the most worrisome aspects of climate change, implications on the natural environment and the impact on future generations were the most common responses. Concerns about the impact on future generations were also consistent with TMT (Greenberg et al., 1986). Participants indicated that their most prominent actions in combating climate change were altering transportation methods to be more sustainable and being more responsible in disposal practices. Lastly, participants were divided on if their program of study reflected their feelings toward climate change. There were more responses who indicated that their program accurately reflected their feelings about

climate change. However, there were also some who identified a neglect within the program regarding the topic of climate change.

Limitations

While our study did find results that support current literature regarding climate change and mental well-being, limitations were present in our research. The first limitation we identified in our research was a small sample size. We had a target goal of 100 participants, however, this was difficult to achieve as our target population consisted of undergraduate students who may not have had the time or incentive to complete our survey. An example of this was the extremely high number of incomplete responses received (n = 191). Additionally, many of the clubs and societies that were contacted did not reply, which limited the range of participants included in survey responses. The lower response rate of 40 responses made it difficult to analyze correlations between variables and find statistical significance. This also had implications on the diversity of participants we were able to recruit. For example, 27 of our participants came from science-based programs of study, and only 7 were from non-science-based. As a result, the amounts of climate anxiety and negative feelings towards climate change did not significantly differ based on students' program of study. Furthermore, the vast majority of our participants were female-identifying (78.1%), displaying a further lack of diversity.

Another limitation was based on extreme items present in the Climate Change Anxiety Scale (CCA) (Clayton, 2023). After looking at all participant responses to the CCA, levels of climate anxiety were generally low. However, after analyzing our qualitative responses, climate anxiety was identified as a prominent theme. Ultimately, individual responses displayed lower levels of climate anxiety in our quantitative scale, which conflicted with the levels found in our qualitative questions. Going forward, future research surrounding climate anxiety might benefit from a scale with less extreme items. This would mitigate the variance in climate anxiety found across individual responses.

Our study was also very constrained by time since we only had two terms to complete the entirety of our research project. This may have limited our recruitment since the survey was only available for a fixed amount of time. A longer amount of time for recruitment may have increased generalisability, since a larger number of students may have had the opportunity to respond to the survey.

Lastly, it is important to consider that possible response biases may have influenced the answers participants selected in the survey. We did not conduct any further checks that tested the attention of participants, and it is possible that not all participants answered each question truthfully. To add, the content of our study may have influenced some participants to adopt social desirability bias while completing the survey. Topics such as the climate crisis and interventions to mitigate it are often linked to political opinions (Dietz, 2020). Participants may have been propelled to conform to a certain political perspective while answering our survey, and ultimately adopting social desirability bias.

Significant Insights

The most significant insights were related to feelings of powerlessness, environmental identity, and program of study. We found that students often felt powerless about the future due to fear surrounding climate change which is consistent with the theoretical underpinnings of TMT. Additionally, environmental identity was positively correlated with both climate anxiety and negative feelings towards climate change. This demonstrates how feelings towards the general environment moderate individuals' mental well-being surrounding climate change. Findings also revealed that environmental identity, climate anxiety, and negative feelings towards climate change were more prominent in science-based programs. These insights demonstrate the importance of protecting the environment to reduce mental stress and anxiety surrounding climate change. Overall, our study found that young adults who perceive the environment as an important part of their identity experience higher levels of anxiety and negative feelings toward climate change.

Implications and Future Directions

We hope that the results and findings of our study add to existing literature surrounding climate change and the resulting psychological implications. Future research should consider including a baseline mental well-being scale to solidify concrete relations between climate change and mental well-being. Although our results may not be generalizable to the entire population, our area of research provides insight into how young adults perceive, feel, and react to the increasingly pertinent issue of climate change. However, future research could benefit from a more diverse population considering we were limited in only recruiting from the undergraduate population at McMaster University. Additionally, future research would benefit from the comparison of types of actions taken to address climate change. Specifically, how feelings of powerlessness could influence individuals' choice in engaging in more individual or systemic interventions to counteract climate change.

In conclusion, research regarding these topics is relevant now more than ever, and we hope that our findings will contribute to further discoveries in this field, especially pertaining to environmental identity, climate anxiety, and negative feelings toward climate change.

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