When Facing a Cosmic Perspective: How and Why People React Differently to the Vastness of the Universe

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Abstract

The vastness of the universe (i.e., cosmic vastness) can evoke polarizing existential experiences. Some people report elevating experience, such as awe, elevation, and self-transcendence, whereas others experience existential distress, such as feeling insignificant, powerless, and vulnerable. The purpose of this thesis was to examine three main research questions: 1) How do people react to the vastness of the universe? 2) What is it about witnessing cosmic vastness (i.e., mediators) that elicits polarizing experiences? 3) What is it about a person and their individual traits (i.e., moderators) that causes people to react differently? Two studies were conducted to investigate these questions. Study 1 was a primarily qualitative in-lab study where participants watched one of two videos depicting the vastness of the universe. Participants answered open-ended questions about their experiences, along with some preliminary quantitative questions, and these responses were used to inform what experiences were measured in Study 2. Study 2 was an online quantitative experiment in which a cosmic vastness video was compared to two other videos (Earth nature vastness and neutral control). Study 2 also examined mediators and moderators that explain the relationship between witnessing cosmic vastness and both elevating experience and existential distress. Both studies found that facing cosmic vastness can elicit positive and negative experiences. Study 1 found that most participants reported positive (93%) and negative experiences (68%), including a substantial degree of elevating experience (58%) and existential distress (46%). Study 1 also found several cognitive responses that were good candidates to be mediators in Study 2, including small self, need for accommodation, experience of the unknown, and existential contemplation. Study 2 showed that a cosmic vastness condition elicited greater levels of elevating experience than the neutral control condition and greater levels of existential distress than both the neutral control and Earth

nature vastness conditions. Results from both studies also found significant polarization in participants responses, such that half of the participants reported more elevating experience, and half of participants reported more existential distress. Mediation analyses in Study 2 demonstrated that the four cognitive responses each mediated the positive relationship between witnessing cosmic vastness and both elevating experience and existential distress. Furthermore, moderation analyses revealed that self-esteem moderated the relationship between witnessing cosmic vastness and elevating experience, whereas both self-esteem and meaning in life moderated the relationship between cosmic vastness and existential distress. This research provided unique contributions to literature on how people react to vast stimuli that has the capacity to be existentially threatening. Further implications of these results are discussed, as well as how these results may generalize to other areas of research.

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Preface

As first author of both studies in this thesis, I was responsible for the study design, data collection, data analysis, and manuscript writing. My supervisor, Dr. Veronika Huta, was also involved in providing guidance, recommendations, and feedback regarding all aspects of the thesis. Andrea LeFebvre assisted with data collection in Study 1. Study 2 was originally planned to be conducted in lab. However, the COVID-19 pandemic made it impossible to run participants during the data collection phase of the thesis. Both studies received approval from the research ethics board at the University of Ottawa.

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General Introduction

> The moons and the planets showed unmistakeably that they had as much claim to being worlds as the Earth does… They might be profoundly different from our planet. None of them might be as congenial for life. But Earth was hardly the only one. This was the next in the series of Great Demotions, downlifting experiences, demonstrations of our apparent insignificance, wounds that science has, in its search for Galileo's facts, delivered to human pride.
>
> *– Carl Sagan, Pale Blue Dot*

> …When I look up at the night sky and I know that yes, we are part of this universe, we are in this universe, but perhaps more important than both of those facts is that the universe is in us. When I reflect on that fact, I look up – many people feel small because they're small and the universe is big – but I feel big, because my atoms came from those stars. There's a level of connectivity.
>
> *– Neil deGrasse Tyson, The Most Astounding Fact*

The evolution of astronomy as a science and the advent of technology has allowed humans to become increasingly aware of the nature and scale of the universe. While much remains a mystery, research has provided some truly outstanding facts. The universe is approximately 14 billion years old, there are at least between 100 billion (1×10^{11}) or more galaxies, and each galaxy contains on average 100 billion stars (Bennett, Donahue, Schneider, & Volt, 2018; Conselice, Wilkinson, Duncan, & Mortlock, 2016). Thus, there are at least 10

sextillion (10×10^{22}) stars in the observable universe. To put this in perspective, the number of stars in the *observable* universe is at least comparable, and perhaps more, than the total number of grains of sand on planet Earth (Bennett et al., 2018). When considering these facts, how does it make you feel?

The excerpts above by Carl Sagan (1994, pp. 20-21) and Neil deGrasse Tyson (Schlickenmeyer, 2008), two astrophysicists who became significant science communicators, represent the potential emotional impact of learning about our place in the universe. Philosophers (e.g., Burke 1759/1958; Kahane, 2014; Kant 1764/2011; Nagel, 1971) and psychologists (Hornsey et al., 2018) have also contemplated how witnessing the vastness of the universe can lead to different reactions. For some people, it might serve as an unsettling reminder of the fallibility of our perceived self-importance and evoke existential distress, such as insignificance, hopelessness, powerlessness, and existential dread (Kahane, 2014; Nagel, 1971; Sagan, 1994). For others, such as astronauts who have been to outer space, it can provide the potential to experience awe, wonder, inspiration, and connection to the bigger picture, including the cosmos (Gallagher et al., 2015; White, 2014; Yaden et al., 2016). These reactions demonstrate seemingly polarizing experiences people can have when they are faced with the vastness of the universe.

The vastness of the universe, which will be referred to as *cosmic vastness*, is defined in the present thesis as the scale of the universe as it is currently understood, including the vast size of celestial bodies, space, and the universe compared to human beings and planet Earth. Cosmic vastness is representative, or at least symbolic, of the largest physical perspective that people can witness or contemplate at this moment in history. It has been referred to as “a near-infinite multiplier of any other display of natural wonder” (Hornsey et al., 2018, pg. 199) and “the most encompassing evaluative perspective, the standpoint that considers everything, everywhere,

without exception" (Kahane, 2014, p. 750).

The purpose of the present research was to understand the types of experiences people have when facing cosmic vastness and why people react differently. To do this, I aimed to answer three questions. First, how do people react to cosmic vastness? Specifically, do people have profound positive experiences (e.g., feeling awe, inspiration, and connection to the bigger picture) and profound negative experiences (e.g., feeling insignificant and undermined), as described above? Second, what is it about cosmic vastness that makes people react differently? Third, which individual characteristics impact how people react to cosmic vastness? Below there will be a review of the known theory and empirical research relevant to how people react to cosmic vastness and other physical forms of vastness, followed by why some people may react more positively or more negatively than others.

Positive Reactions to Cosmic Vastness

Elevating Experience

The sheer scale of the universe has the capacity to evoke intense, expansive, and transcendent positive experiences that are distinct from experiences commonly associated with positive affect such as joy and contentment. These experiences include a broad range of associated concepts such as awe (Keltner & Haidt, 2003), wonder (Gallagher et al., 2015), inspiration (Thrash & Elliot, 2003), moral elevation (Haidt, 2000), peak experiences (Maslow, 1964), spiritual transcendence (Piedmont, 1999), a sense of connection with a greater whole (Csikszentmihalyi, 2000; Yaden et al., 2017), aesthetic experiences (Konecni, 2005; Menninghaus et al., 2019; Schindler et al., 2017), and being emotionally moved (Menninghaus et al., 2015). Researchers have labeled groups of these experiences in various ways, such as self-transcendent emotions (Stellar et al., 2017), self-transcendent experiences (Yaden et al., 2017),

aesthetic emotions (Schindler et al., 2017), "other praising" emotions (Algoe & Haidt, 2009), sublime experiences (Pelowski et al., 2019), and elevating experience (Huta & Ryan, 2010).

For the purpose of the present research, the term *elevating experience* was used. This label was chosen because its definition encompasses a broad range of intense positive experiences, including awe, wonder, inspiration, moral elevation, spiritual transcendence, being emotionally moved and touched, and connection to something greater than the self (Huta & Ryan, 2010). Huta and Ryan (2010) also empirically demonstrated that a measure of elevating experience forms one factor and is distinct from other well-being experiences in factor analyses, such as carefreeness and meaning. Elevating experience is also considered a eudaimonic experience and tends to load more strongly on a factor representing eudaimonic experiences (e.g., meaning, self-connectedness, accomplishment), than hedonic experiences (positive, carefreeness, less negative affect), especially at a state level (Huta, 2022).

Overall, elevating experience is important to consider because it represents well-being experiences that are distinct from other positive emotions (e.g., joy, excitement, contentment) because it involves people feeling connected, elevated, or uplifted in some way (Algoe & Haidt, 2009; Huta & Ryan, 2010) and is seemingly intense and profound, thus encouraging people to transcend the self in some way or connect to something larger than themselves (Shiota et al., 2007; Shiota, et al., 2014; Stellar et al., 2017; Stellar et al., 2018). Thus, elevating experience is considered an *existential* experience because it often represents a deep encounter with existence, where people feel more intensely alive, and their subjective experience of the self can fade into a connection to something much larger than themselves (Bonner & Friedman, 2011).

Elevating experience is particularly relevant for the present research because it has been theoretically and empirically linked to witnessing vastness. For example, a definition of awe

frequently used by researchers requires an experience or perception of vastness (Keltner & Haidt, 2003). Cosmic vastness is also often considered one of the prototypical triggers of a sublime experience (Pelowski et al., 2019). In fact, Schopenhauer (1819/1995) claimed that the fullest feeling of the sublime can be experienced while facing the immensity of the universe. Cosmic vastness is also consistent with many features that are important or necessary to eliciting the experience of the sublime. In a review of the literature on the sublime, Pelowski and colleagues (2019) described specific features leading to sublime experiences that were reported in historical and philosophical texts. These features include, but are not limited to, a sense of greatness, uncommonness, and beauty (Addison, 1773/1718) and a sense of infinity or boundlessness (Burke, 1759/1958; Kant 1764/2011). Many accounts of the sublime can also be either perceptual (e.g., physical vastness, ruggedness, or beauty) or conceptual (e.g., poetry, mathematics, and conceptual vastness). Cosmic vastness has both perceptual vastness (enormous size and space) and conceptual vastness (understanding the number of stars and galaxies) that can feel endless. It is also an experience that is uncommon or unfamiliar in daily life and has an inherent sense of beauty that is evident in astronomical images (Smith, 2014).

Empirical Research on Positive Reactions to Vastness

Past research has demonstrated that cosmic vastness, along with other forms of physical vastness, elicits elevating experience. In this section, I will review the literature on positive reactions to cosmic vastness, looking down on Earth from space, and the vastness of nature on Earth. Together, these three areas of research provide evidence about the types of positive reactions people may have when facing cosmic vastness.

Positive Reactions to Cosmic Vastness. Only one known study has explicitly focused on how people react to cosmic vastness. Hornsey and colleagues (2018) examined how

participants reacted to a two-minute video that depicted cosmic vastness in two experiments. The video featured a comparison of the size of the Earth to other incrementally larger celestial bodies (i.e., moons, planets, stars). After the final comparison was made between Earth and the largest known star, the video faded to an image taken from the Hubble Telescope displaying an expanse of space billions of lightyears across. The video then stated facts about the number of stars and galaxies in the universe. This video was compared to two other videos of the same length. One video consisted of vastness of nature on Earth (i.e., *Earth nature vastness*) in which lava spilled down the side of a volcano and flowed into the surrounding nature. This video was intended to evoke awe without as much self-diminishment (a combination of small self, insignificance, and triviality of personal concerns) as the cosmic vastness video. Another neutral control video displayed only a black screen but featured the same cinematic uplifting music as the other two videos. In two experiments, the researchers found that the cosmic vastness condition elicited higher levels of awe, transcendence (i.e., what they labelled "vastness relative to self"), and positive affect compared to both the Earth nature video and the control video.

Although only one study has explicitly investigated how people react to cosmic vastness, several other studies have used videos of cosmic vastness to evoke elevating experience (predominantly awe) under experimental conditions (Dai et al., 2022; Danvers and Shiota, 2017, experiment 1; Jiang & Sedikides, 2022, experiment 6; Johnson et al., 2017, experiment 3; Johnson et al., 2019, experiment 3; Rivera et al., 2020, experiment 5; Stellar et al., 2018, experiment 3). One study used a cosmic vastness video as a neutral and potentially threatening awe-evoking stimulus (Gordon et al., 2017, experiment 3). All of the videos used in these studies were similar in design. The videos begin by focussing on Earth and either zoom out into space or compare Earth to increasingly larger objects. Overall, the cosmic vastness videos in these studies

elicited greater levels of elevating experience (i.e., awe and wonder) compared to neutral control videos (Dai, et al., 2022; Danvers and Shiota, 2017; Gordon et al., 2017; Jiang & Sedikides, 2022; Rivera, et al., 2020; Stellar et al., 2018), positive emotion videos (i.e., amusement; Johnson, et al., 2017; Johnson et al., 2019), or a video about the microscopic world of a living cell (Johnson et al., 2019). In a few experiments, cosmic vastness videos elicited greater levels of other positive emotions, such as contentment, enthusiasm, love, pride, tenderness, excitement, and happiness compared to neutral control videos (Danvers and Shiota, 2017; Hornsey et al., 2018; Stellar et al., 2018), but not compared to other positive emotion videos (Danvers and Shiota, 2017; Rivera et al., 2019) or Earth nature vastness videos (Gordon et al., 2017). However, several studies showed that the means of the elevating experience were descriptively higher than other positive emotions for cosmic vastness videos (Danvers and Shiota., 2017; Gordon et al., 2017; Hornsey et al., 2018; Stellar et al., 2018), demonstrating that elevating experience is particularly relevant to cosmic vastness.

Positive Reactions to Viewing Earth from Space. Past research has also examined people's reactions to other forms of physical vastness, including viewing the vastness of Earth from outer space (an opportunity that is typically reserved for astronauts). Astronauts frequently report a phenomenon called the *overview effect,* defined as an intense, overwhelming, and profound experience when looking back at the Earth from outer space (White, 2014; Yaden et al., 2016). General reviews (White, 2014; Yaden et al., 2016) and formal qualitative textual analyses (Gallagher, et al., 2015; Gallagher, et al., 2014) have examined astronauts' experiences in outer space and found that the overview effect often includes a broad range of intense elevating experience such as awe, wonder, aesthetic and intellectual appreciation, inspiration, experience of the sublime, and transcendence (e.g., unity, identification, and connection with

others or some greater whole).

Quantitative virtual reality research, intended to replicate the overview effect (i.e., looking down at Earth), has found that looking down at earth elicits significantly more awe than a pre-experiment baseline measure and compared to a neutral control condition (Chirico, et al., 2018). For example, two experiments by Nelson-Coffey and colleagues (2019) used virtual reality and a video to depict looking down at the Earth from space. Both methods involved zooming out from Earth into outer space with an accompanying audio clip from science communicator, Carl Sagan. These experiences elicited more awe, as well as other positive experiences such as happiness, gratitude, compassion, optimism, love, and pride (Nelson-Coffey et al., 2019), compared to control conditions that focused on facts about the solar system (e.g., information about Pluto and the Earth's rotation and orbit around the sun). Similar to studies on cosmic vastness, awe was the most strongly elicited emotion when viewing Earth from space.

It is important to note that viewing Earth from space is different from cosmic vastness in one significant way. Focusing on the Earth as a whole represents not only vastness, but a sense of totality. The Earth becomes a symbol of almost everything that is important to human beings (Yaden et al., 2016). Thus, it is difficult to conclude if these intense positive reactions are due to vastness, or other features such as totality and a sense of beauty.

Positive Reactions to Earth Nature Vastness. When participants are asked to recall an elevating experience (i.e., a time where they experience awe or the sublime), nature on Earth is the most commonly reported experience (especially vast landscapes; Pelowski et al., 2019) compared to human-made environments, art, music, encounters with god, other people's power or accomplishments, or one's own accomplishment (Shiota et al., 2007; Pelowski et al., 2019; Yaden et al., 2019). Thus, researchers most frequently use the vastness of nature on Earth to

elicit elevating experience for experimental purposes (e.g., as an *awe* or *sublime* experimental condition). This type of stimulus will continue to be referred to as *Earth nature vastness* throughout the thesis.

Research typically examines people's reactions to Earth nature vastness by showing a short video (i.e., less than 5 minutes long) of vast natural landscapes (e.g., mountains, oceans, deserts, canyons, waterfalls; Bai et al., 2017; Gordon et al., 2017; Le et al., 2019; McPhetres, 2019; Piff et al., 2015; Rivera et al., 2020; Rudd et al., 2012; Stellar et al., 2018; Valdesolo & Graham, 2014; van Elk et al., 2016; Yang et al., 2018). However, some studies have asked participants to recall experiences they have had in vast nature (Gordon et al., 2017; Shiota et al., 2007; Prade & Saraglou, 2016), look at vast nature images (Joye & Bolderdijk, 2015), enter a virtual reality experience of vast nature (Edwards et al., 2023; McPhetres, 2019), or physically go to places in nature that are vast (Bai et al.., 2017). Together, these experiments have shown that witnessing Earth nature vastness results in more elevating experience (e.g., awe, feeling connected to something larger than oneself, and the experience of beauty) compared to neutral control conditions (e.g., Rivera et al., 2020). In addition, people have more elevating experience in Earth nature vastness conditions compared to positive emotion conditions (e.g., pride, amusement; Edwards et al., 2023; Valdesolo & Graham, 2014), and ordinary or less vast nature conditions (e.g., picture of a tree; Joye & Bolderdijk, 2015).

A few studies have included both a cosmic vastness condition and an Earth nature vastness condition in their experiments. Compared to Earth nature vastness, cosmic vastness has been shown to evoke more positive emotion and awe than Earth nature vastness (Hornsey et al., 2018) or similar levels of awe and wonder (Gordon et al., 2017). In a virtual reality study, a vast nature condition evoked higher levels of awe than a condition that involved looking down at

Earth from space (Chirico et al., 2018). These conflicting results suggest that the degree to which elevating experience is elicited may also depend on how the information is displayed (Klatzky et al., 2017), rather than how vast the stimulus is.

In the literature discussed, vastness appears to elicit a broad range of positive emotions (e.g., joy, happiness, contentment, peace), and it is clear that elevating experience is an integral part of witnessing vastness. The reviewed research also often demonstrates that witnessing vastness is a predominantly positive experience (Shiota et al., 2007; Pelowski et al., 2019; Yaden et al., 2019). However, facing the vastness of the universe also has the capacity to evoke negative experiences too (e.g., Gordon et al., 2017; Hornsey et al., 2018).

Negative Reactions to Cosmic Vastness

Many philosophers (for a review see Pelowski et al., 2019) and researchers (e.g., Chaudhury, Garg, & Jiang, 2022; Gordon et al., 2017; Hur et al., 2018; Keltner & Haidt, 2003) describe how experiences of awe and the sublime can be accompanied by experiences of fear, terror, a sense of danger, and being overwhelmed. This is evident when examining the etymology of the word awe. According to the Oxford English Dictionary ("awe", 2019), awe can be traced to the Old English word *ege*, the Old Germanic word *eye*, and the early Scandinavian word of *agi*, which all predominantly mean terror, dread, and horror. It was not until approximately the 16th century that experiences of reverence and veneration became prominent in the understanding of awe, and when awe and fear began being distinguished from one another.

Existential Distress

Only considering negative emotions such as anxiety, fear, sadness, and general distress (i.e., *negative affect)* leaves out other important experiences that have been reported in response to cosmic vastness. For example, Kahane (2014) provided several quotes of writers and

philosophers who struggled with the immensity of the universe, with descriptions of them feeling terrified, oppressed, lonely, hopeless, powerless, and insignificant. Many of these descriptors appear intense or involve more cognitive-affective integration than negative affect. Thus, these experiences may represent *existential distress*, a negative experience when encountering meaning violations (e.g., Proulx & Inzlicht, 2012), fundamental existential concerns (Koole et al., 2006), or the "givens of existence" (Yalom, 1980), including considering one's own role in the grand scheme of things.

Existential distress has been described in past research and theory under various labels, including noogenic neurosis (i.e., existential vacuum; Crumbaugh & Maholick, 1964), existential anxiety (Good & Good, 1974; Van Bruggen, et al., 2015; Weems et al., 2004), existential fear (Walters, 2001), fundamental or basic anxiety (Glas, 2003), existential state reactions (Thorne, 1970), demoralization (e.g., Clarke & Kissane, 2002; Kissane et al., 2004; Tecuta et al., 2015), or meaninglessness and a sense of *disanxiousuncertlibrium* (Proulx & Inzlicht, 2012).

Existential anxiety is thought to be different from basic forms of anxiety that are immediate and based on an alarm elicited by more primitive biological systems in the brain (e.g., the amygdala; Glas, 2003). Instead, existential anxiety is thought to be based on pervasive existential concerns and feelings (e.g., meaning, freedom, isolation, death, identity) that exist beneath the surface of daily concerns due to humans' unique ability to think abstractly about their own existence (Glas, 2003; Koole et al., 2006; Vandeberg, 1991; Yalom, 1980). However, existential distress is expected to not only involve feeling anxious or sad *about* existential concerns, but the ways in which existential distress is uniquely experienced and embodied (Glas, 2003). Specifically, when reviewing the literature there appeared to be several distinct experiences of existential distress that are relevant to cosmic vastness. They include the

experience of meaninglessness, powerlessness, hopelessness, destabilization, vulnerability, and existential isolation.

Meaninglessness. Meaninglessness is the most cited aspect of existential distress with respect to cosmic vastness (Kahane, 2014; Nagel, 1971), and likely the most relevant. It refers to feelings of insignificance, absurdity, emptiness, a loss of purpose or role in one's life, aimlessness, and that one's goals, accomplishments, activities, and routines are not worthwhile (Crumbaugh & Maholick; 1964; Glas, 2003; Good & Good, 1974; Proulx & Inzlicht, 2012; Van Bruggen et al., 2015, 2017; Weems et al., 2004). Meaninglessness also includes feeling a sense of loss of significance in life, the surrounding world, and the future (Weems et al., 2004). People likely feel insignificance when faced with the vastness of the universe because it leads one to reflect about the self and others from the largest possible perspective (Nagel, 1971; Kahane, 2014). When considering the self from this perspective, people might feel so small that they believe themselves or humanity to be no longer worth paying attention to.

Powerlessness and hopelessness. People can also experience a sense of powerlessness and a lack of control, including feelings of incompetence, impotence, helplessness, feeling like a failure, feeling trapped, not knowing what to do, and a loss of mastery (Clarke & Kissane, 2002; Cockram et al., 2009; Crumbaugh & Maholick, 1964; de Figueiredo, 1993; Rickelman, 2002). The feeling of incompetence also closely overlaps with a feeling of hopelessness and lack of optimism about the future, which includes feeling discouraged, disheartened, and overwhelmed or defeated by one's circumstances (Good & Good, 1974; Tecuta et al., 2015). The combination of hopelessness, helplessness, and a feeling of incompetence is often considered a "hallmark" of demoralization (Cockram, et al., 2009) and is what some call the "giving up – given up" complex (Schmale, 1972; Schmale & Engel, 1967; Sweeney et al., 1970). The experience of

powerlessness and hopelessness can be elicited by cosmic vastness because feeling small or inconsequential can lead people to believe that their actions have no meaningful effect, or that they are unable to evoke meaningful change in their lives or in the world when considering the grand scheme of things.

Destabilization. The experience of destabilization refers to a loss of stability, structure, or connection to either one's sense of self or one's understanding of the world. This includes feelings of confusion, disorientation, incoherence, doubt, instability, uncertainty, inconsistency, inner conflict, or even emptiness about one's self and identity (Akhtar, 1984; Kaufman et al., 2014; Kira et al., 2018; van den Bos, 2009; Weston, et al., 2011). Distress regarding one's identity can include a loss of continuity between one's past, present, and future, unclear boundaries between the self and non-self, a feeling of estrangement from the self, or a sense of losing something critical to one's sense of self (e.g., long-term goals, values, beliefs; Kira et al., 2018; Koole et al., 2006; Clark & Kissane, 2002). Destabilization also includes experiences of a sense of groundlessness, disorder, chaos, or loss related to one's understanding or relationship with the surrounding world and life (Glas, 2003; Ratcliffe, 2005; Van Bruggen et al., 2015). Cosmic vastness may evoke this distress in some people because it provides a distant cosmic perspective on oneself and the world that can bring up questions and doubts about what is important in life, one's role in the world, and one's beliefs about how life and the world works. If one finds these questions challenging, it can destabilize their worldview or sense of self.

Vulnerability. The experience of vulnerability refers to feeling unsafe, unprotected, vulnerable, and fragile (Glas, 2003; Walters, 2001; Van Bruggen et al., 2015; 2017; Janoff-Bulman, 1989). Vulnerability can be experienced when one becomes aware of the finitude and mortality of the self. The vastness of the universe might evoke a sense that the world as insecure,

inhospitable, unsafe, or fragile (Glas, 2003; Walters, 2001) because something can happen at any moment (Van Brugeen et al., 2015, 2017). Life on this planet is small and fragile in the grand scheme of things and this could raise concerns about our safety in a vast universe.

Existential isolation. People may also experience existential isolation, including feeling disconnected and alienated from others or the surrounding world (Bolmsjo, et al., 2019; Ettema, et al., 2010; Glas, 2003; Mayers et al, 2002; Van Bruggen et al., 2015; 2017; Yalom, 1980). At the core, existential isolation refers to the awareness that one will not be able to fully share and understand the experiences of another person because there is an unbridgeable gap between people. However, in the context of cosmic vastness, this can be extended to include an awareness of the fundamental isolation that humans have from the rest of the universe, at least in the foreseeable future. We are currently secluded to one planet in the vastness of the universe, which is filled with mostly empty space, and this may make people feel alone and isolated.

Empirical Research on Negative Reactions to Vastness

Past studies investigating reactions to physical vastness typically do not include measures of existential distress, with a few exceptions. For example, Gordon and colleagues (2017) measured feelings of powerlessness in response to threat-based Earth nature vastness but did not examine powerlessness in response to a cosmic vastness condition. Edwards and colleagues (2023) also measured existential isolation in a study that examined reactions to a virtual reality experience of drone flying over the Alps. Several studies have measured an experience referred to as self-diminishment (e.g., Hornsey et al., 2018; Rivera et al., 2020), which includes feelings of insignificance (i.e., feeling “small or insignificant,” “insignificant in the grand scheme of things”). However, the measure of self-diminishment that is used also included several other concepts that do not refer to experiences directly representative of existential distress (e.g., small

self, vastness relative to self, that one's concerns are not important). Other experiments have measured people's the presence of meaning in life after watching a cosmic vastness video (Dai et al., 2022; Rivera et al., 2020), which can be considered the opposite of feeling insignificant and meaningless. Although existential distress has been rarely examined in this literature, vastness has been shown to evoke negative affect such as sadness, anxiety, fear, and general distress, which are constructs often associated with existential distress (e.g., Van Bruggen et al., 2015; 2017).

Negative Reactions to Cosmic Vastness. Hornsey and colleagues (2018) found that cosmic vastness evoked higher levels of negative affect (i.e., composite of sadness, fear, and anxiety) than a neutral control condition in one of two experiments. However, they found no difference in negative affect compared to an Earth nature vastness condition. Upon closer examination, cosmic vastness may not have consistently elicited more negative experiences than control conditions because they used uplifting cinematic music in all of their videos (see supplemental materials in Hornsey et al., 2018). This may have attenuated negative reactions in all conditions and made differences non-significant. In fact, in their supplemental materials, the authors reported the use of two neutral conditions, one with music and one without. They found that the video with music elicited higher levels of positive affect and lower levels of negative affect. In addition, the Earth nature vastness video may not have elicited less negative affect than the cosmic vastness video because it depicted lava entering natural foliage and burning plants and trees, perhaps evoking negative affect due to the destruction of nature.

A few other studies have reported negative reactions to cosmic vastness. Gordon and colleagues (2017) found that a cosmic vastness video (set to ominous music) evoked higher levels of fear and anxiety than an Earth nature vastness video (music not reported). This also

suggests that the type of music played during the videos affect people's reactions. Other studies found that a cosmic vastness video elicited higher levels of fear and sadness compared to an amusement condition (i.e., animals with comedic voice overs; supplemental materials for Rivera et al., 2020). The cosmic vastness video also elicited higher levels of fear (Jiang and Sedikides, 2022) and sadness (Danvers and Shiota, 2017) compared to neutral videos (i.e., an ordinary street scene and instructions on building a cinder-block wall, respectively), and higher levels of sadness and anger compared to a positive emotions video (i.e., an Olympic figure skater winning a gold medal; Danvers and Shiota, 2017). All other studies that used a cosmic vastness video either did not measure negative experiences (Johnson et al., 2017; Johnson et al., 2019) or did not report comparisons of negative experiences between conditions (Stellar et al., 2018).

However, when researchers measured meaning in life (i.e., an experience comparable to insignificance and meaninglessness), Rivera and colleagues (2020) found no difference in levels of meaning in life between a cosmic vastness condition and an amusement condition. Dai and colleagues (2022) used a multidimensional measure of meaning, which differentiated from general meaning in life statements (e.g., "My life as a whole has meaning") and feelings of significance (e.g., "I feel whether my life ever existed matters even in the grand scheme of the universe"). They found that a cosmic vastness condition elicited higher levels of meaning in life and lower levels of significance compared to a neutral condition. These contradictory results are likely due to whether measures of meaning in life included items that were referring to significance relative to the vastness of the universe. Thus, it will be important to measure insignificance more directly by including items that are negatively valenced (e.g., feeling insignificant and meaningless).

Negative Reactions to Viewing Earth from Space. Nelson-Coffey and colleagues

(2019) found that watching a video or engaging in a virtual reality experience zooming away from Earth evoked more negative affect (fear, shame, and disgust) than a video about facts of our solar system. However, the experiences of shame and disgust may be as result of the accompanying audio of Carl Sagan, which describes how human beings are arrogantly fighting over land and resources instead of working together (see supplemental materials in Nelson-Coffey et al., 2019).

Negative experiences related to leaving earth have also been considered in research on pilots flying aircrafts and astronauts leaving Earth for long duration missions. Pilots have reported the *break-off phenomenon*, which is a feeling of separation from the Earth at high altitudes that can include feelings of remoteness, loneliness, insecurity, fear, and anxiety (Clark & Graybiel, 1957; Sours, 1965). Other researchers have suggested that when astronauts travel to Mars in the future, they may experience an *Earth-out-of-view phenomenon,* from witnessing the Earth become a small dot in the vast cosmos, resulting in experiences of isolation and homesickness (Kanas, 2020).

Negative Reactions to Earth Nature Vastness. There is growing interest amongst researchers to investigate threat-based variants of awe (Gordon et al., 2017). This research often uses stimuli of threat-based nature that includes dangerous natural environments such as volcanoes, hurricanes, and storms. Studies such as these find that threat-based Earth nature vastness evokes more feelings of fear, anxiety, powerlessness, uncertainty, and lack of control (Gordon et al., 2017; Piff et al., 2015) than positive Earth nature vastness, and compared to neutral control conditions (i.e., building a fence or wooden countertop). Danvers and Shiota (2017) also found that vast nature that was threatening elicited more sadness than a neutral condition. It also elicited more sadness, anger, and disgust than a positive Earth nature vastness

condition. However, higher degrees of negative experiences may be due to the witnessing of vast power, rather than vast physical size, because participants also reported that threat-based variants of nature felt less vast than positive-based variants of nature (Gordon et al., 2017). This is consistent with Kant's distinction between two types of sublime experiences, which include the "mathematically" sublime (vast size or quantity) or "dynamically" sublime (vast force and power; Kant, 1790/1986).

Vast nature that does not depict vast power can still evoke some negative experiences. For example, a video of vast nature on Earth was shown to elicit more fear and sadness than an amusement video and a neutral control video (Piff et al., 2015; Rivera et al., 2020; Valdesolo & Graham, 2014). Witnessing images of vast natural landscapes (including some threatening nature images) also evoked more fear than witnessing pictures of mundane nature images (Joye & Bolderijk, 2015). However, studies with measures of existential distress (i.e., existential isolation and powerlessness) did not find that non-threatening Earth nature vastness elicited these experiences more strongly than control conditions (Edwards et al., 2023; Gordon et al., 2017).

Although negative experiences are reported in response to several forms of physical vastness, these experiences were minimal (mean scores far below the midpoint of the scales). In addition, a study by Danvers and colleagues (2017), which measured the valence of emotional reactions to videos (from negative to positive), found that witnessing cosmic vastness was a positive experience (6.37 on a 0 to 8 Likert scale). This further demonstrates that it is important to consider the accompanying music and audio of the videos to ensure negative experiences are not attenuated by positive elements (e.g., uplifting music). In addition, the low levels of negative experiences detected in past research further supports the need to assess existential distress. Existential distress captures experiences that are particularly relevant to cosmic vastness but have

not been considered frequently enough in past research. The consequence of not assessing affect relevant to the context has been shown in some studies related to confrontation with other existential concerns (e.g., the concept of death in terror management theory; Lambert et al., 2014; Park & George, 2018). Researchers often use general measures of affect (e.g., Positive and Negative Affect Schedule; Watson & Clark, 2004) that do not highlight feelings most relevant to the context of the experiment, and consequently miss detecting negative experiences that are actually present (e.g., Lambert et al., 2014).

Cognitive Reactions to Cosmic Vastness

Cosmic vastness elicits cognitive processes that are not necessarily positive or negative in valence but are still important to consider. The most frequently discussed cognitive responses to vastness in the literature include *perceived vastness*, *need for accommodation*, and the experience of *small self*.

Perceived Vastness

Predictably, a cosmic vastness video was expected to elicit a perception or experience of vastness (i.e., *perceived vastness*), as has been demonstrated in studies where participants view physical vastness (e.g., Chirico et al 2017; Chirico et al., 2018; Gordon et al., 2017; Stellar et al., 2018). The perception of vastness is not exclusive to physical size and can include vastness in other forms such as status (e.g., fame, prestige, and authority), power (e.g., threatening nature or authority), time (e.g., vastness of geological time), or conceptual ideas (e.g., a profound scientific theory). Vastness is considered a fundamental component of the experience of awe (Keltner & Haidt, 2003), whether it is positively valenced (e.g., in response to beautiful vast nature) or negatively valenced (e.g., in response to powerful and threatening vast nature). Several researchers measure a subjective experience of vastness and have considered it as a manipulation

check (Gordon et al., 2017), a mediator (Piff et al., 2015; Stellar et al., 2018), an outcome (Hornsey et al., 2018; Shiota et al., 2007), or as a component of awe (Yaden et al., 2019). However, the experience of vastness is often measured with items that overlap with elevating experience (e.g., "I feel part of some greater entity," "I feel like I am a part of a greater whole"; Piff et al., 2015; Yaden et al., 2019). In the context of the present research, the focus was on the perception of vastness without associating it to other experiences (e.g., elevating experience) in the items. Throughout the thesis, perceived vastness was treated as a manipulation check to ensure that cosmic vastness is eliciting perceived vastness to a high degree.

Need for Accommodation

When faced with vastness, people often experience the *need for accommodation*. This is considered another key component of experiencing awe or the sublime (Keltner & Haidt, 2003; Pelowski et al., 2019). Need for accommodation is defined as the challenge, negation, or adjustment of previous mental structures (e.g., schemas) to make sense of an experience (Keltner & Haidt, 2003; Yaden et al., 2019). It is often also associated with other reactions, such as surprise, shock, confusion, uncertainty, obscurity, and having cognitive difficulty, but cannot be defined by any of these alone (Chirico et al., 2018; Pelowski et al., 2020; Taylor & Uchida, 2020; Valdesolo & Graham, 2014). No research has examined the link between cosmic vastness and need for accommodation directly. Dai and colleagues (2022) examined how a cosmic vastness video related to coherence seeking (e.g., seeking to make sense of the events of one's own life), a construct that has some overlapping features with need for accommodation. However, Dai and colleagues (2022) did not find that cosmic vastness increased the levels of coherence seeking. This may be due to the construct focusing on self-related coherence (i.e., making sense of one's personal life and identity), rather than how people make sense of what

they witnessed (e.g., making sense of the scale of the universe). Overall, cosmic vastness was expected to challenge peoples' understanding of themselves, the world, and bring them out of a typical mode of thinking about everyday concerns because it evokes a big picture perspective.

Small Self

The experience of *small self* has been examined considerably in research on people's reactions to vastness (Bai et al., 2017; Edwards et al., 2023; Le et al., 2019; Piff et al., 2015; Preston & Shin, 2017; Shiota et al., 2007; Stellar et al., 2018; Weger & Wagemann, 2018; Yaden et al., 2019). Small self has been shown to be induced by many forms of physical vastness compared to non-vast control conditions (e.g., neutral control, amusement condition), including cosmic vastness (Hornsey et al., 2018), viewing Earth from space (Chirico et al., 2018; Nelson-Coffey et al., 2019), and Earth nature vastness (Bai et al., 2017; Chirico et al., 2017; Chirico et al., 2018; Edwards et al., 2023; Le et al., 2019; Joye & Bolderdijk, 2015). One study demonstrated that cosmic vastness also elicits higher levels of small self compared to an Earth vastness condition (Hornsey et al., 2018).

However, the definition and measurement of small self is varied, particularly when considering what it means for the *self* to be small. Some studies focus more on the feeling of diminishment of one's *size* (e.g., Bai et al., 2017), whereas others focus on losing or a reduction of the *sense of self* (e.g., self-loss; Yaden et al., 2019). Many researchers use measures that pair "feeling small" with other concepts such as insignificance, reduction of daily worries or concerns, and witnessing vastness (e.g., Le et al., 2019; Piff et al., 2015; Preston & Shin, 2017; Shiota et al., 2007). As a result, Tyson and colleagues (2021) argued that there are three aspects to small self, including self-size (metaphorical experience of small self), vastness relative to the self (which includes many items from a measure of elevating experience; Huta & Ryan, 2010),

and self-perspective (feelings as though one's day-to-day concerns irrelevant in the grand scheme of things). Finally, some researchers define small self as a complex and multilayered concept (i.e., quiet ego; Perlin & Li, 2020). For the purpose of the present research, small self is defined as the experience of feeling metaphorically smaller without making assumptions about other experiences that may be associated to it. Specifically, participants in the present research will be simply asked whether they felt "small".

Why do People React Differently to the Vastness of The Universe?

The affective reactions that people experience in response to cosmic vastness, such as elevating experience and existential distress, are a consequence of how a person relates to it. When considering why people react differently to the vastness of the universe, it is important to consider both ends of this relationship. First, what is it about the stimulus (cosmic vastness) and the experiences it commonly elicits in people (i.e., cognitive responses) that causes polarizing reactions? Second, what it is about people and their individual traits that causes polarizing reactions? These two aspects fit nicely into examining the mediators (i.e., what it is about cosmic vastness) and moderators (i.e., what it is about a person) that impact the relationship between cosmic vastness and the most relevant positive and negative experiences (i.e., elevating experience and existential distress).

What is it About Witnessing Cosmic Vastness That Causes People to React Differently?

The present thesis investigated cognitive responses as potential mediators between cosmic vastness and both elevating experience and existential distress. Need for accommodation and small self are both experiences that relate to both positive and negative experiences (e.g., Yaden et al., 2019). Some past research has also examined these variables as mediators between experiencing vastness and positive or negative outcomes. Hornsey and colleagues (2018)

performed moderated mediation analyses with a cosmic vastness condition (i.e., cosmic vastness condition vs. control condition) as the independent variable, self-esteem as a moderator, self-diminishment (i.e., small self, insignificance, and personal concerns not being important) as a mediator, and positive affect or negative affect as outcomes. They found that self-diminishment mediated the positive relationship between cosmic vastness and both negative affect (e.g., anxiety, fear, and sadness) and positive affect (i.e., happiness, excitement, and wonder). Dai and colleagues (2022) examined the mediating role of a variable similar to need for accommodation called seeking coherence, as well as two other variables (purpose pursuit, feelings of significance), between witnessing cosmic vastness (an "awe" condition compared to a neutral control condition) and general meaning in life judgements. They did not find evidence for seeking coherence as a mediator, but found that purpose pursuit and feelings of significance mediated the relationship between witnessing a cosmic vastness video (compared to a neutral control video) and meaning in life. Specifically, a cosmic vastness video related to higher levels of pursuit of purpose, which related to higher levels of meaning in life. In contrast, the cosmic vastness video related to lower levels of significance, which was detrimental to participants levels of meaning in life. In addition, Stellar and colleagues (2018) found that need for accommodation mediated the positive relationship between an awe condition (i.e., participant recalling a past experience of awe compared to recalling a past experience of amusement or going to a grocery store) and the experience of awe. A closer examination of why small self and need for accommodation may be significant mediators is reviewed below.

Need for Accommodation as a Potential Mediator. Need for accommodation was expected to be a mediator between cosmic vastness and both elevating experience and existential distress because it can relate to intense positive or negative experiences. A need for

accommodation was expected to lead to elevating experience because it is a mind-expanding process that pulls a person beyond their usual boundaries to experience something new and potentially awe-inspiring and transcendent. People who are challenged beyond their typical limits have the opportunity to accommodate some aspects of cosmic vastness and subsequently elevating experience such as enlightenment, wonder, inspiration, and a connection to a greater whole (Bonner & Friedman, 2011; Keltner & Haidt; 2003; Sundararajan, 2002; Valdesolo et al., 2017; Weger & Wagemann, 2018). Empirical research has provided some evidence that need for accommodation relates to positive experiences, such as awe, transcendence, interest, and curiosity (Campos et al., 2013; Edwards et al.,, 2023; Mcphetres, 2019; Stellar et al., 2018; Yaden et al., 2019).

However, cosmic vastness was also expected to lead to existential distress because it may shake previously held beliefs and destabilize the person. For example, researchers suggest that if people are unable to accommodate vastness, it can relate to negative experiences such as confusion, bewilderment, fear, terror, and powerlessness (Bonner & Friedman, 2011; Keltner & Haidt, 2003; Sundararajan, 2002; Valdesolo et al., 2017; Weger & Wagemann, 2018). Given the sheer scale and size of the universe, participants were not expected to be able to *fully* accommodate the experience. Since full accommodation in this case is unlikely (facing cosmic vastness leaves unanswered questions and an experience of incomprehensible scale), this may lead to vulnerability, uncertainty, and a sense of powerlessness about the fact that one cannot fully understand or know what is being witnessed. In addition, past research has demonstrated that when a person confronts an experience that needs accommodation but cannot be fully processed, it can evoke negative feelings such as existential distress (e.g., feeling powerless, lost, and unsteady) because it leaves the participant in a state disequilibrium that can be distressing in

itself, and perhaps violates a sense of coherence, understanding, and meaning one has made about the life and the world (Keltner & Haidt, 2003; Janoff-Bulman, 1989; Sundararajan, 2002; Park, 2010). Limited empirical research has examined the relationship between scales that measure need for accommodation and negative experiences, but one study found that need for accommodation relates to increased feelings of anxiety, fear, and sadness (Yaden et al., 2019).

However, it is important to consider that it may be impossible to meaningfully understand the enormous scale of the universe. Feeling challenged and having difficulty accommodating the scale of the universe may not lead to distress, even if full accommodation does not happen. Paradoxically, being unable to grasp the scale of the universe might be a potentially elevating experience (e.g., evoking inspiration, feeling uplifted, or in awe of what one cannot understand). In this case, accommodation of cosmic vastness may be more about how one makes sense of their relationship to the cosmos and the bigger picture, rather than meaningfully understanding the enormity of the universe.

Small Self as a Potential Mediator. The experience of small self was expected to be a mediator between witnessing cosmic vastness and both elevating experience and existential distress because small self was found to be related to both positive and negative outcomes in past research. The experience of small self was expected to result in elevating experience because the diminishment of one's size nudges one to consider and feel impressed by the bigger picture to a greater degree. Research has demonstrated that feeling small often involves a person focusing less on the self and more on others and the surrounding world (Bai et al., 2017; Piff et al., 2015; Stellar et al., 2018), or at least having a more balanced attention between self and the surrounding world (Perlin & Li, 2020). Directing one's attention outward allows an individual to open up to something greater than the self, consequently allowing them to relish in the grandeur

of the spectacle laid out before them. Research has also demonstrated a positive relationship between small self and elevating experience, including experiences of awe, wonder, and feeling connected to the bigger picture (Bai et al., 2017; Campos et al., 2013; Edwards et al., 2023; van Elk et al., 2016; Weger & Wagemann, 2018; Yaden et al., 2019).

Experiencing a high degree of small self was also expected to evoke existential distress in many people. Feeling small likely evokes primal feelings of inferiority, powerlessness, and insignificance because size is often associated with dominance and power, which is evident in hierarchies in animal kingdoms (Schubert, 2005) and when considering the functions of monumental religious architecture (Joye & Verpooten, 2013). Furthermore, Thomas Nagel eloquently noticed in a notable philosophical paper discussing people's reaction to cosmic vastness that a "reflection on our minuteness and brevity appears to be intimately connected with the sense that life is meaningless" (Nagel, 1971, p. 717). The link with existential distress has also been supported in past research in that a small self has often been associated with negative experiences, including negative affect (e.g., anxiety, fear, sadness; Yaden et al., 2019), insignificance and lower levels meaning in life (Bai et al., 2017; Rivera et al., 2020), powerlessness (Gordon et al., 2017), existential isolation (Edwards et al., 2023) and lower self-esteem and self-efficacy (Bai et al., 2017). However, it is important to note that since measures of small self in the literature often include several concepts (e.g., feeling small, self loss, witnessing vastness, insignificance, worries and concerns not feeling important), its relationship with the highlighted outcomes are less clear.

What is it About a Person that Causes People to React Differently?

To date, only one study has examined why people react differently to the vastness of the universe. Hornsey and colleagues (2018) predicted that self-esteem would moderate the

relationship between witnessing cosmic vastness and the reactions people experienced (e.g.,positive affect, negative affect, and elevating experience). Specifically, they predicted that people with high levels of self-esteem would be more likely to see cosmic vastness as an opportunity for self-transcendence, to embrace feelings of self-diminishment, and to subsequently experience more positive affect. In contrast, they predicted that people with low self-esteem would see cosmic vastness as a threat to the self, resist feelings of self-diminishment, and subsequently experience more negative affect.

The results of their study supported their hypothesis in one experiment. They found that people with low levels of self-esteem experienced more negative affect than people with high levels of self-esteem. As expected, people with high levels of self-esteem had higher levels of positive affect compared to people with low levels of self-esteem. However, self-esteem did not moderate the relationship between the cosmic vastness condition and measures of elevating experience (i.e., awe or transcendence).

Notably, self-esteem is only one of many possible reasons why people may react to cosmic vastness differently. In fact, Hornsey and colleagues (2018) reported additional analyses that examined three other moderators (narcissism, openness to experience, and neuroticism) but did not find that they consistently moderated the relationship between cosmic vastness and the outcomes they examined. In the present research, five variables were expected to play an important role in how people react to cosmic vastness as well. Specifically, *self-esteem*, *humility*, *intellective processing style*, *big picture thinking,* and *meaning in life* were all expected to facilitate elevating experience and buffer the experience of existential distress because they help people cope with cosmic vastness in different ways.

Self-Esteem. Self-esteem can be defined as a subjective assessment of one's worth as a

person (Donnellan, Trzesniewski, & Robins, 2015). People can evaluate their worth based on many different standards but two dimensions that are often considered central are liking the self and feeling competent (Tafarodi & Swann, 2001). Self-esteem has been shown to buffer the negative effects of existential threats (e.g., thoughts of death; Routledge et al., 2010) and violations of meaning (Heine, Proulx, & Vohs, 2006).

In the present research, self-esteem was expected to be an important indicator of how people react to cosmic vastness because it provides a "protective shield", a resilient place within the self, and a secure base from which to explore their reactions, that helps people cope with psychological and existential threats to the self (e.g., feeling small, insignificant, or powerless; Heine et al., 2006; Hornsey et al., 2018; Routledge et al., 2010). It is also the only variable that has been shown to moderate the relationship between cosmic vastness and affective outcomes in past research (Hornsey et al., 2018). In addition, it represents a good proxy for many associated concepts that may be important when facing existential threats, such as self-efficacy, locus of control, and low levels of neuroticism (Judge, Erez, Bono, & Thoresen, 2002). Thus, if one has a low or fragile sense of self-esteem, they will have more difficulty coping with the threat and will likely experience and maintain a sense of anxiety, sadness, and existential distress. People with a healthy high self-esteem can protect the self from threat and reduce the degree of existential distress experienced, or perhaps not even feel threatened, by being able to assure themselves of their own worth and competence in the world.

Moreover, people with high self-esteem were expected to be able reappraise their experience or consider facing cosmic vastness as a challenge, an opportunity, and be able to maintain their meaning-making framework (Heine et al., 2006) because they are ultimately able to return to an internal safe haven that reassures their sense worth if they feel threatened in some

way. Thus, individuals that have a high degree of healthy self-esteem were expected to be able to expand the self, see further, and open up to elevating experience that would be much more difficult when one feels under threat.

Humility. Humility was also expected to be important in determining how people react to the vastness of the universe in the present research. Humility is defined as having a realistic and open understanding of oneself, accepting one's own limitations, being aware of one's place in relation to others or the greater world, and being more open to negative information about the self (Chancellor & Lyubormirsky, 2013; Kesebir, 2014; Tangney, 2000). Thus, humility can be considered as people's comfort with, experience of, and acceptance of feeling smaller in importance or status compared to others or the surrounding world. Humility is not simply the opposite of narcissism because narcissism represents an unhealthy inflated sense of self importance and self-esteem, whereas humility tends to represent a healthy self-esteem with a balanced perspective of one's worth and importance (i.e., does not reflect low self-esteem). Trait-level humility has also been shown to relate to more frequent and intense experiences of awe (Stellar et al., 2018), less trait-level existential distress (i.e., existential anxiety; Nadelhoffer & Wright, 2018), and to buffer against the experience of death anxiety when confronting the concept of death in an experimental protocol (Kesebir, 2014).

People with high levels of humility were expected to be less likely to experience existential distress when facing the vastness of the universe because they would cope better with feeling small. People with high humility are likely more accustomed to seeing themselves in a realistic way and as someone who is not more important, powerful, or greater than other people or the surrounding world (e.g., one human being amongst billions of people in a large and complex society and universe), thus accurately judging oneself as a small part within a much

larger context of existence (Kesebir, 2014). They were expected to be more comfortable playing a small role in the grand scheme of things and not to consider this fact as something negative about the self. In contrast, people with low levels of humility, who may have an unhealthy inflated sense of self-esteem (e.g., someone who may be narcissistic), were expected to experience exposure to cosmic vastness as distressing because it challenges their sense of self as large, important, or grand.

Higher levels of humility were also expected to facilitate more elevating experience because people who are more humble have a more balanced degree of focus on the self and others, and can consequently direct more of their attention toward the world beyond themselves (Tangney, 2000), including the vastness of the universe. This was expected to facilitate elevating experience such as awe, inspiration, and connection to the bigger picture (e.g., Stellar et al., 2018) because humility promotes a welcoming attitude towards something other than oneself and a willingness to be moved, inspired, and in awe.

Intellective Processing Style. Intellective processing style is a general preference for complex, elaborative, and effortful forms of thinking, in contrast to automatic, expedient, and effortless processing (Eigenberger et al. 2007). Cosmic vastness is inherently abstract, complex, and difficult to fathom. It is possible that the enormous scale of the universe is impossible to meaningfully understand. Intellective processing style was expected to be a significant moderator because this extreme degree of vastness requires a significant degree of intellectual accommodation, as it challenges one's previous conceptions, or at least brings the person outside their typical mode of thinking.

People with an intellective processing style were predicted to be more likely to have elevating experience in response to cosmic vastness because they are more equipped to process

and contemplate the size and complexity of the universe. Thus, they were expected to be more open to integrate the bigger picture into their own cognitive framework and understanding, providing them the opportunity to feel inspired, uplifted, in awe, and moved by it. This processing style was expected to be important for how people react to cosmic vastness because it reflects the capacity for people to engage with, accommodate, and make sense of an experience that challenges their perspective or understanding of the world (i.e., the vastness of the universe). Elevating experience has been shown to positively relate to concepts that have good convergent validity with intellective processing style (Eigenberger et al., 2007), such as a need for cognition (McPhetres, 2019; Pilgrim et al., 2017), openness to experience (McCrae, 2007; Nusbaum & Silvia, 2011; Silvia et al., 2015; Yaden et al., 2019), and lower levels of a need for cognitive closure (Pilgrim et al., 2017). However, intellective processing style is considered distinct from these concepts because it represents a broader measurement of one's general implicit cognitive style that may underly many of these variables (Eigenberger et al., 2007).

People with a higher degree of an intellective processing style were also expected to be less likely to experience existential distress because being challenged to think about abstract, complex, philosophical, and existential issues is not an adverse experience for them. Thus, they were less likely to feel destabilized or powerless by it because they are able to accommodate it in a significant way. In contrast, people who are low on intellective processing style may feel pulled outside their preferred way of operating in the world, or perhaps their capacity to reflect on these questions, thus leading to existential distress when they are not able to process the abstract, complex, and big picture aspects of cosmic vastness.

Big Picture Thinking. Big picture thinking refers to the tendency to think beyond the self and focus on understanding and relating to a larger system than the self (e.g., one's own

purpose, one's community, the surrounding world, or how one makes sense of the entire universe; Huta, 2015; Pearce et al., 2021; Peterson et al., 2005) and the deeper meaning of existence (Allan & Shearer, 2012). Cosmic vastness is a symbolic representation of the largest physical perspective one can conceivably reflect upon. Thus, the degree to which someone engages in *big picture thinking* was expected to be particularly relevant because it represents one's preference for reflecting on vastness, larger perspectives in life, and the deeper aspects of human existence (e.g., Huta, 2015; Pearce et al., 2021; Peterson et al., 2005). Big picture thinking has not been explicitly examined in the vastness literature. However, research on concepts related to big picture thinking, such as spirituality, existential thinking, a meaning orientation to life, or taking distant perspective provides some evidence that these constructs help people cope with adversity (Fuochi, et al., 2018), existential threats (Routledge & Juhl, 2010), and facilitate elevating experience (Le et al., 2019; Ortner, et al., 2018; Preston & Shin, 2017; Van Cappellen & Saroglou, 2012).

People who engage in more big picture thinking were expected to experience more elevating experience because they are seeking out a larger context to contemplate and situate themselves in. Thus, witnessing cosmic vastness is a welcome opportunity to engage connect and feel inspired, uplifted, or in awe of that larger context. The vastness of the universe is compelling to many people with this perspective because of its literal and symbolic representation of the big picture. In addition, people who engage in big picture thinking were predicted to experience less existential distress because they are already used to thinking about a broader and deeper perspective. Thus, it will not be as much of a stretch to consider the vastness of the universe and it will not surprise them in a way that is destabilizing.

Meaning in Life. The degree that a person believes they have meaning in life was

expected to be a significant moderator for the relationship between cosmic vastness and both elevating experience and existential distress. Meaning in life is typically defined as a subjective sense of whether a person believes their life has meaning or purpose. Recently researchers have conceptualized meaning and its components more specifically, which include a sense of purpose, significance (or existential mattering), and comprehension (or coherence; e.g., George & Park, 2017; Martela & Steger 2016).

People with high levels of meaning in life were expected to experience more elevating experience because individuals with a pre-existing meaning-making framework (e.g., spiritual beliefs, worldviews, or a set of values or goals guiding their lives) that provides a sense of comprehension, significance, and purpose in life are more likely to use this framework to make sense of, be inspired by, and connected to a much larger perspective. In contrast, people who have low levels of meaning in life were expected to have difficulty accommodating the existential nature of cosmic vastness, especially since it often brings up questions about one's significance, making it difficult to be emotionally moved in a positive way.

People with high levels of meaning in life were expected to experience less existential distress because they can rely on their pre-existing frameworks to maintain their feeling of significance and ability to makes sense of their lives. This is important because when people experience meaning violations, they will engage in meaning making processes to maintain their global meaning systems (Park, 2010) and even bolster their existing worldview beliefs (Heine et al 2006; Proulx & Inzlicht, 2012). Thus, people with high levels of meaning in life are likely more able to maintain a sense of what makes their life meaningful due to their stronger framework to make sense of existential threats. In contrast, people with lower levels of meaning in life may struggle with whether they are relevant relative to something much greater than

themselves, or to question if there is in point to pursuing goals that provide their life purpose when considering the grand schemes or things. This can be very destabilizing, especially if there isn't pre-existing belief system that can re-affirm that life is meaningful, and this can lead to a sense of meaninglessness and existential despair.

Overview of Research Objectives and Hypotheses

The focus of the present research was to examine how and why people react to the vastness of the universe differently. Overall, there were three main objectives. The first objective was to understand the type of reactions people have in response to witnessing cosmic vastness. The second objective was to understand what facets of cosmic vastness elicit positive and negative reactions, with a particular focus on elevating experience and existential distress. Specifically, this research aimed to investigate what cognitive responses (e.g., need for accommodation, small self) mediate the expected positive relationship between cosmic vastness and both elevating experience and existential distress. The third objective was to understand what individual traits (i.e., self-esteem, humility, intellective processing style, big picture thinking, meaning in life) moderate people's reactions to cosmic vastness.

Only one study to date explicitly examined how and why people react differently to cosmic vastness (Hornsey et al., 2018). The present research aimed to expand on this study and take a more comprehensive approach (with respect to the present research hypotheses) in several ways. First, there was a focus on optimizing the videos used for cosmic vastness by removing confounds (e.g., the use of music) and using videos that depict cosmic vastness more comprehensively (e.g., longer videos with a more complete depiction of the vastness of the universe). Second, the present research used both qualitative and quantitative methods to understand peoples' reactions (e.g., positive, negative, and cognitive responses) to cosmic

vastness. Third, the present research focused predominantly on both positive and negative existential experiences (i.e., elevating experience and existential distress). Fourth, the present research examined mediators and moderators that have not been examined before and were expected to impact people's reactions to cosmic vastness.

The present research consisted of two studies. Study 1 was a primarily qualitative study, with some preliminary quantitative measures, that examined participants' reactions to cosmic vastness. This qualitative approach allowed participants to share their reactions to the cosmic vastness video in their own words. Doing so allowed the opportunity to find any additional experiences that should be examined in Study 2 that had not been considered in the literature. This study consisted of two conditions that consisting of two different cosmic vastness videos to help select the most appropriate cosmic vastness video for Study 2.

Study 2 was a quantitative study aimed to investigate all three of the objectives described above. This study examined participants' reactions to cosmic vastness with multi-item measures that were based on experiences observed in Study 1 and described in past empirical research. Study 2 also compared a cosmic vastness video to two control videos (i.e., neutral control video and Earth nature vastness video) to better understand some of the unique features of cosmic vastness leading to divergent experiences. Furthermore, the second study examined the role of cognitive reactions that were described Study 1 and in past research as mediators between the cosmic vastness condition and the outcomes of interest. Finally, this study examined individual traits that moderate the relationship between experiencing a cosmic vastness condition and both elevating experience and existential distress.

There are several overarching hypotheses that guided the two studies that were conducted. Hypotheses 1-3 reflect the types of experiences elicited by cosmic vastness (objective

1). Hypothesis 4 reflects mediators that were expected to elicit polarizing responses to cosmic vastness (objective 2). Hypothesis 5 reflects individual characteristics (moderators) that were expected to impact people's reactions to cosmic vastness (objective 3). These hypotheses are cited throughout the two studies and more specific predictions for these hypotheses are provided in Study 1 and Study 2 respectively.

Hypothesis 1: Cosmic vastness will elicit positive and negative experiences, including existential experiences (i.e., elevating experience and existential distress) because they are particularly relevant when witnessing cosmic vastness.

Hypothesis 2: There will be substantial *variability* in the degree that people report elevating experience and existential distress in response to cosmic vastness across participants. Specifically, there will be substantial polarization of people who experience either predominantly elevating experience or predominantly existential distress. In addition, the presence of elevating experience and existential distress will vary to a greater degree when participants witness cosmic vastness compared to other stimuli that are less vast (i.e., Earth nature vastness or neutral control videos in Study 2).

Hypothesis 3: Cosmic vastness will elicit several distinct cognitive responses (e.g., small self and need for accommodation) to a high degree.

Hypothesis 4: There are several distinct cognitive responses that are expected to mediate the relationship between cosmic vastness and both elevating experience and existential distress. Specifically, cognitive responses from past literature (i.e., small self, need for accommodation) and others discovered in Study 1, will mediate the positive relationship between witnessing cosmic vastness (i.e., cosmic vastness condition vs. neutral control condition) and both elevating experience and existential distress.

Hypothesis 5: The relationship between witnessing cosmic vastness (i.e., cosmic vastness video vs. neutral control video) will vary across levels of five moderators, including self-esteem, humility, intellective processing style, big picture thinking, and meaning in life. Specifically, at high levels of each of these moderators, the relationship between witnessing cosmic vastness and elevating experiences will be significantly positive, whereas at low levels of each moderator the relationship will be non-significant. In contrast, at low levels of each of the moderators, the relation between witnessing cosmic vastness and existential distress will be significantly positive, whereas at high levels of each moderator the relationship will be non-significant.

Study 1

The purpose of Study 1 was to investigate how people react when presented with videos depicting the vastness of the universe using a largely qualitative approach and some preliminary quantitative measures. To do this, Study 1 tested two separate videos depicting cosmic vastness and had participants provide open-ended responses about their experiences, as well as rate several preliminary questions using Likert scales. The qualitative responses allowed participants to report experiences through their own words. This approach helped reveal experiences that would not have otherwise been considered in this research. In Study 1, hypotheses about the presence of certain affective responses (e.g., elevating experience and existential distress) were tested. The preliminary quantitative questions also tested the degree that different experiences were elicited and helped compare the two videos. Study 1 primarily tested Hypotheses 1, 2, and 3, with a preliminary examination of Hypothesis 4.

Objectives

Examining the Presence of Positive and Negative Experiences

Hypothesis 1 focuses on the types of positive and negative experiences elicited by cosmic vastness and is separated into two parts for Study 1.

Hypothesis 1a: Cosmic vastness will elicit both positive (positive affect and elevating experience) and negative (negative affect and existential distress) experiences. Specifically, these experiences are expected to be categories frequently described by participants in the qualitative data.

Hypothesis 1b: Elevating experience and existential distress (i.e., existential experiences) are predicted to be elicited to a strong degree because they are particularly relevant when witnessing cosmic vastness. Specifically, existential experiences are expected to be reported as frequently or more frequently than experiences of positive and negative affect in the qualitative data.

Examining if Cosmic Vastness Elicits Polarizing Experiences

In Hypothesis 2 it is predicted that there will be substantial variability across participants in the degree that elevating experience and existential distress are experienced when witnessing cosmic vastness. This was finding expected to demonstrate how cosmic vastness can elicit polarizing reactions. Hypotheses 2 was tested using preliminary single-item quantitative measures of elevating experience and existential distress and can be summarized in one hypothesis. It is called Hypothesis 2a because it is the same as Hypothesis 2a in Study 2.

Hypothesis 2a: It is expected that there will be substantial polarization of people who experience predominantly elevating experience or predominantly existential distress. This will be observed through a bipolar question that forces participants to report which of the two existential experiences they experienced more of. This will also be observed when examining two independent measures of elevating experience and existential distress.

Specifically, there will be substantial proportions of participants who score high on one experience (elevating experience or existential distress) and low on the other experience when separating participants into four groups at the midpoint of the scale (i.e., combination of high or low on each experience).

Examining the Presence of Cognitive Responses

In addition to positive and negative experiences, it is predicted in Hypothesis 3 that the cosmic vastness videos will also elicit cognitive responses (i.e., small self and need for accommodation) that were commonly found in past research related to witnessing vastness.

Hypothesis 3: Cosmic vastness is expected to elicit cognitive responses, such as small self and need for accommodation, to a high degree. Specifically, these experiences will be frequently described by participants in the qualitative data. In addition, the mean scores on the preliminary quantitative measures of small self and need for accommodation are expected to be significantly above the midpoint of their respective scales.

How Cognitive Responses Relate to Positive and Negative Experiences

In Hypothesis 4 it is predicted that some of the cognitive responses will account for why cosmic vastness relates to higher levels of both elevating experience and existential distress. Therefore, a preliminary examination of Hypothesis 4 was conducted by examining the correlations between the cognitive responses (i.e., small self and need for accommodation) and affective outcomes.

*Hypothesis 4***:** Cognitive response that are expected to be mediators in Study 2 (i.e., experience of small self and need for accommodation) are expected to positively correlate with both positive and negative experiences.

Comparing the Two Cosmic Vastness Experimental Videos

A final objective to Study 1 was to determine which of the two videos to use in Study 2. Overall, it was important to examine which video was more effective in the following five ways:

1. Which video is more effective at inducing elevating experience and existential distress (Hypothesis 1)? This was tested by comparing which of the two videos scored higher on preliminary quantitative items assessing the degree to which the video elicits elevating experience and existential distress.
2. Which video is more effective at producing greater variability in scores of elevating experience and existential distress (Hypothesis 2)? This was tested by using Levene's test for equality of variance.
3. Which video elicits more balanced proportions of people who experience more elevating experience or more existential distress? This was tested using a bipolar item which forced participants to choose between experiencing more elevating experience and more existential distress. This was also examined by creating four groups from the two separate items for elevating experience and existential distress, as described in Hypothesis 2a.
4. Which video is more effective at producing cognitive responses (e.g., experience of small self, need for accommodation) when facing cosmic vastness (Hypothesis 3)? This was tested by comparing which of the two videos scored higher on preliminary quantitative measures assessing the degree to which the video elicits each of these experiences.
5. Which video is more effective at eliciting the manipulation checks of perceived vastness and engagement in the video? This was tested by comparing which of the two videos scored higher on preliminary quantitative measures assessing these two

experiences.

Methods

Participants

One hundred and three undergraduate students at a Canadian University participated in the study in exchange for credits towards a first-year undergraduate class. Participants provided demographic and background information (see Appendix A for all questions). They were on average 18.92 years old (between 17 and 30, SD = 1.99) and 69% female. Participants identified as White (55%), Asian (12%), Indian (12%), Black (8%), Arab/Middle Eastern (8%), Filipino (1%), Jewish/Israeli (1%), or as mixed ethnicity (4%). A total of 41% of participants were in arts, social sciences, business or management related programs, 33% in health science related programs, and 26% in science, technology, engineering, or mathematics related programs. Participants were also asked about their religious or spiritual inclinations (they were informed it does not need to be their official affiliation). Participants were also asked to indicate their religious or spiritual inclinations from a large list of possibilities. Participants could select up to four. The most common choices selected (not below 1%) were Christianity (44%), "unsure where I stand on religion/spirituality" (21%), not religious or spiritual in any way (19%), Atheist (14%), Islam (13%), "Spirituality" (5%), Agnostic (4%), Buddhism (3%), Existentialism (2%), Sikhism (2%), and Judaism (2%).

Procedure

Participants signed up to the experiment by selecting it from a list of studies presented online to undergraduate students. The study was entitled "Feedback on a short video (LAB STUDY)". As shown in Appendix B, the recruitment text informed participants that they would come into the lab, watch a short video, and answer some questions. Both the title of the study

and the recruitment text intentionally excluded information about the content of the video to decrease selection bias to keep as much variability of potential participants as possible.

Up to two people participated at once to balance the efficiency of data collection, degree of potential distractions, and amount of privacy provided to allow more personal reactions to the video. Participants were seated at two different computers in the same room and a barrier was placed between them to provide them as much privacy as possible. Participants were randomly assigned to watch one of two videos depicting the vastness of the universe. Participants completing the experiment at the same time received the same video.

After participants read and provided informed consent (see consent form in Appendix C) a researcher provided a series of instructions (see full instructions to participants in Appendix D). The instructions informed participants that the video would have no sound, the video was factual and accurate, they would not be tested or quizzed about the information, and there would be no deception (i.e., the video is not for some other purpose). These instructions were provided to ensure that participants were as engaged in the video as possible and to minimize preoccupation with other concerns, such as wondering why there is no sound, memorizing facts, or questioning the purpose of the experiment.

Once the instructions were completed, the researcher ensured the environment of the lab was conducive to immersion and engagement in the videos by turning off bright ceiling lights and keeping dim lights in the room to provide some comfort. Once participants completed the videos, they were directed to a survey where they completed both open-ended (qualitative) and Likert-type (quantitative) questions described in the *measures and materials* section.

The study was approved by the research ethics board at the University of Ottawa and all participants provided informed consent and were debriefed about the purpose of the study after

they completed the experiment (see debriefing form in Appendix E).

Measures and Materials

Experimental Videos. As described earlier, participants were assigned to watch one of two videos (see link to watch videos in Appendix F). Both videos depicted the vastness of the universe by starting at a relatively small scale (i.e., human scale on earth) and progressively showing larger and larger scales of size and space. After each video reached a depiction of the observable universe, it zoomed back to near the start of the video, showing Earth and stating "you are here". The videos zoomed out at the original speed of the videos and zoomed back at a faster pace to reduce boredom due to repetition and to keep the video under 10 minutes long. Past research examining emotional reactions to videos, including cosmic vastness, have all used videos that are under 5 minutes long (Dai et al., 2022; Danvers & Shiota, 2017; Gordon et al., 2017; Hornsey et al., 2018; Jiang & Sedikides, 2022; Johnson et al., 2017; Johnson et al., 2019; Rivera et al., 2020; Stellar et al., 2018). Although the current video could have been modified to be close to five minutes, it was deemed more important to keep the content and pace of the videos close to their original design. In addition, the goal of these videos was to create an immersive experience that provided the participants time to process and reflect on their experience.

In contrast to past studies using videos depicting cosmic vastness that included uplifting music (e.g., Hornsey et al., 2018), ominous music (e.g., Gordon et al., 2017; Stellar et al., 2018;), or narrations of the content (e.g., Nelson-Coffey et al., 2019), both videos did not include sound. Although including sound would likely increase participants' engagement in the videos, it can be a significant confound because music has a significant impact on people's affective experience (e.g., Pilgrim, et al., 2017; Zentner et al., 2008) and can thus interfere with their own private

experience.

The first video used a video clip from a documentary called *Cosmic Voyage* (Silleck & Marvin, 1996). Throughout Study 1 this video is labeled Cosmic Voyage (CV). The video starts on the streets of Venice, Italy and slowly zooms out while displaying rings to demonstrate the space encompassed at every factor of 10 (each rings displayed is 10 times farther and wider than the previous ring), with text at the bottom of the video to indicate this and other notable information (e.g., "Our solar system," "The Milky Way, with 100 thousand million stars"). The video provides a journey through space which shows a view of earth, the milky way, superclusters of galaxies, and ultimately the edge of the observable universe. It then zooms back to a view of earth stating "You are here" to reorient the participant to how small Earth is relative to everything that was witnessed. Overall, the video is seven minutes and 11 seconds.

The second video used a video clip retrieved from a user from YouTube (morn1415, 2016). Throughout Study 1 this video will be labeled Star Size Comparison (SSC). This video depicted the vastness of the universe in a similar, but slightly different way. This video starts on a grassy field orienting toward a view of the moon in the sky. It zooms in towards the moon and the video changes to an incremental comparison of the size of moons, planets, and stars. Once reaching the largest object (a large sun), the video starts zooming out to show the scale of the universe by showing a vast number of stars, the size of the milky way, superclusters of galaxies, and ultimately the end of the observable universe. As with the first video, the video was edited so it reversed and went back to earth at an increased speed until it reached an image of Earth and stated "You are here". The video is seven minutes and 47 seconds in length.

Qualitative Questions. Participants were asked a series of open-ended qualitative questions about their experience watching the videos (see all questions in Appendix G). The

purpose of these questions was to acquire subjective accounts of participant's experiences to help inform quantitative measures in Study 2. These questions were also intended to capture unique experiences that were not expected or had not been captured by existing Likert scales in this study.

Immediately after watching the video, participants were asked a general question about their feelings, thoughts, and experiences. The question stated, "Please describe what feelings, thoughts, and experiences you had during or after the video. People can have very different and unique reactions. Feel free to describe everything you experienced." The question was worded in a broad and non-suggestive way to allow participants to express what first came to mind. They were also requested to provide 50 words to ensure they provided sufficient content for the qualitative analyses.

Participants were then asked a series of more specific questions about their affective experiences watching the video. This included questions about their positive emotions ("Did you experience any positive emotions or feelings during or after the video? If so, what emotions and feelings did you have?"), negative emotions ("Did you experience any negative or uncomfortable emotions or feelings during or after the video? If so, what emotions and feelings did you have?"), and whether their feelings changed during the video ("Was there a point during the video when your feelings changed? If so, please describe the moment in the video when that happened"). A question about spiritual, existential, or aesthetic experiences was also asked in order to elicit responses that described positive or negative existential experiences ("What spiritual, existential, or aesthetic experiences did you have during or after the video, if any?"). Finally, a question about physical sensations was asked because these experiences are closely associated with one's affective experiences (e.g., Fernández et al., 2012). The question stated "Did you experience any

physical sensations or changes during or after the video? If so, what physical sensations did you have? (e.g., faster/slower breathing, goosebumps, tension, chills, etc.)".

Quantitative Questions. Several single-item Likert-scale questions were used to represent key concepts (see questions in Appendix A). However, one multi-item measure was formed with several of the questions due to conceptual overlap of the items (i.e., need for accommodation). Single item measures were chosen to minimize the amount of time needed to answer these questions in order to allow enough time for participants to answer the qualitative open-ended questions, a predominant focus of the present study. Almost all quantitative questions were asked after the series of open-ended qualitative questions. The only exception was *positive affect* and *negative affect*, as they were asked directly after their corresponding qualitative question about positive or negative experiences.

Manipulation Checks. It was important to ensure that participants felt engaged with the video because the video used in the present study was longer than past studies and did not contain any sound. Engagement was measured using a single item ("Overall, how immersed and absorbed were you in the video?"). In addition, given that vastness is an inherent feature of the videos, it is important to confirm that participants perceived and experienced vastness when watching the video. A single item question ("How much did the video make you feel that you were experiencing or perceiving something vast?") was used to measure *perceived vastness.* Both of these items used a Likert scale from 1 (not at all) to 7 (extremely).

Affective Experiences. Participants were asked several questions about their affective experience watching the video. Participants were asked a single question for *positive affect* ("Overall, how positive was the experience for you?), *negative affect* ("Overall, how negative or uncomfortable was the experience for you?"), *elevating experience* ("Overall, how much did the

video make you feel elevated, inspired, and/or uplifted?"), and *existential distress* ("Overall, how much did the video make you feel diminished, insignificant, and/or undermined?"). As described in Hypothesis 1, elevating experience and existential distress is of particular interest in this study and an additional bipolar question was added to force participants to choose whether they felt more elevating experience or existential distress ("If you had to choose, where would you place yourself on the scale below between feeling diminished/insignificant/undermined and elevated/inspired/uplifted during or after the video?"). A Likert scale from 1 (extremely diminished/insignificant/undermined) to 8 (extremely elevated/inspired/uplifted) was selected to force participants to choose one side of the scale.

Cognitive Responses. Cognitive responses that were expected to be important and relevant when witnessing cosmic vastness were measured. It was expected that cosmic vastness would elicit an experience of *small self* and a single item was used (i.e., "How much did the video make you feel small?"). The video was also expected to elicit a *need for accommodation*. There were five distinct items used to measure a need for accommodation because the concept is less clearly defined in past literature and contains multiple elements (e.g., Keltner & Haidt, 2003; Sundararajan, 2002; Yaden et al., 2019). The five items included were, "How much did the video get you thinking?", "How much did the content of the video differ from the things you usually think about?", "How surprising was the information in the video for you?", "How much did you *try* to make sense of the content of the video?", and "How much were you *able to* make sense of the content of the video?" (reverse scored). Unfortunately, the items did not create an acceptable internal consistency as a multi-item scale (Cronbach's alpha = .51). Thus, both the composite and the individual items were examined in the analyses. All items used a Likert scale from 1 (not at all) to 7 (extremely).

Data Cleaning. For the quantitative questions, all variables were examined for univariate outliers and normality. There was one participant who did not complete all the questions but was included in analyses when data was available. For univariate outliers, recommendations by Tabachnick and Fidell (2007) were used when considering fairly large (i.e., greater than 100 people) and smaller sample sizes. Thus, a raw score with a z-score greater than the absolute value 3.29 was considered an outlier when examining the full sample (n = 103). When examining the z-scores for each video individually (n = 51 or n = 52) a raw score with a z-score greater than the absolute value of 2.58 was considered an outlier. Skewness and kurtosis were examined to assess the normality of each variable. A commonly recommended cut-off of +/- 2.0 (George & Mallery, 2019; Ryu, 2011) was used for each to indicate if variables violated normality.

Analyses were first conducted with all 103 participants (both conditions combined). None of the variables had univariate outliers or reached the cut-off for non-normality. Therefore, when analyses used the full sample (i.e., correlations) the original scores were used. Next, these analyses were conducted for each group individually (CV video and SSC video separately). There was a total of 12 z-scores (across all participants and variables) that exceeded the 2.58 z-score cut-off. Winsorization was used to adjust participants' scores to the next closest extreme score. The Winsorized scores were used in analyses that examined the groups independently.

Qualitative Results

Qualitative Analysis Procedure

The focus of the qualitative analyses in this study was to identify the most common and relevant experiences that were elicited by cosmic vastness. All 103 participants' responses were examined and the program QDA Miner was used to code and analyze the qualitative data.

Content analysis was used to analyze the qualitative data. Content analysis is a qualitative research method that involves subjective interpretation of text data with a systematic process of coding and identifying categories and themes (Hsieh & Shannon, 2005). Hsieh and Shannon (2005) described three types of content analyses that are used to interpret text data and a combination of directed content analysis and conventional content analysis were used. Directed content analysis involves using a structured approach where codes are defined before the analyses based on previous research and theory. In a directed approach, additional codes can be added if categories are discovered during the coding process that go beyond previous conceptions. In contrast, conventional content analysis involves avoiding preconceived categories and allowing the qualitative data to inform coders on the themes present in the data. This method is particularly helpful when there is a lack of research in the area. The approach used in the present study is more closely linked to a directed approach because both coders were familiar with past research and theory that made it impossible to not have some preconceived notion of the qualitative categories that would emerge. However, the intention of the qualitative analysis was to allow the data to inform the coders of the categories present (i.e., conventional content analysis), rather than strictly imposing preconceived notions, because there is limited empirical research on how people react specifically to cosmic vastness.

The procedure for the content analysis in present study involved the author of the thesis (Coder 1) examining the qualitative data in an exploratory way to become familiar with the responses and to understand the experiences being described. During the initial scanning of the responses a draft of initial codes was constructed. Coder 1 then combed the data a second time to refine themes and create an initial set of codes. Thus, codes were created during the examination of data, rather than creating a preconceived coding system beforehand. The supervisor of the

thesis (Coder 2) collaboratively discussed the codes with Coder 1 and both coders arrived at a consensus regarding higher order categories that provided a balance of parsimony and specificity. These higher order categories included experiences described in previous research and theory, as well as experiences that were not previously considered. Once the codes and the coding scheme were finalized, Coder 1 went through all the responses and coded each instance words or phrases appeared to represent categories. Coder 2 coded 30% (n = 31) of the data (i.e., participant IDs that ended in 0, 3, and 5) to determine inter-rater reliability using Cohen's Kappa coefficient. This is consistent with the minimum sample size recommended for computing interrater reliability (McHugh, 2012) and based on the recommendation from Bujang and Baharum (2017) for when considering a large number of categories to be coded, 80% power to achieve a significant Kappa, Kappa of .8, excluding a Kappa of .4 from the error bars around Kappa, and if the frequencies of different categories vary substantially. Cohen's Kappa coefficient was computed based on the presence or absence of a given code in a given case and then combining across all codes. The coefficient was .81 and is thus considered excellent (Landis & Koch, 1977).

The final categories and their coding guidelines are displayed in Appendix H. The context surrounding the coded words or phrases were not considered except when it was very clear the response did not relate to the *content* of the video (e.g., "I was *anxious* because I did not know what the video was going to be about" was not coded as *fear*) or did not represent that category (e.g., "I did not experience any *negative* emotions" was not coded as *general negative experiences*). A given category was still coded if the participant's description was conflicting (e.g., "I felt *insignificant*, but it was *calming*" was coded as both *existential distress* and *calmness*).

The percentage and number of participants that indicated a category in their responses was examined. The total frequency that a category was present within and across all participants was not considered because some participants were more verbose than others. Participants reporting the same experience multiple times were not considered to experiencing that category more intensely than someone who only mentioned it once. Therefore, the presence of a category, not the intensity or frequency within a participant, was considered.

Qualitative Categories

The qualitative categories are organized into five sections. They include *manipulation checks*, *positive experiences*, *negative experiences*, *mixed experiences,* and *cognitive responses*. The higher order categories were formed by grouping more specific subcategories together after the qualitative data was coded. The positive and negative experiences are each organized in a hierarchical way, as shown in Appendix H and Tables 1 and 2. *Mixed experiences* does not represent a specific category that was coded but illustrates how participants can experience both positive and negative experiences. Cognitive responses included several experiences that cannot be clearly categorized as positive or negative.

A description of the coding guidelines each category and how they were coded are displayed in Appendix H, examples of responses in each category are shown in Table 1, and percentages and frequencies of each theme are reported in Table 2. As shown in Table 2, there were no significant differences in percentages between the two videos. Thus, overall numbers are reported in the main text.

Manipulation Checks. Participants reported experiences that were expected to be fundamental and important to consider when determining the effectiveness of a cosmic vastness video for the present research, such as feeling engaged with the video and that they witnessed

Table 1

Examples in Each Qualitative Category in Study 1

Categories	Examples (Participant ID)
Manipulation Checks	
Engagement	Video 1 • "At first I thought the video was very **intriguing**; showing us the universe from a perspective we physically don't get to see it from." (18) • "I feel very **curious**. There is so much undiscovered territory that is beyond the capacity of our understanding that I can't help but wonder what's out there." (28) • "This video made me **feel like I was actually there**, almost like a ride. Having no distractions, I **was involved with everything** that was happening and I was **absorbing** the information and images I was seeing." (41) Video 2 • "During the video I felt **mesmerised**. I had no idea that the universe was that big, and that it contained many of the things that were shown in the video. **I couldn't look away from the screen** when the video started." (62) • "It is very **interesting** to me to think about how incredibly large the rest of the solar system, galaxy, and universe is compared to us and how we came to be in all of that." (67) • "I think this is very **fascinating** and believe we should explore the universe more to see what is out there." (69)
Perceived Vastness	Video 1 • "During the video, I felt very blown away **how big our universe and galaxy is**. It amazed me **how big space is**, it really opened my eyes to how much room there is that we can not explore" (14) • "I realized that I am a part of something **gigantic**." (33) • "The **sheer scale of it all** left me awestruck, scared and to a lesser extent, grief." (35) Video 2 • "During the video, I found myself feeling a lot of shock at **how large the universe really is**, and began to think quite heavily about my place in the universe, given **how large it really is**." **(57)** • "The **universe is so huge and complex** and it sparks curiosity within me." (60) • "During this video, I felt awestruck by **the magnitude of the galaxy**. It made me feel very small and insignificant because Earth is just a small portion of our Universe." (63)

All Positive Experiences	
Core Positive Affect	
Joy and associated experiences	Video 1 • "I felt a sense of **happiness**." (9) • "The amount of galaxies and planets that are yet to be explored and discovered **excites** me." (30) • "The universe is a big place -- it makes me **very happy** to know that **there is such beauty as the beauty** that can be found in space" (31) Video 2 • "It made me **happy** and **excited** and amazed." (52) • "[I felt] **Joy**, curiosity, **enjoyment**, relaxation, **happiness.**" (60) • It is really **beautiful** and to think there might be other planets parts of billions of other stars that are part of billions of other galaxy is something that gives me **hope** for extraterrestrial life. (79)
Calmness	Video 1 • "I felt really **lightweight** and **did not have any tension**." (5) • "It gave a realization that we are likely not alone in this universe, but that fact was **reassuring** and **calming**." (15) • "I felt **calmness** for the entire video. It was **peaceful** to watch." (45) Video 2 • "[The] feeling of the fleetingness of our existence makes one feel certain freedom to view life more simply and **light**." (88) • "I felt **serene** and **calm**, it was kind of **relaxing** in a sort of way and I felt my problems not being that big of a deal in the end." (89) • "I felt a positive feeling of **relief** during this video. **Relief** that I may not have to take myself so seriously because we are so small in such a big universe." (101)
Elevating experience	Video 1 • "There was also a feeling of **wonder** and **awe** at seeing just how big the universe is." (11) • "I just felt **spiritually uplifted**, and the video made me feel good." (29) • "I was in **awe** at the beauty of the milky way and what is beyond it. The clusters of stars are **jaw dropping**" (48) Video 2 • "My eyes were wide open the whole time and was in **awe** of it all. It made me happy and excited and **amazed**. I want to show it to people close to me to show just how **amazing** our universe is!" (52) • "I felt, **speechless** when watching the video. To think something so **amazing** and large and unknown is out there gave me chills." (62) • "I was **amazed**, I felt some kind of **admiration** for how gigantic the universe is." (97)

All Negative Experiences

Core Negative Affect

General Negative Experiences

Video 1

- "However as the video progressed and moved farther and farther away from earth I felt **uneasy.** The idea of knowing there is so much out there and how tiny we actually are is an **uncomfortable** thing to think about" (32)
- "It undeniably left me **physically and emotionally uncomfortable.**
- "I had an **uneasy** feeling as I went trough the video - more of a realization that so many things are occurring at once and it is important that we take the time to alleviate ourselves from the many distractions of everyday life." (41)

Video 2

- "I felt **overwhelmed.** I've always been told how big the universe is, but putting it in perspective like that, how our galaxy is basically a speck in the whole universe, and how we're a speck in our galaxy, was a little shocking, almost terrifying." (70)
- "When watching this video, I felt **uncomfortable** for one instance when the video showed all of the 100,000 galaxies including the milky way and said that it was full of stars which each had at least one planet…This is really cool to me but also made me a little bit **uncomfortable**, it's kind of **creepy** to think about." (75)
- "The feeling of being unique in the universe vanishes and puts your existence into perspective. Which to me is **unnerving**." (79)

Sadness

Video 1

- "The video invoked some **sad feelings**, I have a hard time grasping the insignificance of earth." (28)
- "It is **depressing**, knowing that in my lifetime I will not live to have answers to these questions, or in the grand scheme of things, anything I do will have zero effect on our surroundings." (35)
- "During the video I felt a sort of **sadness**, because the entire video put in perspective really how big the universe is and how insignificant our planet is." (38)

Video 2

- "The video made me feel **sad** in the sense that it made me really begin to question my place in the universe, given how small my planet is in comparison to everything else." (57)
- "The only negative emotion I experienced, was that it made me have this **sad feeling** of how us humans believe we run the world when in reality we do not even make up half of the universe." (69)
- "The feeling of insignificance is common [in these types of videos]. There is some sort of **sadness** that comes with it." (79)

Fear

Video 1

- "Space we know is also quite dark and empty and **scary** being unknown (but also cool)." (2)

	• "Acknowledging the true scale of the universe is something I have tried before, and it is something I actively avoid becoming too absorbed. It leaves me **anxious** and **stressed**." (35) • "As the camera took me further and further from Earth I grew increasingly **anxious**, with the hope that I would return seeming less and less palpable." (51) <u>Video 2</u> • "If there are so many different galaxies, with so many stars and planets, there is so much we do not know and that we cannot comprehend which is sort of **frightening**." (56) • "I felt **scared**, **nervous**, and **worried** about our planet and how small it is compared to the milky way" (83) • "It's surprising and **terrifying** how big this whole universe is and how small we are." (97)
Existential Distress	<u>Video 1</u> • "I felt a sense of **uselessness**, as in **it doesn't matter what we do** on this earth because there are probably thousands of other species more capable than us somewhere out there" (16) • "I guess I just can't fathom the idea that my life, which occupies 100% of my thoughts and feelings, is so **irrelevant** in the grand scheme of things. I also feel **insignificant** given that humankind doesn't have the capacity to even slightly explore or understand the full extents of our universe." (28) • "As the vast unknown consumed more of the screen and I watched the solar system fade away I began to feel **inconsequential** and **trivial** in regards to the universe, a slight **existential crisis** even" (51) <u>Video 2</u> • "I've seen a similar videos like that but I have this feeling that I am somehow **lost** every time" • "Yes, I felt like we were overwhelmingly **alone**" (70) • Watching this made me think how unsafe, small, and **worthless** (because of how tiny we are compared to other planets). (83) • "I just had a feeling of **inferiority** and **insignificance**." (92)
<u>Mixed Experiences</u>	<u>Video 1</u> • "My feelings changed from small and **irrelevant** to **amazed** and **in awe** when I was shown the cluster of galaxies." (22) • "During the video I felt a sort of **sadness**, because the entire video put in perspective really how big the universe is and how **insignificant** our planet is. Also how **insignificant** humans are. Also I found it **amazing** at the same time. Seeing how large the universe is and how much of it is undiscovered is so **incredible** to think about all the discoveries that are going to be made" (38) • "I had **positive and negative feelings**. There was a dialogue in my mind going from **stressed** (**existential crisis**) to being **relaxed** (my problems are insignificant)" (39)

	Video 2 • "It made me feel **sad**, in some ways, to see how small my planet and myself really are in the grand scheme of things and in other ways, i felt quite **impressed**, because it was **cool** to see how **wonderfully** large, and **amazing** our universe is when you break it down by size." (57) • "I sometimes feel slightly **discomforted** by the fact that the universe is so big, however that is normally overruled by my **interest** in the unlimited possibilities it holds." (64) • "My feelings went from being **calm** to feeling a bit **uneasy** when the video had shown images of the milky way being inside a bunch of other galaxies. I just had a feeling of **inferiority** and **insignificance**." **(**92)
Cognitive Responses	
Small Self	Video 1 • "During the video, I realized the fact that humans are truly just a **very tiny** part of the universe. This gave me the physical sensation of feeling **very small**. Additionally, I realized that humans, even though we are **very small** compared to the rest of the universe, have an impressive potential and capacity to produce creative and successful ideas." (19) • "Felt **incredibly small** obviously, but the thought has comforting. Day to day stress seems less significant. Also a little terrifying because my life ultimately means nothing, but more comforting than anything else." (21) • "It made me feel **small,** in a good way, as if my worries and concerns were irrelevant." (43) Video 2 • "It was just kind of cool to see the size differences between the planets, but once they became so large that the others compared to it were just a **speck**, it became terrifying **how small we really are**." (56) • "I was at a loss of words to **how small I really am** to the universe." (61) • "The video made me realise how **tiny** and insignificant I may be as a person compared to the big universe." (68)
Existential Contemplation *General Existential Contemplation*	Video 1 • **"How did we get here on Earth? How did this all start?"** (2) • "Existential crisis maybe considering **I questioned my existence**. Life seemed incredibly insignificant, but again is was kind of comforting" (21) • "With so much unknown, **it becomes easy to speculate about the true significance of the universe.** Does it just get bigger? What lies

	beyond? Is there extra-terrestrial life? How many earth-like planets are there? Is the observable universe as we know it (scale-wise) a mere atom in the grand scheme of things? Will humanity crumble before it can unlock the answers?" (38) <u>Video 2</u> • "The video made me feel sad in the sense that **it made me really begin to question my place in the universe**, given how small my planet is in comparison to everything else. **It also made me question if i, myself, have any purpose, and if, when I die, if my existence really matters in the grand old scheme of things**. Compared to the sun, I mean nothing. I will become nothing at the end." (57) • I felt a sense of purpose, a calm, **knowing that of all the billions and billions of possibilities, we have life.** It gives me a feeling of belonging, like **we may not be here for a reason** and that's ok, the universe will be fine without us. (70) • "It made me wonder what could be out there and made me **made me think of some existential questions like how all of this came to be**… **I thought about the meaning of life, religion and science**." (98)
Extraterrestrial Life Contemplation	<u>Video 1</u> • It made me wonder also that there must be a **possibility of another living planet.** (5) • It really **makes you ponder if we are really alone in this universe** (16). • Having a universe so big, so many galaxies, **it is naive to think we are the only ones here**. (45) <u>Video 2</u> • **There is no way we are the only planet with living organisms on it**, there has to be more out there (56) • I did **think about other life out there** because there **is no way that we, as humans, are the only ones living in this world.** (78) • I also felt that **there has to be life somewhere in the universe** with its sheer size (89)
Experience of the Unknown	<u>Video 1</u> • "There is so much **undiscovered territory** that is beyond the capacity of our understanding that I can't help but wonder what's out there." (28) • "Also I found it amazing at the same time. Seeing how large the universe is and how much of it is **undiscovered** is so incredible to think about all the discoveries that are going to be made. There are **so many unanswered questions or unknown questions** about the universe and I think its exciting that one possible those answers will be known." (38) • "I felt anxious, uneasy, uncomfortable, uncertain, and alone being pulled back from the streets of Venice into the expansive, **unknown** space." (51)

	Video 2 • "[I felt] scared, insignificant, **like we don't really know anything** about the universe, let alone our own planet." (56) • "I felt, speechless when watching the video. To think something so amazing and large and **unknown** is out there gave me chills." (62) • "I also felt fear as well as curiosity towards the **unknown knowledge**." (71)
Need for Accommodation	Video 1 • "To realise that we are just a speck **shocks** me the most." (16) • "**I attempted to wrap my head around** the larger perspective of life, and if there is even a meaning to it." (22) • "…it was **difficult to truly acknowledge and appreciate** the size of the universe. There is so much unseen, so much more to know that it is truly astounding and frightening; we are but a tiny insignificant speck in the blackness of space (35) Video 2 • "I was in awe. As I started seeing how big some of the planets were after our star I was **shocked.** And I kept on being **surprised** about how much there is out there and just the magnitude of it all. It was amazing" (52) • "I feel like we are such a small part of the universe and **it is almost incomprehensible** how insignificant we are." (56) • "When planets and stars just kept appearing larger **it was difficult to imagine quite the scope of the size**." (67)

Note. Words that are bolded represent category it was coded for. Examples selected are meant to be representative and diverse. All examples are from participants who gave permission to share examples from their data. Each participant was assigned an identification number from 1 to 103, where approximately half viewed Video 1 (Cosmic Voyage video; participants 1-51) and half represented Video 2 (Star Size Comparison video; participants 52-103).

Table 2

Percentage and Frequency of Qualitative Themes Discovered in Study 1

Qualitative Themes	All (N = 103) % (*f*)	CV video (*n* = 51) % (*f*)	SSC video (*n* = 52) % (*f*)	Comparison between proportions *z*
Manipulation checks				
Engagement	58% (60)	53% (27)	64% (33)	-1.08
Perceived vastness	70% (72)	65% (33)	75% (39)	-1.14
Positive Experiences	93% (96)	92% (47)	94% (49)	-.42
Positive Affect (PA)	80% (82)	77% (39)	83% (43)	-.78
Joy and associated experiences	68% (70)	63% (32)	73% (38)	-1.12
Calmness	33% (34)	35% (18)	31% (16)	.49
Elevating Experience (ELE)	58% (60)	51% (26)	65% (34)	-1.48
Negative Experiences	68% (70)	61% (31)	75% (39)	-1.55
Negative Affect (NA)	52% (53)	53% (27)	50% (26)	.30
General negative experiences	39% (40)	41% (21)	37% (19)	.48
Fear	18% (19)	18% (9)	19% (10)	-.21
Sadness	9% (9)	10% (5)	8% (4)	.38
Existential Distress (EXD)	46% (47)	39% (20)	52% (27)	-1.29
Mixed Experiences				
Positive and Negative Experience[a]	63% (65)	55% (28)	71% (37)	-1.71
PA and NA[b]	43% (44)	43% (22)	42% (22)	.09
ELE and EXD[c]	29% (29)	22% (11)	37% (18)	-1.67
Cognitive Responses				
Small Self	68% (70)	67% (34)	69% (36)	-.28
Existential Contemplation	64% (66)	59% (30)	69% (36)	-1.10
General Existential Contemplation	44% (45)	39% (20)	48% (25)	-.91
Extraterrestrial Life Contemplation	36% (37)	33% (17)	39% (20)	-.54
Experience of the Unknown	45% (46)	51% (26)	40% (21)	1.08
Need for Accommodation	34% (35)	28% (14)	42% (22)	1.58

Note. [a] This represents the percentage and number of people who reported at least one positive experience and one negative experience. [b] This represents the percentage and number of people who reported at least one PA and one NA. [c] This represents the percentage and number of people who reported at least one ELE and EXD.

something vast.

Engagement. Overall, most participants (58%) explicitly referred to feeling engaged in the videos despite their length and not having sound. This included experiences of engagement, attentiveness, interest, fascination, curiosity, immersion, and absorption in the video. Although many participants did not explicitly express feeling engaged, this may not have been an experience that came to mind when answering the questions. Quantitative analyses described later further tested whether the videos were engaging.

Perceived Vastness. Vastness is an inherent aspect of the content of the video and it was no surprise that participants often referenced witnessing vastness explicitly in their responses. Overall, 70% of participants referred to witnessing vastness while watching the video. This included directly describing experiencing vastness, describing the stars, galaxies, space, or the universe as vast, and referencing large numbers or concepts (e.g., the billions of…, infinite number of…, expanse of…).

Positive Experiences. Overall, the videos elicited some type of positive emotion in nearly all participants (93%). This supports Hypothesis 1a that cosmic vastness would elicit positive experiences. However, it is important to examine the types of affective experiences that were most common. Two major categories were discovered, including *positive affect* and *elevating experience*.

Positive Affect. Responses in this theme represented several associated experiences that are positive and pleasant. Two subcategories were created separated *calmness* from *joy and associated experiences.* These categories were separated due to the significant number of responses that reflected feelings of calmness, carefreeness, and other low-arousal terms that were qualitatively different from the more activating experiences of positive affect such as joy and

excitement. Together, 80% of participants reported positive affect.

Specifically, a total of 68% of participants expressed *joy and associated experiences*. This included descriptions of joy, excitement, and several other associated experiences such as pride, hope, optimism, aesthetic pleasure, and feeling impressed when watching the video. This category also included responses that represented a positive response but did not have a clear category (e.g., feeling positive but not specifying an emotion or feeling).

In addition, just approximately one third of the sample (33%) reported experiencing calmness or carefreeness. This included descriptions of calmness, low-arousal positive experiences that included feelings of calmness, comfort, carefreeness, and sense of negative feelings fading away from oneself.

Elevating Experience. Participants often referenced seemingly intense, expansive, and elevating emotions that appeared to go beyond positive affect. These experiences included feelings of awe, wonder, amazement, admiration, feeling "blown away" or speechless, empowered or enlightened, a sense of gratitude and appreciation for life, meaning and purpose, or connectedness to the surrounding world. Although many of these concepts can be considered to represent different experiences, these experiences have often been discussed together under a single label (Stellar et al., 2017; Yaden et al., 2017), such as elevating experience (Huta & Ryan, 2010). Over half of participants reported having one of these experiences (58%) and supports Hypothesis 1a that elevating experience are an important experience when witnessing cosmic vastness. However, in contrast to Hypothesis 1b, it appears that elevating experience were reported less often than positive affect.

Negative Experiences. Overall, approximately two thirds (68%) of participants expressed some type of negative experience during the video. This supports Hypothesis 1a that

cosmic vastness also elicits negative experiences. There were two major categories discovered, including *negative affect* and *existential distress*.

Negative Affect. Responses in this category represent several associated experiences that can be considered negative and unpleasant. Three subcategories were created that separate *general negative experiences, anxiety and fear*, and *sadness*. Overall, just over half of participants (52%) reported experiencing some form of negative affect.

Specifically, 39% of participants reported a general negative experience, making it the most common experience of negative affect to be reported. When examining the qualitative data, it became clear that participants often referenced negative or uncomfortable experiences without labeling a specific emotion. General negative experiences included descriptions of feeling negative, bad, uncomfortable, distressed, or overwhelmed, amongst other descriptors (see Appendix H).

In addition, under one fifth of the sample (18%) reported explicitly feeling anxious or fearful. This also included descriptions of feelings stressed, worried, nervous, scared, terrified, or frightened. The lower frequency may be due to participants using more vague and general descriptors (e.g., feeling uneasy or unsettled), as outlined in general negative experiences.

Furthermore, only 9% of people referenced experiencing sadness. This also included descriptions of depression and grief. The low frequency may also be a result of participants who using more vague descriptors (e.g., feeling bad, distraught, distressed) or referring to existential distress (e.g., loneliness, insignificance).

Existential Distress. Participants often referred to experiences related to existential distress. Participants primarily referred to feelings of insignificance (e.g., feeling irrelevant, inconsequential, unimportant, meaningless, that “we don’t matter”) and powerlessness (e.g.,

feeling useless, helpless, powerless, inferior), but also occasionally to feeling lost, alone, hopeless or experiencing an "existential crisis". Just under half of participants reported experience existential distress (46%). This is very close to the frequency of negative affect, suggesting that existential distress is an important experience to consider when examining cosmic vastness, as predicted in Hypothesis 1a and 1b.

Mixed Reactions. In the qualitative data, participants often expressed both positive and negative experiences. As described above, 93% of participants reported some type of positive experience and 68% of participants expressed having some type of negative experience. A total of 63% of participants reported a combination of both positive and negative experiences. When looking more closely at the difference between basic affect and existential experience, 43% of participants experienced a combination of positive affect and negative affect, whereas 29% of participants experience a combination of elevating experience and existential distress. These results demonstrate that there was also variability within participants and their experiences were not unilaterally pleasant or unpleasant. Table 1 provides some examples of responses that include both positive and negative experiences in the same answer.

Cognitive Responses. There were many experiences observed in the qualitative data that were not clearly valenced as either positive or negative. Overall, there were four cognitive responses themes noticed. These included experiences often described in past literature, such as *small self* and *need for accommodation.* Two experiences that were not previously considered before examining the qualitative data were also discovered. They included *existential contemplation* and *experience of the unknown*. Examples of all cognitive responses associated with both positive and negative experiences are provided (see Table 1 for examples) to demonstrate that these responses can be associated with both positive and negative experiences.

Small Self. As participants witnessed the vastness of the universe, they often described themselves as feeling small. The definition small self has been a topic of discussion in recent research because of different perspectives on what the "self" is (Perlin & Li, 2020; Tyson et al., 2021; Yaden et al., 2019). In the present study, participants predominantly described themselves as feeling smaller when witnessing the cosmic vastness, rather than feeling as though the were losing their sense of self. Specifically, participants often reported feeling the self as small (e.g., feeling small, miniscule, little, tiny) or small in comparison to something bigger (e.g., compared to stars, galaxies, space, universe, or bigger picture). Participants also often referred to the earth, solar system, or milky way as extremely small compared to the vast universe, and these experiences were also coded as representing small self. Overall, 68% of participants referred to an experience of small self, supporting Hypothesis 3 that this would be a common experience. In Table 1, there are also examples of small self making people feel positive (e.g., participant 43 feeling good), negative (e.g., participant 56 feeling terrified), and a mix of positive and negative (e.g., participant 21 feeling terrified and comforted). This suggests that small self can be experienced in various ways by different people.

Existential Contemplation. Participants often described contemplating existential issues. These responses were divided into two separate categories, *general existential contemplation* and *extraterrestrial life contemplation*. These were considered separate categories because contemplation about the existence of extraterrestrial life seemed specific to the context of cosmic vastness, whereas general existential contemplation refers to broader existential concerns that are present during other experiences that can be existential in nature (e.g., an irreversible choice, a medical diagnosis, confrontation with death; Yalom, 1980). Together, 64% of people experienced one of the two forms of existential contemplation.

A total of 44% of people reported engaging in *general existential contemplation*. This included contemplation about the meaning or purpose of one's own life, the meaning or purpose of some greater framework (e.g., humanity, the universe), one's beliefs about spirituality or the nature of reality, the nature of existence, mortality and the end of things (e.g., one's life, humanity, Earth), or one's philosophy or perspective of life. In Table 1, there are also examples of participants having positive experiences (e.g., participant 70 feeling elevating experience and calmness), negative experiences (e.g., participant 57 feeling sad and insignificant), and a mix of positive and negative experiences (e.g., participant 21 feeling insignificant and calmness) when engaging in existential contemplation. In addition, 36% of people engaged in *extraterrestrial life contemplation (e.g., "*It really makes you ponder if we are really alone in this universe).

Experience of the Unknown. Participants also often described a sense of venturing into the unknown and unfamiliar when watching the videos. This theme encompassed several types of responses. It included participants explicitly expressing experiences of the unknown, unfamiliar, unexplored, undiscovered, unseen, and the mysteries of the universe. Participants also referred to the amount that humans do not know, have not discovered, can not be reached, seen, or visited, and an infinite number of possibilities. Finally, this theme also included responses that expressed how much there is to learn and discover, given how much humans do not know. Overall, just under half of the participants (45%) reported experiencing the unknown, suggesting that this was a common experience. In Table 1, there are also examples of people describing positive experiences (e.g., participant 38 feeling amazed), negative experiences (e.g., participant 51 feeling anxious, uncomfortable, and alone), and a mix of positive and negative experiences (e.g., participant 71 feeling fear and curiosity) with the experience of the unknown.

Need for Accommodation. Some participants explicitly reported having difficulty

accommodating the information in the video. Participants referred to feeling confused or bewildered by the content of the video, having difficulty processing the content (e.g., difficulty acknowledging, appreciating, grasping, imagining, understanding, making sense of the content), feeling surprised and shocked at the content (e.g., feeling surprised, shocked, disbelief), and needing time to gather and process their own thoughts. Approximately one third (34%) of participants reported a need for accommodation. This partially supports Hypothesis 3 that a need for accommodation would be a common experience amongst participants. However, the lower frequency may be due to some of these experiences being difficult to describe and due to the qualitative questions being focused on feelings. In addition, several descriptions that could be considered related to need for accommodation were categorized as elevating experience (e.g., feeling speechless or blown away). In Table 1, there are also examples of participants describing positive experiences (e.g., participant 52 feeling awe and amazement), negative experiences (e.g., participant 56 feeling insignificant), and a mix of positive and negative experiences (e.g., participant 35 feeling astounded and frightened) when also reporting a need for accommodation.

Quantitative Results

Quantitative Analysis Strategy

One of the objectives of this study was to determine whether the videos elicit expected reactions, including positive and negative experiences (Hypothesis 1), and cognitive responses (Hypothesis 3). Exploratory one-sample t-tests were conducted to compare the observed mean to the midpoint of the scale for each variable (see Table 3).

Another main objective was to test Hypothesis 2a, which stated that there would be substantial proportions of people who experience predominantly elevating experience or predominantly existential distress, demonstrating variability in the degree that a cosmic vastness

video elicits elevating experience and existential distress across participants. The proportions of people who experienced elevating experience compared to existential distress was examined in two ways. First, a bipolar question forcing participants to choose between feeling existential distress or elevating experience (i.e., EXD vs. ELE) was used by separating participants at the midpoint of the scale. Second, a more detailed approach was used to examine the variability in scores of elevating experience (ELE) and existential distress (EXD). This approach examined different profiles of responses. Four groups were created: 1) High ELE/Low EXD; 2) High EXD/Low ELE; 3) High Both ELE/EXD; 4) Low Both ELE/EXD. A score of 4 or higher on either variable was considered high, whereas a score 3 or lower on either variable was considered low. Although a score of 4 is the midpoint of the scale, it was considered "high" because the mean for both ELE and EXD across all participants was below 4. Zero-order correlations were performed to preliminarily test whether cognitive responses related to both positive and negative reactions to cosmic vastness (Hypothesis 4). Results, indicated that both videos are very similar (see Comparisons of videos section below). Thus, both conditions were combined to create a sufficient sample size for these analyses.

Another main objective of this study was to determine which of the two videos is more suitable for Study 2. First, independent-samples t-tests were conducted to compare the two videos on all the variables measured. Second, Levene's Test for Equality of Variance was examined because it demonstrates whether there are differences in the variability of responses for a specific outcome (i.e., difference in variances) between the two conditions. This test helped demonstrate whether participants had more variable responses to one video compared to the other.

Presence of Positive and Negative Experiences

The means and standard deviations for each variable are reported in Table 3. Exploratory

one-sample t-tests were conducted to compare the observed mean to the midpoint of the scale for items assessing positive affect, negative affect, elevating experience, and existential distress. The average score of positive affect was significantly higher than the midpoint of the scale, whereas the average score of negative affect was significantly lower than the midpoint of the sale. This suggests that participants on average found the experience of watching the videos more positive than negative. However, in Hypothesis 1b it was also predicted that elevating experience and existential distress would be particularly relevant for a video depicting extreme vastness. Using one-sample t-tests, participants did not score significantly differently from the midpoint of the scale on elevating experience or existential distress. This may suggest that responses to questions related to elevating experience and existential distress were more balanced and potentially more polarizing. In addition, in support of Hypothesis 1b, existential distress ($M = 3.98$) appeared to score higher than negative affect ($M = 2.05$), suggesting that existential distress may be more relevant than negative affect when examining negative experiences in response to cosmic vastness. However, in contrast to Hypothesis 1b, elevating experience ($M = 3.86$) appeared to score lower than core positive affect ($M = 4.92$).

Variability in Scores of Elevating Experience and Existential Distress

When comparing people who indicated more elevating experience compared to more existential distress when using the bipolar item, an essentially even split occurred. A total of 51% of participants reported that they felt more elevating experience and 49% of participants reported that they felt more existential distress. The results were also essentially the same for both the CV video (52% vs. 48%) and the SSC video (50% vs. 50%). A histogram of the bipolar question

Table 3

Descriptive Statistics, Comparison of Means to Midpoint, and Comparisons Between Cosmic Vastness Videos in Study 1

	One-Sample t-Tests Comparing Means to Midpoint of Scales						Comparison of Videos		
	Both Videos Combined		Video 1: Cosmic Voyage (CV)		Video 2: Star Size Comparison (SSC)		t-Test for Equality of Means	Effect Size	Levene's Test for Equality of Variances
Variable	Mean (*SD*)	*t*	Mean (*SD*)	*t*	Mean (SD)	*t*	*t*	Cohen's d	*F*
Manipulation Checks									
Engagement	5.40 (1.46)	9.72***	5.08 (1.41)	5.41***	5.77 (1.29)	9.87***	-2.57*	-.51	.06
Perceived Vastness	5.72 (1.47)	11.77***	5.50 (1.43)	7.41***	6.00 (1.28)	11.24***	-1.56	-.37	.31
Affective Experiences									
Negative Affect	2.05 (1.22)	-16.18***	2.27 (1.28)	-9.61***	1.81 (1.09)	-13.83***	2.00*	.39	2.34
Positive Affect	4.92 (1.42)	6.60***	4.65 (1.34)	3.45**	5.19 (1.46)	5.91***	-1.98	-.39	.13
Existential Distress (EXD)	3.98 (2.02)	-.10	4.02 (1.97)	.07	3.94 (2.08)	-.20	.19	.04	1.42
Elevating Experience (ELE)	3.86 (1.86)	-.75	3.76 (1.90)	-.89	3.96 (1.83)	-.15	-.55	-.11	.49
EXD vs. ELE[b]	4.41 (1.84)	-.48	4.34 (1.87)	-.61	4.48 (1.83)	-.08	-.38	-.08	.00
Cognitive Responses									
Small Self	5.85 (1.64)	11.43***	5.94 (1.36)	10.08***	5.85 (1.72)	7.74***	.31	.06	5.09*
Need for Accommodation	4.48 (.96)	5.03***	4.14 (1.00)	1.02	4.80 (.81)	7.16***	-3.64***	-.72	5.20*
Degree of Thinking	5.45 (1.44)	10.18***	5.20 (1.50)	5.66***	5.75 (1.17)	10.64***	-2.06*	-.41	1.30
Content Different Than Usual	4.52 (1.76)	2.98**	4.22 (1.77)	.88	4.81 (1.73)	3.37**	-1.70	-.34	.00
Information Surprising	4.05 (1.91)	.26	3.46 (1.93)	-1.98	4.62 (1.73)	2.57*	-3.19**	-.63	1.24
Tried to Make Sense of Video	5.14 (1.64)	7.02***	4.96 (1.64)	4.14***	5.33 (1.58)	6.05***	-1.15	-.23	.02
Able to Make Sense of Video[a]	4.76 (1.45)	5.33***	5.10 (1.34)	5.79***	4.44 (1.49)	2.14*	2.34*	.46	.34

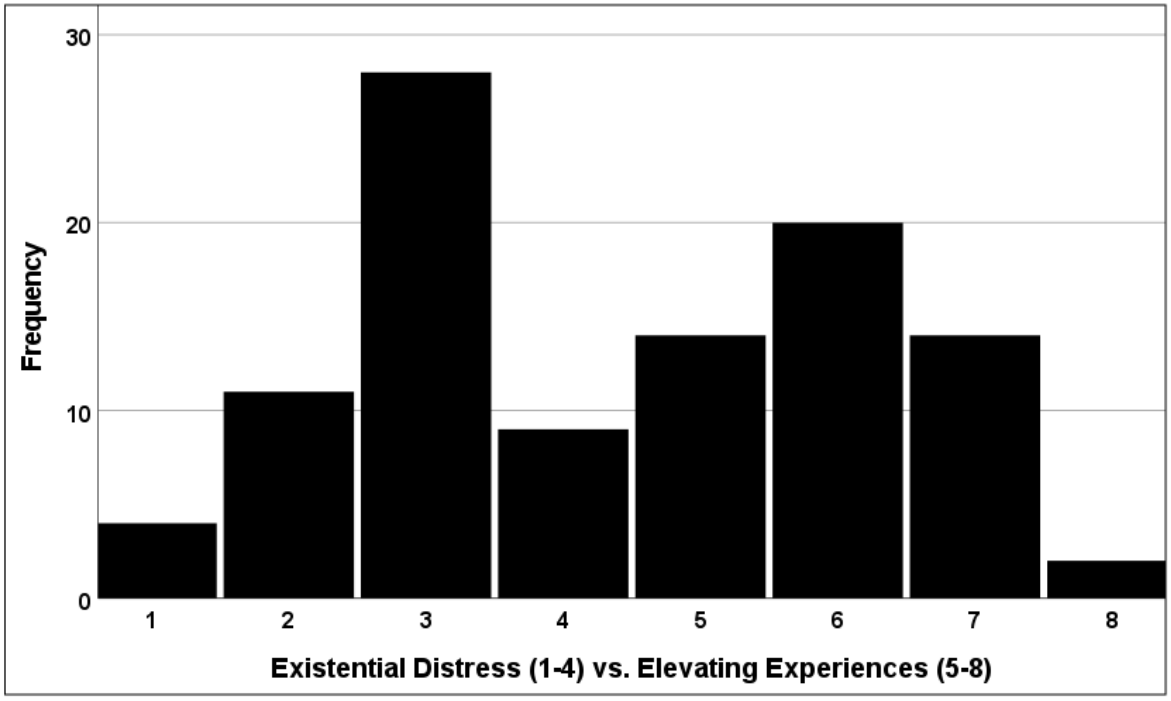
Note. [a]This item was reversed when calculating the Need for Accommodation composite. [b] The midpoint for EXD vs. ELE is 4.5 because it is a 1-8 Likert scale. The midpoint for all scales except EXD vs. ELE is 4. Higher scores on EXD vs. ELE indicate higher levels of ELE and lower levels of EXD. * $p < .05$, ** $p < .01$, *** $p < .001$

combining the two videos is also displayed in Figure 1 to visually present the balance in responses between elevating experience and existential distress.

However, elevating experience and existential distress may not be mutually exclusive because the correlation between the two unipolar items measuring these variables was not significant (r = -.15, p = .143). This indicated that it is worth examining these two concepts separately. As shown in Table 4, the results indicated that 30% of the total sample were high on elevating experience and low on existential distress, 29% of the sample were high on existential distress and low on elevating experience, 26% scored high on both, and 15% scored low on both.

Figure 1

A Histogram of The Bipolar Question



Note. This figure includes a histogram of the bipolar question forcing participants to choose between experiencing more existential distress or more elevating experience in Study 1. The Likert scale was labeled as follows: extremely (1), very (2), somewhat (3), slightly (4) diminished/insignificant/undermined (existential distress) and slightly (5), somewhat (6), very (7), extremely (8) elevated/inspired/uplifted (elevating experience).

These results were very similar for each video (see Table 4). As a result, participants appeared to score high on either elevating experience or existential distress equally as often. In addition, participants appeared to score high on at least one of these existential variables more often compared to scoring low on both of them. Overall, these results support Hypothesis 2a that people have variable and polarizing reactions to cosmic vastness when measuring experiences that are more existential, such as elevating experience and existential distress. These analyses were not conducted on positive affect and negative affect because it was clear that participants appeared to consider the experience watching the videos as more positive than negative.

Presence of Cognitive Responses and Manipulation Checks

In Hypothesis 3, it was predicted that the cognitive responses of small self and need for accommodation would be strongly elicited by cosmic vastness videos. As displayed in Table 3, the results indicated that participants experienced a significantly higher level of small self

Table 4

Frequency of Existential Distress and Elevating Experience Groups in Study 1

	All (N = 102) % (f)	CV video (n = 50) % (f)	SSC video (n = 52) % (f)	Comparison of proportion z-score
EXD vs. ELE split[a]				
Existential Distress (EXD)	51% (52)	52% (26)	50% (26)	0.20
Elevating Experience (ELE)	49% (50)	48% (24)	50% (26)	-0.20
Combinations of EXD and ELE[b]				
High ELE and Low EXD	29% (30)	28% (14)	31% (16)	-0.31
High EXD and Low ELE	30% (31)	30% (15)	31% (16)	-0.08
High Both	26% (26)	28% (14)	23% (12)	0.57
Low Both	15% (15)	14% (7)	15% (8)	-0.19

Note. [a] The EXD vs. ELE split is based on the bipolar item that forces participants to choose between experiencing more existential distress or more elevating experience. The item is on a 1-8 Likert scale. Those who scored between 1-4 reported more existential distress and participants who scored between 5-8 reported more elevating experience. [b] Participants were considered high on ELE or EXD if they score a 4 or higher (on a 1-7 Likert scale) and low on ELE or EXD if they scored a 3 or lower. Although 4 is technically the midpoint, it was chosen to represent "high" because the mean for both ELE and EXD was slightly below 4.

compared to the midpoint of the scale on both videos. For a need for accommodation, the composite, as well as most individual items, had significantly higher means for the SSC video and when both videos were combined. However, the CV video had inconsistent results, as the composite did not have a significantly higher score than the midpoint, but some individual items did. Both videos also had significantly higher levels of perceived vastness and engagement than the midpoint of the scale. The high levels of engagement suggest that a longer video (i.e., greater than 5 minutes) without sound can still be very engaging.

Correlations Between Cognitive Responses and Affective Reactions

The prediction in Hypothesis 4 that cognitive responses would relate to both positive and negative experiences was only partially supported. Small self was only significantly positively related to existential distress ($r = .60$, $p < .001$) and a need for accommodation composite only had a significant positive relationship with core positive affect ($r = .23$, $p = .020$). When examining the need for accommodations items more closely, the degree of thinking item was significantly positively related to positive affect ($r = .28$, $p = .004$), elevating experience ($r = .39$, $p < .001$), and existential distress ($r = .34$, $p < .001$). Therefore, there is some evidence that cognitive reactions relate positively to both elevating experience and existential distress and that it is worth examining further with more reliable multi-item measures.

Correlations Between Cognitive Responses

It is also worth noting that the need for accommodation composite did not significantly correlate with an experience of small self. In addition, only one of the five items intended to measure a need for accommodation (i.e., degree of thinking) related positively to small self and to a moderate degree ($r = .33$, $p < .001$). This suggests that these variables are likely distinct and are worth examining separately as potential mediators in Study 2.

Correlations Between Positive and Negative Experiences

Almost all the relationships between positive and negative experiences related to each other to a moderate degree in a valence congruent way. The only non-significant relationship was between elevating experience and existential distress (r = -.15, p = .114). This suggests that these two variables may not be mutually exclusive. As shown earlier, there appears to be a noteworthy number of participants who score high on both variables (see Table 4). Overall, these results provide preliminary support to Hypothesis 1b that basic affect and existential experiences are distinct and should be examined separately. See Table 5 for a full correlation table.

Comparison of Videos

As shown in Table 4, independent-samples t-tests demonstrated that the SSC video had significantly higher scores on engagement, the need for accommodation composite, and significantly lower scores on negative affect. When examining the items that created the need for accommodation composite, three of the five items suggested that the SSC video required more need for accommodation. However, there was no significant differences between the videos when examining perceived vastness, small self, positive affect, elevating experience, existential distress and the bipolar item. In addition, there were no significant differences in the proportions of qualitative categories reported, as displayed in Table 2.

Results from Levene's Test for Equality of Variance indicated that the CV video had greater variability in scores related to the need for accommodation composite. However, this was not reflected in any of the individual items for a need for accommodation. In contrast, the SSC video had greater variability in responses for experience of small self. Otherwise, there was no significant difference in variability between the two videos. To further compare the variability in responses to the videos, a closer examination of elevating experience and existential distress was

Table 5

Zero-Order Correlations in Study 1

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Manipulation Checks														
1. Perceived Vastness	-													
2. Engagement	**.55**	-												
Affective Experiences														
3. Negative Affect	-.01	-.07	-											
4. Positive Affect	**.25**	**.45**	**-.50**	-										
5. Existential Distress (EXD)	.18	.06	**.36**	**-.29**	-									
6. Elevating Experience (ELE)	**.35**	**.37**	**-.35**	**.47**	-.15	-								
7. EXD vs. ELE[a]	.11	.17	**-.35**	**.49**	**-.58**	**.73**	-							
Cognitive Responses		g												
8. Small Self	**.33**	**.24**	.19	-.03	**.60**	.01	**-.28**	-						
9. Need for Accommodation Composite	.14	**.29**	-.05	**.23**	.06	.02	.06	.10	-					
10. Degree of Thinking	**.56**	**.61**	-.03	**.28**	**.34**	**.39**	.07	**.33**	**.44**	-				
11. Content Different than Usual	-.11	-.02	-.11	.08	-.09	-.05	.10	-.14	**.61**	.04	-			
12. Information Surprising	.10	**.20**	-.06	**.24**	.02	-.06	.06	.04	**.80**	**.23**	**.48**	-		
13. Tried to make Sense of Video	.05	.10	.04	.08	-.04	.03	.08	.11	**.55**	**.20**	-.02	**.25**	-	
14. Able to Make Sense of Video	.13	-.02	-.04	.03	.03	.19	.15	.02	**-.48**	.10	-.15	**-.23**	.18	-

Note. [a]Higher scores on EXD vs. ELE suggest higher levels of ELE and lower levels of EXD. The p-value was below .05 when r = .20, below .01 when r = .26., and below .001 when r = .35. Bolded values indicate significance at $p < .05$.

conducted to determine if one of the videos produces more polarizing reactions. As shown in Table 4, both videos had near identical percentage of people who chose more existential distress or elevating experience with the bipolar question. In addition, there was no significant differences between the two videos in the proportion of participants in each group representing high/low elevating experience or existential distress.

Overall, these results indicated that both videos were successful at engaging the participant and eliciting perceived vastness, experience of small self, and need for accommodation. The videos also appeared to elicit a variety of responses related to elevating experience and existential distress. However, the SSC video had a slight advantage because it has significantly higher degree of engagement and there was some evidence to suggest that it elicited a higher need for accommodation.

Study 1 Discussion

There were several objectives in the present study. First, this study aimed to better understand the types of experiences elicited by witnessing the vastness of the universe. The qualitative data provided convincing evidence for Hypothesis 1a that cosmic vastness elicits both positive and negative reactions. Almost all participants reported experiencing some type of positive experience (93%), whereas approximately two thirds (68%) of the sample reported experiencing some type of negative experience. In addition to experiencing positive affect (80%) such as joy, excitement, calmness, and carefreeness, most participants also reported elevating experience (58%), such as awe, wonder, amazement, and connection to the bigger picture. At the same time, approximately half (52%) of participants reported negative affect (e.g., uneasiness, anxiety, fear, sadness) and almost half (46%) reported existential distress (e.g., insignificance, powerlessness, loneliness). This supports Hypothesis 1b that cosmic vastness has the capacity to

elicit existential experiences frequently, whether positive (elevating experience) or negative (existential distress). Furthermore, the majority of participants (63%) reported at least one positive experience and one negative experience, suggesting that there was within-participant variability in emotional responses and that participant experiences were often not unilaterally pleasant or unpleasant.

Another main objective was to assess whether there is evidence that cosmic vastness elicits polarizing reactions (Hypothesis 2a). When examining the quantitative data, participants reported that the videos were more positive than negative on average. This is consistent with past research demonstrating that a higher percentage of people report positive experiences compared to negative experiences when witnessing vastness (e.g., Gordon et al., 2017; Pelowski et al., 2019; Yaden et al., 2019). In retrospect, it is also possible that the wording of the questions for positive and negative affect impacted responses. The questions did not ask whether the *video made them feel,* but whether the *experience watching the video* was positive or negative. In addition, the question did not specify any particular feelings (e.g., sadness, anxiety, fear). However, when examining questions related to elevating experience and existential distress, there was much more balance and variability in how people responded. Overall, 29% of participants reported high levels of elevating experience and low levels of existential distress. An almost an identical 30% of participants reported high levels of existential distress and low levels of elevating experience. Meanwhile, 26% reported experiencing high levels of both elevating experience and existential distress. Furthermore, when participants were forced to choose which experience they had more of, there was a near identical split between existential distress and elevating experience. This further supports Hypothesis 1b that measuring existential experiences is important for capturing the polarizing effect of cosmic vastness. It also supports Hypothesis 2a

which predicted that there would be a substantial proportion of participants reporting elevating experience and existential distress.

Another main objective was to test Hypothesis 3, which predicted that cosmic vastness would elicit cognitive responses that may also account for the polarizing experiences. Both the qualitative and quantitative data supported the prediction that cosmic vastness would elicit experiences of small self and need for accommodation. In addition, small self predominantly involved participants feeling metaphorically smaller, which was an important consideration for the multi-item measure in Study 2. In addition, the qualitative data revealed the presence of two novel experiences that was not previously considered: *existential contemplation* and the *experience of the unknown*. Thus, these experiences these experiences may also account for why cosmic vastness elicits polarizing reactions. Therefore, existential contemplation and experience of the unknown were examined further in Study 2.

Study 1 also consisted of some preliminary analyses to test if the experience of small self and need for accommodation related to both positive and negative experiences, thus accounting for some of the polarizing experiences. The qualitative data provided some anecdotal examples of all the cognitive responses being associated with both positive and negative reactions (see Table 1). However, these examples must be taken with caution and cannot be applied to the whole sample. Results from zero-order correlations were mixed, as the experience of small self related to more existential distress, whereas only one of the items measuring a need for accommodation (i.e., degree of thinking) related to higher levels of positive affect, elevating experience, and existential distress. This provides some preliminary evidence that these variables may account for some of the polarizing responses to cosmic vastness. Therefore, more reliable multi-item measures were selected for Study 2 that assessed all cognitive responses discovered in

the qualitative data.

Finally, another important aspect of Study 1 was to determine which video depicting cosmic vastness would be a better choice for Study 2. Both quantitative and qualitative data indicated that both videos successfully engaged the participants and elicited elevating experience, existential distress, and the expected cognitive responses. Both videos also elicited substantial variability in elevating experience and existential distress. Perhaps the most important aspect of this finding is that two different videos trying to depict the same concept (cosmic vastness) elicited similar responses, providing evidence that it was the vastness of universe that elicited these experiences and not a unique characteristic of a specific video. Although both videos were effective, the Star Size Comparison video (Video 2) appeared to have a slight advantage because the quantitative data suggested it was more engaging and had higher scores on items intended to measure a need for accommodation. Having a video that evokes higher levels of engagement will ensure that people are more immersed in the video, which allows them to consider the content of the video and their own experience watching the video more meaningfully. In addition, a video that is more difficult to accommodate suggests it will likely do a better job at challenging people's previous conceptions or typically mode of thinking in some way, thus making the experience potentially more intense and polarizing across participants.

Study 2

The purpose of Study 2 was to conduct a quantitative experimental study that examined all three main research questions. This included examining how people reacted to cosmic vastness, what aspects of cosmic vastness (i.e., mediators) elicited both elevating experience and existential distress, and what individual characteristics (i.e., moderators) caused people to react differently (i.e., with more elevating experience or more existential distress) to cosmic vastness.

In addition, all variables of interest were assessed using multi-item measures, rather than the predominantly single-item measures used in Study 1. The only exceptions were single-item measures of how engaged participants were when watching the videos. Multi-item measures were retrieved from the literature when available and adequate. When adequate measures were not available, multi-items measures were created and the psychometric properties of these scales are described in the methods section.

To test the hypotheses presented below, a cosmic vastness video was compared to two other videos (a neutral control video and an Earth nature vastness video). The purpose of the neutral control video was to have an engaging control video that did not elicit strong levels of either positive or negative experiences. This video also made it possible to create a dichotomous variable (i.e., cosmic vastness video vs. neutral control video), which was needed in the mediation and moderation analyses. The purpose of the Earth nature vastness video was to match some of the qualities of the cosmic vastness video that elicit high levels of elevating experience, but to a lesser degree with regard to existential distress. The inclusion of this video made it possible to study what was unique about cosmic vastness because Earth nature vastness videos similar to the one used in the present study (i.e., video footage from *Planet Earth* documentary series that depicted vast non-threatening nature) was found to successfully evoke high levels elevating experience in past research (e.g., Bai et al., 2017; Piff et al., 2015; Rivera et al., 2020), even though it is not as theoretically or conceptually vast as a cosmic vastness video. Specifically, an Earth nature vastness video was expected to evoke perceived vastness and elicit experiences of the predicted mediators (i.e., small self, need for accommodation, existential contemplation, and experience of the unknown) to a degree that is conducive to elevating experience. However, it was predicted that the Earth nature vastness video would not elicit

existential distress to the same degree as a cosmic vastness video, which was expected to reach a degree of vastness that could be overwhelming, destabilizing, and result in higher levels of existential distress. In other words, comparing a cosmic vastness video to an Earth nature vastness video allowed me to determine whether cosmic vastness produces experiences that are not only elevating, but also leads to existential distress above and beyond what people may experience from facing the vastness of nature on Earth. Throughout the remainder of the thesis, the three videos will be referred to as the *cosmic vastness condition*, *Earth nature vastness condition*, and *neutral control condition*.

Objectives

Examining the Distinctiveness of Experiences Elicited by Cosmic Vastness

In order to test all the research questions, it was important to determine whether there was a distinction between existential experiences and commonly measured aspects of positive and negative affect. Thus, one objective of the present study was to use exploratory factor analyses to assess whether elevating experience is distinct from positive affect and if existential distress is distinct from negative affect.

Likewise, it was important to determine if the cognitive responses examined (i.e., small self, need for accommodation, existential contemplation, experience of unknown) were distinct from each other because many of these concepts have been theoretically or empirically associated to each other (e.g., the experience of awe involves need for accommodation and the experience of small self; e.g., Keltner & Haidt, 2003; Yaden et al., 2019), have not previously been examined in relation to vastness (i.e., existential contemplation and experience of the unknown), or have some conceptual overlap with each other (e.g., need for accommodation and experience of the unknown both involve considering something beyond previous understanding

or knowledge). Exploratory factor analyses provided information about whether it was reasonable to examine these experiences separately as mediators between cosmic vastness and both elevating experience and existential distress, and provided some evidence that there was not excessive multi-collinearity in the parallel multiple mediation analyses that were conducted.

Examining the Presence of Positive and Negative Experiences

Study 2 examined the prediction in Hypothesis 1 that cosmic vastness would elicit both positive and negative experiences using multi-item measures. Thus, Hypothesis 1 was broken down into two hypotheses.

> *Hypothesis 1a*: Cosmic vastness will elicit both positive (positive affect and elevating experience) and negative (negative affect and existential distress) experiences. Specifically, the cosmic vastness condition will elicit higher levels of positive affect, negative affect, elevating experience, and existential distress than the neutral control condition.
>
> *Hypothesis 1b*: Cosmic vastness will elicit elevating experience and existential distress to a strong degree because these experiences are particularly relevant when witnessing cosmic vastness. This will be tested by comparing the cosmic vastness condition to the Earth nature vastness condition because past theory and research indicate that Earth nature vastness elicits high levels of elevating experience and may elicit some existential distress (e.g., Gordon et al., 2017; Pelowski et al., 2019; Rivera et al., 2020). Therefore, the cosmic vastness condition is expected to elicit similar levels of elevating experience and higher levels of existential distress than the Earth nature vastness condition.

Examining if Cosmic Vastness Elicits Polarizing Experiences

Study 2 also examined the prediction in Hypothesis 2 that cosmic vastness would elicit

substantial polarization in scores of elevating experience and existential distress across participants. Hypothesis 2 was broken down into two hypotheses for Study 2. Hypothesis 2a is identical to Hypothesis 2a in Study 1 and Hypothesis 2b is unique to Study 2 because the variability in scores could now be compared across the videos.

Hypothesis 2a: There will be a substantial proportion of people who experience more elevating experience and more existential distress. This will be observed when participants answer a bipolar question that forces them to report which of the two existential experiences they had most. Specifically, the distribution of this item for the cosmic vastness condition is expected to be uniform or bimodal, rather than unimodal for the neutral control condition (most participants in the middle representing neither elevating experience nor existential distress) and the Earth nature condition (most participants scoring towards higher elevating experience). This will also be observed when examining two independent measures of elevating experience and existential distress. Specifically, there will be substantial proportions of participants who score high on either elevating experience or existential distress and low on the other experience when separating participants into four groups using the midpoint of the scale (i.e., four groups representing combinations of high and low levels of elevating experience and existential distress).

Hypothesis 2b: There will be significantly more polarization in the scores of elevating experience and existential distress in the cosmic vastness condition compared to the neutral control and the Earth nature vastness conditions. This is expected to occur because of the degree of vastness and existential themes present in the cosmic vastness condition, which are expected to elicit stronger emotional reactions. Since cosmic

vastness is expected to elicit polarizing reactions, the variability in both elevating experience and existential distress is expected to be larger than the other two conditions.

Examining the Presence of Cognitive Responses

Study 1 provided more clarity about what types of cognitive responses are elicited by cosmic vastness. Cosmic vastness elicited responses that were expected (i.e., small self and need for accommodation) and two new cognitive responses that were not previously considered (existential contemplation and experience of the unknown). Therefore, Hypothesis 3 was updated to include these two new experiences.

Hypothesis 3: Cosmic vastness will elicit cognitive responses, including small self, need for accommodation, existential contemplation, and experience of the unknown, to a high degree. Specifically, the cosmic vastness condition will elicit all these responses to a higher degree compared to both the neutral control and Earth nature vastness conditions.

Examining the Mediators Between Cosmic Vastness and Existential Experiences

Study 1 provided more clarity as to which cognitive responses could be potential mediators between facing cosmic vastness and both elevating experience and existential distress. The results included two new experiences. Therefore, in addition to need for accommodation and small sell, Study 2 examined two new mediators that resulted from Study 1, existential contemplation and experience of the unknown. A rational is provided here regarding why existential contemplation and experience of the unknown are expected to result in polarizing reactions (rationales for small self and need for accommodation are provided in the general introduction).

Existential Contemplation. When people confront existential themes and fundamental facts about human existence (i.e., the “ultimate concerns” or “givens of existence”; Yalom,

1980) such as death (e.g., terminal diagnosis, death of loved one), limitations in life (e.g., due to a medical condition, socioeconomic status), an irreversible choice (e.g., choosing between two job offers), or considering one's own role in the grand scheme of things (e.g., when considering the vastness of the universe), they can experience many existential thoughts or questions. For example, people will ask themselves what the meaning of life is, the purpose of their own life and what role they play, contemplate why they exist and whether there is an explanation for everything, and wonder what they should live for and how they should live (Yalom, 1980). The process of reflecting on and engaging with the fundamental concerns of human existence (i.e., existential concerns) will be referred to as *existential contemplation,* which has also been labeled as existential thinking (Allan & Shearer, 2012) or critical existential thinking (King & DeCicco, 2009) in the literature.

It was expected that experiencing cosmic vastness would evoke a high degree of existential contemplation because of the existential nature of the vastness of the universe. Cosmic vastness puts one's life in perspective when considering the grand scheme of things, encouraging people to think about their role, meaning, and purpose in life (Kahane, 2014; Nagel, 1971; Proulx & Inzlicht, 2012). It also evokes questions about how things came to be and whether there is an explanation to everything (e.g., How did the universe or life come to be? Is there a God?). Overall, encountering vastness and a larger framework raises questions about one's own role and anything's role within that framework, including the role of the framework itself (Bonner & Friedman, 2011).

Existential contemplation was expected to lead to more elevating experience because it puts people in touch with grand concepts, pulling them temporarily beyond their usual boundaries. Getting in touch with the bigger picture and what is meaningful in life can be

extremely uplifting and inspiring, especially if it connects people with their values (Jiang and Sedikides, 2022) when one has lost sight of these fundamental concerns with the seemingly ordinary, mundane, or even absurd routines of life (Nagel, 1971).

At the same time, existential contemplation was also expected to lead to existential distress because it raises fundamental questions that are difficult to answer and thus risks raising a sense of uncertainty. Existential issues can be experienced as a threat and evoke experiences of existential distress (Lambert et al., 2014; Juhl & Routledge, 2016; van Bruggen et al., 2017) because they can bring into question some of the meaning systems people develop (e.g., that humans or Earth is special or central in the grand scheme of things) and illuminate some of the unfortunate realities and limitations of life and human existence (e.g., death due to the vulnerability and fragility of Earth, isolation from the rest of the universe, personal and human limitations based on current circumstances; Koole, et al., 2006; Yalom, 1980).

Experience of the Unknown. In Study 1, participants often described feeling an *experience of the unknown* when watching the cosmic vastness videos. This reflects witnessing, experiencing, or becoming aware of something that feels unknown, unfamiliar, or mysterious. The experience of the unknown has some conceptual overlap with a need for accommodation because both concepts involve becoming aware of something that may not have previously been known or understood. However, it may not be challenging for an individual to process and incorporate the experience of the unknown into their understanding of the world. For example, a participant may experience a sense of mystery about whether there is other life in the universe, but the idea that other life may exist does not challenge their worldview and thus does not need accommodation. In contrast, a need for accommodation refers to having difficulty understanding or processing something that may not be mysterious. For example, a participant already be aware

that the universe is enormously vast, but still have a hard time embracing this vastness when they witness it.

Cosmic vastness is expected to evoke the experience of the unknown because the video takes the viewer far away from everyday experience and shows places that cannot be visited or experienced first-hand. This video is a reminder that much of the universe is unknowable even if the scientific method has, and continues to make, significant of progress. Qualitative research on experiences related to awe found that vastness often elicits a sense of mystery and uncertainty (Bonner & Friedman, 2011). The relationship between the vastness of the universe and experience of the unknown was described eloquently by Albert Einstein, “One cannot help but be in awe when he contemplates the mysteries of eternity, of life, of the marvelous structure of reality. It is enough if one tries merely to comprehend a little of this mystery every day" (statement to William Miller, as quoted in Einstein’s obituary in Life magazine, May 2, 1955).

Experiencing the unknown was expected to lead to elevating experience because it ultimately raises questions, stimulates curiosity, and invokes a sense of wonder that provides an invigorating invitation to explore and understand more (Bonner & Friedmann; Gallagher et al., 2015; Weger & Wagemann 2018). This can trigger a sense of adventure and imagination beyond everyday experience that feels uplifting and inspiring. In addition, when imagining things beyond our current knowledge or understanding, it allows people to venture into possibilities that feel grander than the self, whether in terms of knowledge and theory, spirituality, or through admiration of how the natural world is or may be.

Experiencing the unknown was also expected to lead to existential distress because it pulls people out of their comfort zone and makes people think about existence beyond their current understanding. People have an inherent desire to understand *what* they are seeing and

why it exists (e.g., Proulx and Inzlicht, 2012) and a general need to know and feel certain (Heine et al., 2006; Kruglanski and Webster, 1996). Being aware of what they do not know can be threatening to their self-efficacy about being able to make sense of the world. Furthermore, exposure to something whose parameters are not known can make people feel insecure because they don't know the degree of danger involved, whether that danger is physical, psychological, or existential. Cosmic vastness brings forward the existential reality that people live in a world and universe that will likely be impossible to be fully understood. The fact that the universe and its size cannot be fully understood is at odds with the human need to understand, leading to a feeling of lack of control and powerlessness.

Taken together, an objective of Study 2 was to determine if the cognitive responses relate to both elevating experience and existential distress, small self, need for accommodation, existential contemplation, and experience of the unknown were all examined as potential mediators. Therefore Hypothesis 4 was updated, as described below.

> *Hypothesis 4:* Small self, need for accommodation, existential contemplation, and the experience of the unknown are expected to positively mediate the relationship between cosmic vastness (i.e., cosmic vastness condition vs. neutral control condition) and both elevating experience and existential distress.

Examining the Moderators That Impact How People React to Cosmic Vastness

Another main objective to the present research was to understand why people have different reactions to cosmic vastness. There are several individual traits that were expected to moderate the relationship between witnessing cosmic vastness and elevating experience or existential distress. These moderators are listed in Hypothesis 5 and rationales for each of these was provided in the general introduction.

Hypothesis 5: The relationship between witnessing cosmic vastness (i.e., cosmic vastness video vs. neutral control video) will vary across levels of five moderators, including self-esteem, humility, intellective processing style, big picture thinking, and meaning in life. Specifically, at high levels of each of these moderators, the relationship between witnessing cosmic vastness and elevating experiences will be significantly positive, whereas at low levels of each moderator the relationship will be non-significant. In contrast, at low levels of each of the moderators, the relation between witnessing cosmic vastness and existential distress will be significantly positive, whereas at high levels of each moderator the relationship will be non-significant.

Methods

Participants

Participants in this study consisted of 619 undergraduate students at a Canadian University. Participants were screened for invalid data prior to the final sample size of 619 (see data cleaning at the end of the methods section). The average age was 19.6 years (*SD* = 3.94) and 77% identified as female, 23% identified as male, and less than 1% did not identify as male or female (e.g., gender fluid, non-binary). In terms of ethnic background, the sample was 50% White, 12% Middle Eastern and North African, 11% East Asian, 9% Black, 8% East Indian, 3% Hispanic, <1% Indigenous, and 8% mixed or other. A total of 43% of participants were in arts, social science, and business or management related programs; 31% were in science, technology, engineering, or mathematics related programs; and 26% were in health science related programs. Participants were also asked to indicate up to four religious or spiritual inclinations from a large list of possibilities (see Appendix A for more details). The most common choices selected (not below 1%) were Christianity (38%), “unsure where I stand on religion/spirituality” (21%), not

religious or spiritual in any way (16%), Islam (14%), Agnostic (12%), Atheist (12%), "Spirituality" (7%), Buddhism (4%), Hinduism (3%), Existentialism (2%), Occult and Magic (2%), and Paganism (2%).

Sample Size Rationale

This sample size was determined by considering an adequate sample for several of the analyses being conducted. It is important to note that both the mediation and moderation analyses use only two thirds of the sample (i.e., cosmic vastness condition vs. neutral control condition was the independent variable), which was 413 participants. First, a large sample size is recommended for multiple mediation models that attempt to detect small effect sizes. For example, Fritz & Mackinnon (2007) recommend a sample size of approximately 400 people when the effect between the mediator and the outcome has a small effect size. Ma and Zeng (2014) also found through multiple Monte Carlo simulations that there was only sufficient power (i.e., .80 or above) for small indirect effects if sample sizes were 500, but not 100 or 200. The present study was expected to include several indirect effects with small effect sizes, especially since the relationship between any of the mediators and the outcome controls for the three other mediators being measured. This may reduce the size of the relationship for each mediator. Thus at least 200 participants per group (i.e., sample of 400 for mediation analyses) provided adequate power to test of multiple mediation models.

Second, the power to detect moderating effects (i.e., interaction effects) in moderated multiple regressions are often low because they must account for the main effects of both the independent and moderating variables (Aguinis et al., 2005; Shieh, 2009). In addition, interaction effects including categorical variables (i.e., dichotomous variable such as cosmic vastness vs. neutral control condition) can have very small effect sizes, which would require larger sample

sizes to detect them. For example, Aguinis and colleagues (2005) calculated that subgroups of 158 would be required to detect a small effect size. Therefore, in conjunction with the recommendations of the other analyses described above, 200 participants per group appears to be an adequate sample size to detect a meaningful moderating effect.

Finally, exploratory factor analyses traditionally recommends at least 10 cases per item and 500 people or more when possible (minimum of 300, Comfrey and Lee, 1992). Even larger sample sizes with large participant to item ratios (e.g., 20 to 1) are recommended to get more reliable results (Costello and Osborne, 2005). In addition, a large sample size was desired to detect nuanced but meaningful differences between variables (i.e., the difference between existential distress and negative affect). Exploratory factor analyses conducted in the present study used participants who watched all three videos (i.e., 619 participants). Thus, the exploratory factor analyses that used the highest number of items (31 items for negative experiences) had almost a 20 to 1 ratio of participants to items.

Procedure

Like in Study 1, participants signed up for the experiment by selecting it from a list of studies presented to undergraduate students online. The study was entitled "Experience Watching a Short Video" and was conducted online rather than in lab. The recruitment text (see Appendix B) informed participants that they would watch a short video online and answer questions about their experiences watching a video and about their personality. Consistent with Study 1, both the title of the study and the recruitment text intentionally excluded information about the content of the video to avoid self-selection bias and to not limit participant variability. The online posting also asked participants to complete the study from a desktop computer, laptop, or another device with a screen of a similar size. Participants were also reminded of this after they read the consent

form (see Appendix C) and consented to participate in the study.

Before participants were presented with the video, they first received a series of instructions (see Appendix J). In brief, participants were informed that the video has no sound, does not contain any mature content (i.e., can be watched by someone of any age), is factual and accurate, and that they will not be tested or quizzed about the information. These instructions were provided to ensure that participants were as engaged in the video as possible and were not preoccupied with other concerns. Further instructions were inspired by Irvin Yalom's (1980, p. 8) suggestion to create conditions that facilitate reflection and awareness of existential concerns and experiences, which was an important consideration for the present study. He stated that existential experiences are more likely to occur if there is solitude, silence, time, and freedom from everyday distractions. To attempt to meet these conditions, participants watched a video that provided sufficient time to process the information (videos that are approximately eight minutes long) and did not have sound in the video (to facilitate silence). Participants were also encouraged to watch the video in a private room (i.e., encourage solitude), to silence their electronic devices, and wear headphones to reduce distracting sounds in their environment (i.e., encouraging freedom from everyday distractions). A series of questions were asked at the end of the survey to see how well participants were able to meet these conditions (see Appendix I). Participants were not removed from the analyses for not meeting these conditions given potential limitations of their living conditions, but participants predominantly watched the video in silence (93%), in a private space (92%), and with no distractions (87%).

Participants were randomly assigned to watch one of three videos, which included a cosmic vastness video (207 participants), an Earth nature vastness video (206 participants), and a neutral control video (206 participants). See Appendix F for a link to the videos. Measures of the

manipulation checks, affective outcomes, and mediators were always administered directly after the video because they were the most reactive and sensitive to the video. The questions about moderators were randomly presented either before the video or after the video near the end of the study (i.e., after questions about manipulation checks, affective outcomes, and mediators). This was to counterbalance priming effects that can occur in either direction, whether answering questions about the moderators impacts reactions to the video, or whether the videos influence answers to the moderator scales. Questions about demographics and background information were presented last. When participants were finished, they were presented with a debriefing form about the purpose of the study (see Appendix E). The study was approved by the research ethics board at the University of Ottawa and all participants provided informed consent and were debriefed about the purpose of the study after they completed the experiment (see debriefing form in Appendix E).

Measures and Materials

Videos. Links to all three videos are provided in Appendix F. All videos were approximately eight minutes long and had no sound to remove a potential confound that could influence participants reactions. One video was the experimental *cosmic vastness* video. This video was the star size comparison video (Video 2) from Study 1 with a few minor changes based on feedback from participants. A new caption was created to replace a previous caption that described the Andromeda galaxy colliding with the Milky way in the distant future (4.5 billion years from now), as some participants reported anxiety about this. The new caption described the Andromeda galaxy as the closest major spiral galaxy. The end of the video, when the sizes of celestial bodies were displayed (e.g., planets and suns), was made slightly faster because some participants expressed that it was too slow and repetitive with the beginning of the

video. Finally, the video reversed all the way back to the beginning because the previous ending of the video was too abrupt. Please see Video 2 of Study 1 for a more detailed description of the video.

A second video was an *Earth nature vastness* video. The Earth nature vastness video included a compilation of video clips from the video documentary series *Planet Earth.* Past research that used Earth nature vastness videos frequently used clips from Planet Earth to evoke elevating experience (e.g., Bai et al., 2017; Piff et al., 2015; Rivera et al., 2020). The Earth nature vastness video contained eight minutes of clips that focus on nature that depicts vastness, including sweeping landscapes of deserts, canyons, forests, waterfalls, glaciers, and mountain ranges. The video also included several captions with interesting facts about different biomes to match the use of captions in the cosmic vastness video.

A third video was a *neutral control* video. This was an eight-minute video depicting a time lapse of a house being built. It also included captions with interesting facts about building materials and the construction industry. The content of this video was inspired by a neutral control video used by other researchers (e.g., Rivera et al., 2020; Stellar et al., 2018; i.e., it is a non-emotional instructional video about how to build something).

Insufficient Effort Responding. To ensure quality data was obtained from participants, several methods were used to detect participants who provided Insufficient Effort Responding (IER). First, three items were included in the questionnaire to assess whether participants were paying attention by asking them to select a value on a Likert scale that is not commonly chosen by people who are not paying attention (i.e., not the extremes or midpoints on a Likert scale, e.g., "Please select the number 3 to show you are paying attention to the questions"). Second, the three-item Shortened Infrequency Scale (Huang, Bowling, & Liu, 2015) was used to detect

insufficient effort responding (i.e., ‘‘I eat cement occasionally,’’ ‘‘I can teleport across time and space,’’ and ‘‘I have never used a computer’’). These items were interspersed among the questionnaires and a participant was considered to have “failed” an item if they choose a rating higher than 1 (i.e., not at all/strongly disagree).

Manipulation Checks.

Engagement. Engagement was measured to ensure that the effects discovered are due to the content of the videos and not the degree that the participants remained attentive and engaged in the videos. Although all three videos were expected to be equally engaging, it is possible that the neutral control video would be less so because the aim of the video was to not evoke a significant amount of positive or negative emotions. Thus, it was important to check and control for engagement in the analyses if needed. Engagement was measured with three items. On a scale from 1 (not at all) to 7 (extremely), participants were asked “How much do you agree with each of the following statements?” Similar to Study 1, one item represented *subjective engagement* (i.e., “I felt attentive, engaged, and immersed with the video”). In addition, two items that represented *behavioural engagement* (i.e., “I was doing something else while the video was playing”, “I was distracted while the video was playing”) were included due to concerns that subjective engagement might relate strongly to elevating experience, an important outcome in the present study. The items for behavioural engagement were reverse scored so that higher scores represented higher levels of engagement. Cronbach’s alpha for behavioural engagement was acceptable ($\alpha = .70$).

Perceived Vastness. Although past research has used multi-item scales to measure perceived vastness (also referred to “vastness relative to self” in other studies), the scales included items that measure other variables of interest in the present study. For example, when

measuring vastness, some studies used items that refer to the experience of feeling small (Piff et al., 2015) to measure vastness. In addition, Piff and colleagues borrowed items from the elevation scale by Huta and Ryan (2010) that represent feeling connected to something bigger than oneself, which many subsequent studies have continued to use in measures of vastness (Hornsey et al., 2018; Piff et al., 2015; Tyson et al., 2021; Yaden et al., 2019). This is a significant confound because the elevation scale from Huta and Ryan (2010) is the same scale used for measuring elevating experience in the present study. Although subtle, there is an important difference between witnessing something vast (a stimulus) and feeling connected to or a part of something vast (an outcome).

Therefore, a five-item scale was created to measure whether people are experiencing something vast in *size*. Participants were asked "How much did the video make you feel like you were experiencing or perceiving something…" and were provided with five items (i.e., "vast", "immense", "enormous", "immeasurable", "huge") to rate between 1 (not at all) to 7 (extremely). These items were interspersed with items related to experience of the unknown because it had the same prompt and anchors. Cronbach's alpha was excellent (α = .95).

Affective Outcomes. All the items used to measure affect (i.e., positive affect, negative affect, elevating experience, existential distress) were randomly interspersed with each other in a single scale. Participants were asked immediately after the video "How much did the video make you feel…" and participants rated each item on a scale from 1 ("not at all") to 7 ("extremely").

When retrieving scales and creating items for Study 2, there was an emphasis on measuring emotions that are particularly relevant to the context of the vastness of the universe based on past research and the qualitative data in Study 1. This is important because assessing emotions relevant to an existential threat (e.g., measuring fear and anxiety when primed with

death), rather than using an affect scale that measures a diverse set of emotions that are less closely tailored (e.g., the PANAS-X; Watson & Clark, 1994), can have a significant impact on whether affect is detected in experimental studies (e.g., Lambert et al., 2014).

Exploratory factor analyses were also conducted to demonstrate that positive and negative existential experiences (i.e., elevating experience and existential distress) are distinct from positive and negative affect in the present study. These analyses are presented after the scales are introduced below.

Elevating experience. Elevating experience was measured using the 13-item state level version by Huta and Ryan (2010). This scale was chosen because it is easily adapted to the methodology of the present study (e.g., items followed "How much did the video make you feel…") and encompasses several relevant associated concepts including awe (i.e., ''in awe,'' ''deeply appreciating,'' 'emotionally moved,'' ''in wonder,'' ''profoundly touched by experiences''), inspiration (i.e., "inspired", "enriched"), moral elevation ("spiritually uplifted", "morally elevated"), and transcendence (i.e., ''connected with a greater whole,'' ''part of something greater than myself,'' ''part of some greater entity,'' ''like I was in the presence of something grand''). Huta and Ryan (2010) found that a trait version of elevating experience had an excellent internal consistency (α = .93) and provided evidence that it is distinct in factor analyses from several other measures of well-being, such as carefreeness and meaning. The elevating experience scale also loads stronger on a factor representing eudaimonic experiences (e.g., meaning, self-connectedness) compared to a factor representing hedonic experiences (e.g., positive affect, carefreeness) at the state level (Huta, 2022), further supporting its distinction from positive affect in the present study. The scale had excellent internal consistency (α = .95) and was adequately distinct from positive affect in EFA analysis (see below).

Existential Distress. There are several scales that have been proposed to measure aspects of existential distress (Kissane et al., 2004; Mayers, et al., 2002; Kira et al., 2018; Weems et al., 2004; van Bruggen et al., 2017). Many of these measures only focus on specific aspects of existential distress (e.g., existential anxiety, loneliness, or identity distress) or are intended for specific populations (e.g., people suffering from medical conditions). All measures considered are also designed to assess affect over longer periods of time (i.e., they are not state level measures) and are difficult to adapt to the state level (i.e., items do not easily follow "the video made me feel…"). Therefore, a scale was created to measure state level existential distress in response to watching the videos. The scale was created to measure a breadth of associated concepts that are expected to represent a unified account of existential distress. Twenty items were created that represent six facets of existential distress derived from theory, empirical measures in past research, and from the qualitative data from Study 1. Although the items were created when considering different facets of existential distress that may seem conceptually separable, they were expected to be closely related and to form a single factor in factor analysis.

The first facet measured was *meaninglessness* (i.e., loss of sense of personal meaning and value) and this was measured with five items ("diminished", "insignificant", "irrelevant", "meaningless", "worthless"). This dimension was assigned the greatest number of items because it is considered a central aspect of existential distress related to the vastness of the universe (e.g., Kahane, 2014; Nagel, 1971) and appeared the most frequently in the qualitative data in Study 1. The remainder of the themes were each measured with three items, including *powerlessness* ("powerless," "helpless," "useless"), *hopelessness* ("hopeless," "discouraged," "demoralized"), *destabilization* ("destabilized," "unsteady," "lost"), *vulnerability* ("undermined," "vulnerable," "weak"), and *isolation* ("alone," "solitary," "isolated"). As shown in the exploratory factor

analyses below, three items did not perform well ("unsteady", "discouraged", and "demoralized") and these items were removed from the scale. Thus, the final scale had 17 items, which had excellent internal consistency (α = .96).

Existential Distress vs. Elevating Experience. Parallel to Study 1**,** an additional bipolar question was added to force participants to choose whether they felt more elevating experience or more existential distress ("If you had to choose, where would you place yourself on the scale below between feeling diminished/insignificant/undermined and elevated/inspired/uplifted during and after the video?") on a Likert scale from 1 (extremely diminished/insignificant/undermined) to 8 (extremely elevated/inspired/uplifted). Although the present study also included multi-item scales to measure these outcomes, this item helped to easily differentiate participants who felt more elevating experience or more existential distress.

Positive and Negative Affect. To measure positive and negative affect, the 12-item Scale of Positive and Negative Experience (SPANE; Diener et al., 2009) was used. The SPANE was chosen because it has good internal reliability and convergent validity with other measures of affect (Diener et al., 2009). It also includes items that measure affect in a general way, whether positive (i.e., "positive", "good", "pleasant") or negative (i.e., "negative", "bad", "unpleasant"). The general non-specific feelings are a good fit for the present study because they encompass broad experiences, which participants in Study 1 often referred to instead of specific emotions in their qualitative responses (e.g., see general negative experiences category in Study 1). The SPANE also included items that measure specific relevant positive (i.e., "happy", "joyful", "contented") and negative (i.e., "sad," "afraid," and "angry") affect.

For negative affect, fear (i.e., "afraid" item from the SPANE) was expanded by adding several items (i.e., "scared", "frightened", "anxious" "nervous", "worried") because these were

commonly cited experiences in the qualitative data in Study 1. Fear is also an affect that is closely related to existential experiences (e.g., van Bruggen et al., 2015; 2017) and has been found to be significantly evoked in participants experiencing threat-based awe (Gordon et al., 2017) or an existential threat (e.g., mortality salience condition in terror management theory; Lambert et al., 2014). These items were retrieved from Lambert and colleagues (2014) because their multi-item measures had good internal reliability and were successful in detecting significantly higher levels of fear and anxiety in response to an existential threat. As shown in the exploratory factor analyses below, *fear* and *negative affect* (i.e., "negative", "bad", "unpleasant", "sad", "angry") were distinct experiences. Thus, the item "afraid" from the SPANE was used for the fear composite, rather than the negative affect composite. Cronbach's alpha for positive affect (α = .94), fear (α = .94), and negative affect (α = .87) were all good.

Exploratory Factor Analyses of Positive and Negative Experiences. Exploratory factor analyses (EFAs) were conducted to determine if existential experiences (i.e., elevating experience and existential distress) were distinct from other commonly measured emotions (i.e., positive and negative affect). These analyses were performed independently for positive and negative experiences because the current study focused on the presence of positive and negative experiences separately, as well as their independent relationship with other variables (i.e., mediators and moderators). In addition, separate EFAs helped increase the participant to item ratio, an important consideration when developing reliable factor structures (Costello & Osborne, 2005), especially when detecting nuanced differences. All EFAs used the full sample (all three video conditions) and were conducted using unweighted least squares because it is robust to violations of normality. In addition, an oblique rotation (direct oblimin, delta = 0) was used because the factors were expected to be substantially correlated with each other. The pattern

matrices of factor loadings are reported for each analysis. For each EFA, several considerations were examined to determine the number of factors to extract and the number of items to retain. This included the number of eigenvalues greater than 1, the variance explained by the number of factors included, a visual examination of the scree plot, the strength of factor loadings (i.e., at least .40), and whether items cross loaded across multiple factors (cross-loadings were items that loaded on multiple factors within .10 units of each other).

First, an exploratory factor analysis with items representing positive experiences was conducted to determine if elevating experience can be empirically distinguished from positive affect. In the unrotated solution, two factors had eigenvalues larger than 1 (highest five eigenvalues: 11.33, 1.53, .86, .63, .48), which explained 68% of the variance. A visual examination of the scree plot also supported a two-factor solution. As shown in Table 6, almost all items loaded more strongly on the factor they were supposed to represent, with a factor loading above .40. The item "inspired" was the only exception. This item is a part of the elevating experience scale but loaded more strongly on the factor representing positive affect. In addition, the item "morally elevated" appeared to cross load on both factors equally. Considering both scales are already established in the literature and have been empirically distinguished from other experiences in past research, the scales remained unchanged. The factor correlation between the two factors and the Pearson correlation between the two composite scales were both very strong (.74 and .78, respectively), suggesting that the two experiences are highly related in this context. Thus, the EFA supports a subtle distinction between elevating experience and positive affect and these variables were examined separately.

Second, an EFA was conducted to determine if the items created to represent existential distress were distinct from negative affect. In the unrotated solution, three factors had

eigenvalues above 1 and a fourth eigenvalue was close to 1 (highest six eigenvalues: 17.38, 1.67, 1.21, .92, .72, .69 respectively). Four factors explained 68% of the variance. A visual examination of the scree plot appeared to support a potential four factor solution. However, many items did not load on any factor with at least a .40 factor loading. Thus, the three-factor solution was examined next. This created a three-factor solution that appeared to represent *existential distress*, *negative affect* (e.g., negative, sad, angry), and *fear* (e.g., afraid, anxious). In this solution, all items loaded on a factor with a factor loading of at least .40. However, some

Table 6

Exploratory Factor Analysis of Positive Experiences

Item	Factor	
	1	2
Elevating Experience		
Part of some greater entity	**.93**	-.16
Part of something greater than myself	**.90**	-.10
Like I'm in the presence of something grand	**.86**	-.04
Connected with a greater whole	**.79**	.03
Emotionally moved	**.70**	.07
In wonder	**.69**	.02
Profoundly touched by the experience	**.69**	.11
In awe	**.58**	.10
Enriched	**.57**	.25
Spirituality uplifted	**.56**	.28
Deeply appreciating	**.53**	.27
Morally elevated	**.41**	.39
Inspired	.30	**.56**
Positive Affect		
Happy	-.07	**.96**
Positive	-.02	**.91**
Good	.01	**.87**
Pleasant	-.01	**.85**
Joyful	.08	**.81**
Contented	.10	**.68**

Note. Items with a factor loading of .40 or above are bolded.

Table 7

Exploratory Factor Analysis of Negative Experiences

Item	Factor		
	1	2	3
Existential Distress			
Insignificant	**.86**	.01	-.12
Meaningless	**.84**	- .07	.00
Irrelevant	**.78**	.01	-.06
Worthless	**.78**	-.11	.20
Alone	**.75**	-.08	.13
Powerless	**.71**	.10	.03
Isolated	**.68**	.05	.02
Solitary	**.65**	-.02	-.07
Diminished	**.64**	.06	.14
Useless	**.63**	.09	.15
Helpless	**.63**	.16	.11
Hopeless	**.59**	.00	.30
Weak	**.58**	.22	.00
Lost	**.56**	.27	.01
Vulnerable	**.50**	.16	-.35
Undermined	**.45**	.10	.19
Destabilized	**.41**	.30	.09
Fear			
Nervous	-.02	**.84**	.03
Afraid	.05	**.83**	.01
Scared	.09	**.82**	.01
Frightened	.09	**.77**	.04
Anxious	.01	**.72**	.14
Worried	.04	**.67**	.20
Negative Affect			
Negative	.15	.09	**.69**
Bad	-.01	.29	**.63**
Angry	.03	.01	**.57**
Unpleasant	.20	.23	**.48**
Sad	.17	.24	**.45**

Note. Items with a factor loading of .40 or above are bolded.

items cross-loaded across two factors and some items did not load on their intended factors. First, two items representing existential distress that loaded primarily on another factor were removed from the EFA (i.e., “unsteady” loaded on the fear factor, “discouraged” loaded on the negative affect factor). After the EFA was re-run, one item representing existential distress was removed due to a high cross-loading at with a factor loading of at least .40 on two factors (i.e., “demoralized” cross-loaded on the existential distress factor and the negative affect factor .51 and .44 respectively). The EFA was re-run a final time and a three-factor solution did not include any cross-loadings. This resulted in 17 items on the existential distress factor, six items on the fear factor (including the item “afraid” from the SPANE), and five items on the negative affect factor. The unrotated final solution had three eigenvalues above 1 (Highest 6 eigenvalues: 15.63, 1.62, 1.09, .90, .71, .67), which explained 66% of the variance. The factor correlations and correlations using composite scales between existential distress and fear (.77 and .80 respectively), existential distress and negative affect (.56 and .74 respectively), and negative affect and fear (.61 and .77 respectively) were all high. Overall, the factor analyses support existential distress as a distinct experience, even if the distinction is subtle.

For the mediation and moderation analyses, only elevating experience and existential distress were examined as outcomes because they were outcomes of particular interest and relevance to the research questions. Positive affect, negative affect, and fear were only used when comparing reactions to the three video conditions using one-way ANOVAs and post-hoc comparisons.

Mediators (Cognitive Responses).

Small Self. The purpose of the scale in the present study was to assess the degree to which a person’s self *feels* smaller without making assumptions about potentially associated

experiences (e.g., feeling of insignificance). This is similar to what Tyson and colleagues (2021) refer to as *self-size*, defined as metaphorical experiences of smallness. There are multi-item scales in the literature that measure the experience of small self that were considered. Researchers (e.g., Gordon et al., 2017; Hornsey et al., 2018) have predominantly used a five-item scale of small self developed by Piff and colleagues (2015). However, several items overlapped with other variables being measured in the present study such as existential distress (i.e., "I feel small and insignificant", "I feel insignificant in the grand scheme of things") and elevating experience (i.e., "like I was in the presence of something greater than myself"). Bai and colleagues (2017) also measured small self by having participants rate two statements (i.e., "In general, I feel relatively small," "In general, I feel insignificant") and three pictorial items, which ask what picture on the Likert scale best represents the participant (i.e., participants select the option that most represents how they feel about themselves in three separate questions that display circles, stick figures, or the word "me" that each increase linearly in size as the Likert scale increases). However, one of the statements measured feeling existential distress and the three pictorial items may capture a more literal evaluation of one's self-size when considering the vastness of the universe (i.e., participants putting the lowest score on size in response to the enormity of cosmic vastness), rather than the subjective experience of feeling small, thus potentially resulting in highly skewed responses (i.e., most people pick the smallest option). A scale by Yaden and colleagues (2019) also measured *self-diminishment*, which included several items referring to losing one's sense of self. While measuring self-loss is interesting, there is an important distinction between a loss of one's sense of self and feeling small.

A five-item Likert scale was therefore created for the present study to measure the experience of small self that assesses a subjective sense of feeling metaphorically small without

making assumptions about associated constructs (e.g., feeling insignificant). Participants were asked "How much did the video make you feel…" and rated five items (i.e., "Small", "Tiny", "Miniscule", "Little", "Miniature") on a Likert scale from 1 (not at all) to 7 (extremely). These items were interspersed with items representing affective experience because the scale has the same prompt and anchors. Experience of small self had an excellent internal consistency (α = .96).

Experience of the Unknown. The experience of the unknown is a concept that was observed in the qualitative data in Study 1 and refers to witnessing and experiencing something that feels unknown, unfamiliar, or mysterious. To my knowledge, there are no scales that measure this experience. The most closely related concept in the literature is the experience of uncertainty (e.g., Carleton, 2016; Han, Klein, & Arora, 2011; McGregor, Nash, Mann, & Phills, 2010) and it is often examined to understand its relationship to anxiety. However, the experience of the unknown is broader, encompassing not only feeling uncertain about what is witnessed, but becoming aware of something in the world or universe that has not been encountered or considered, or is simply unfamiliar and mysterious.

Thus, a five-item scale was therefore created, and participants were asked "How much did the video make you feel like you were experiencing something…" and are provided with five items (i.e., "unfamiliar", "unknown to you", "you knew little about", "mysterious to you", "you were unaware of"). Participants rated these items from 1 (not at all) to 7 (extremely). These items were randomly interspersed with items measuring perceived vastness. Internal consistency for this scale was excellent (α = .90).

Existential Contemplation. To my knowledge, there are only two measures that examine people's degree of existential contemplation (Allan & Shearer, 2012; King & DeCicco, 2012).

They are both trait level measures about people's tendency to think about fundamental existential concerns and engage in meaning-making processes related to these issues. Therefore, a 12-item scale was created to measure state-level contemplation about existential issues. The items for this scale were created by adapting relevant questions from the previous trait-level existential contemplation scales, from theory about fundamental existential questions that people often ask (Yalom, 1980), and from examples described by participants in Study 1. Participants were asked "How much did the video make you think about…" and rated the 12 items on a scale from 1 (not at all) to 7 (extremely). The 12 items represent existential questions or thoughts about individual meaning and life priorities (i.e., "The meaning of my life," "My purpose in life," "My role in the world," "My importance in the world," "How to live my life and what to live for," "What matters in my life,") and the nature of existence, reality, and the bigger picture (i.e., "The meaning and purpose of life, the universe, or the grand scheme of things," "How everything came to exist," "The nature of reality or the universe," "Whether there is an explanation for everything," "Why we are here and the meaning of our existence," "My beliefs about reality, the big picture, or spirituality"). As described in the next section, exploratory factor analyses support a one-factor solution, but a two-factor solution was also viable (i.e., *existential contemplation about the self* and *existential contemplation about reality and the universe*). For the purpose of the present study, the full 12-item scale was used and had an excellent internal consistency (α = .95).

Need for Accommodation. The items used to measure a need for accommodation in Study 1 did not form an internally consistent measure of the concept. Need for accommodation has been defined in various ways throughout the literature (e.g., Sundararajan, 2002; Yaden, 2019). Keltner and Haidt's (2003) original description of the need for accommodation emphasized the challenge or negation of previous mental structures because a person has

difficulty making sense of the experience of vastness. Thus, the five-item need for accommodation subscale from Yaden and colleagues' (2019) Awe Experience Scale (AWE-S) was chosen because it measures how much one is challenged, or struggles, to understand and process the experience. Participants were asked "Please rate how much do you agree with each of the following statements. During the video…" and rate five statements (i.e., "I felt challenged to mentally process what I was experiencing," "I found it hard to comprehend the experience in full," "I felt challenged to understand the experience," "I struggled to take in all that I was experiencing at once," "I tried to understand the extent of what I was experiencing") on a scale from 1 (strongly disagree) to 7 (strongly agree). One of the items was revised and the word "magnitude" was replaced with "extent" to reduce its overlap and confound with the concept of vastness (i.e., "I tried to understand the *extent* of what I was experiencing"). Yaden and colleagues (2019) demonstrated that the scale had strong internal consistency (α = .80). In addition, they found that both exploratory factor analysis and confirmatory factor analysis demonstrated its distinctiveness from other factors (i.e., altered time perception, self-diminishment, connectedness, vastness, physical sensations) that they considered a part of the experience of awe. In the present study, the scale also had a good internal consistency (α = .83) and was distinct from other cognitive responses in an exploratory factor analysis, as described below.

Exploratory Factor Analyses of the Mediators. Given that three of the four scales used to measure mediators were created ad hoc for the present study, an EFA was conducted to determine if all four mediators (i.e., small self, need for accommodation, experience of the unknown, existential contemplation) were distinct from each other. The analyses were conducted in an identical way to the EFAs for positive and negative experiences. In the unrotated solution,

five factors had eigenvalues above 1 (highest eight eigenvalues: 11.86, 3.30, 2.39, 1.69, 1.02, .74, .59, .52), which explained 75% of the variance. Visual examination of the scree plot also supported a 5-factor solution. When examining the factor structure and loadings, the items cleanly separated into 5 distinct factors with all items loading above .40 and did not have any cross-loadings. The five factors represented experience of small self, need for accommodation, experience of the unknown, existential contemplation *about the self*, and existential contemplation *about the universe and reality*. Since these variables were used as mediators in parallel multiple mediation analyses, factor and Pearson correlations between these variables were examined. The relationship between existential contemplation about the self and existential contemplation about the universe and reality were the only variables correlated above an absolute value of .60 (factor correlation = .70, correlation between composites = .75). Since multicollinearity in the mediation analyses needs to be considered, and these two variables were expected to form one factor (i.e., existential contemplation), a four-factor solution was examined. As shown in Table 8, the four-factor solution also cleanly separated all the items into their respective factors. Overall, this supports that these four experiences are distinct from each other and represent their own constructs.

Moderators.

Self-Esteem. To measure self-esteem, the Rosenberg Self-Esteem Scale (Rosenberg, 1965) was used. This is the most widely used measure of self-esteem and has very good psychometric properties (Donnellan et al., 2015). The Rosenberg Self-Esteem Scale is a 10-item measure where participants are instructed, "Below is a list of statements dealing with your general feelings about yourself. Please indicate the extent to which you agree or disagree with each statement." The scale traditionally uses a four-point Likert scale from 1 (Strongly Disagree)

Table 8

Exploratory Factor Analysis of Cognitive Responses

Item	Factor			
	1	2	3	4
Existential Contemplation				
My purpose in life	**.90**	-.06	.10	-.06
The meaning of my life	**.89**	.01	.07	-.08
What matters in my life	**.85**	-.09	.02	-.04
My role in the world	**.87**	-.04	.11	-.06
My importance in the world	**.86**	.08	.05	-.05
How to live my life and what to live for	**.81**	-.13	.03	-.00
The meaning and purpose of life, the universe, or the grand scheme of things	**.73**	.19	-.07	.09
My beliefs about reality, the big picture, or spirituality	**.70**	.10	-.05	.08
Why we are here and the meaning of our existence	**.70**	.18	-.03	.11
Whether there is an explanation for everything	**.57**	.15	-.10	.24
The nature of reality or the universe	**.53**	.24	-.12	.21
How everything came to exist	**.49**	.21	-.12	.24
Small Self				
Tiny	-.01	**.91**	.05	-.01
Miniature	.00	**.91**	.02	.01
Little	.01	**.91**	.03	-.00
Miniscule	-.03	**.88**	.05	-.04
Small	.02	**.86**	.06	.02
Need for Accommodation				
I felt challenged to understand the experience	.08	-.03	**.76**	-.02
I felt challenged to mentally process what I was experiencing	.08	.07	**.74**	.01
I found it hard to comprehend the experience in full	-.09	.06	**.69**	.05
I struggled to take in all that I was experiencing at once	-.06	.10	**.65**	.06
I tried to understand the extent of what I was experiencing	.18	-.04	**.41**	.14
Experience of the Unknown				
You were unaware of	-.01	-.06	.01	**.83**
Unknown to you	.02	-.01	.04	**.82**
Unfamiliar	-.06	.08	.05	**.79**
You knew little about	-.05	-.04	.09	**.77**
Mysterious to you	.20	.09	.05	**.63**

Note. Items with a factor loading of .40 or above are bolded.

to 4 (Strongly Agree). However, there are studies that use a larger range Likert scale and maintain good psychometric properties (e.g., Donnellan, et al., 2012). In the present study, participants rated the items (e.g., "On the whole, I am satisfied with myself," "At times I think I am no good at all," "I feel that I have a number of good qualities") on a Likert Scale from 1 (strongly disagree) to 7 (strongly agree) to detect more variability in people's responses. Cronbach's alpha for the scale was excellent in the present study (α = .90).

***Humility*.** Measuring humility is a challenge because there are concerns about the validity of self-report measures of the concept (Davis et al., 2011; McElroy-Heltzel, et al., 2019). In short, humble people are more likely to be humble about their scores. McElroy-Hetzel and colleagues (2019) completed a review of 22 measures of humility and provided recommendations to researchers. They evaluated factor structure, reliability, and validity of each of the scales. One of the self-report measures they recommended was the Modesty facet of the Honesty-Humility Subscale of the HEXACO-PI (Lee & Ashton, 2004) because it has strong evidence of construct validity. Thus, this scale was used in the present study.

Instructions for the scale are "Please read each statement and decide how much you agree or disagree with that statement". Participants rated the four items on a scale from 1 (Strongly Disagree) to 7 (Strongly Agree), including: "I am an ordinary person who is no better than others," "I wouldn't want people to treat me as though I were superior to them," "I think that I am entitled to more respect than the average person is" (reverse scored), "I want people to know that I am an important person of high status" (reverse scored). The scale's Cronbach's alpha has ranged from .68 to .79 (Lee & Ashton, 2018). In the present study the internal consistency was lower than expected (α = .64). However, some researchers still consider this to be within an acceptable range (Taber, 2018).

Intellective Processing Style. To measure participants' intellective processing style (i.e., preference for abstract and complex thinking) the 18-item intellective position subscale of the Epistemic Preference Indicator (Eigenberger et al., 2007) was used. This scale is intended to measure two opposing epistemic positions called the *default position* and the *intellective position.* The default position refers to a preference for thinking, learning, or problem-solving strategies that are more automatic or effortless. In contrast, the intellective position refers to a preference for more elaborated forms of thinking and judgement. Eigenberger and colleagues' (2007) results supported a two-factor solution, good internal consistency (Cronbach's alpha .90 or above), test-retest reliability, criterion validity, and construct validity. Although Eigenberger and colleagues expressed some concern about whether the two positions were distinct concepts, as the correlations between the intellective and default positions were very high in their study (r = -.79), the present study had high but smaller correlation (r = -.58), suggesting intellective processing style can be looked at independently.

The epistemic preference indicator is a 36-item scale which provides items in pairs (i.e., 18 pairs). Each pair has an item that reflects an intellective position (e.g., "I generally consider myself to be more philosophical – evaluating many diverse ideas…") and an item that reflects a default position (e.g., "I generally consider myself to be more practical – finding the answer that works for me right now"). Pairing the items together was done intentionally to allow participants to compare the positions and rate each item when considering the other (Eigenberger et al., 2007). Participants rated all 36 items using a seven-point Likert scale from 1 (completely disagree) to 7 (completely agree). Cronbach's alpha for the intellective subscale in the present study was good (α = .88).

Big Picture Thinking. A scale developed by Allan & Shearer (2012) was chosen because

it was considered the best available scale to measure the degree that people engage with existential concerns and contemplating the big picture. Participants were asked, "Please rate the degree to which you agree with each of the following statements" and were presented with 11 questions (e.g., "Do you ever reflect on your purpose in life?", "Do you have a philosophy of life that helps you to manage stress or make important decisions?", "Do you ever think about a "grand plan or process that human beings are a part of?", "Have you ever thought about what is beyond the "here and now" of your daily life?", "Have you ever reflected on the nature of reality or the universe?") on a Likert scale between 1 (not at all) and 7 (extremely). The scale has also demonstrated excellent internal consistency (α = .95) and exploratory factor analysis demonstrated that the scale forms one factor (Allan and Shearer, 2012). The scale also demonstrated excellent internal consistency (α = .92) in the present study.

Meaning in Life. A five-item subscale from the Meaning in Life Questionnaire by Steger and colleagues (2006), that measures *presence* of meaning in life, was used. This scale was chosen because it is the most frequently used measure of meaning in life and assesses participants subjective evaluation of whether they have meaning and purpose in life in a general way (i.e., without making assumptions about what make life meaningful to a person). Participants were asked "Please take a moment to think about what makes your life feel important to you. Please respond to the following statements as truthfully and accurately as you can, and also please remember that these are very subjective questions and that there are no right or wrong answers." Participants rated five items on a scale from 1 (Absolutely Untrue) to 7 (Absolutely True), including: "I understand my life's meaning", "My life has a clear sense of purpose", "I have a good sense of what makes my life meaningful", "I have discovered a satisfying life purpose", and "My life has no clear purpose" (reverse scored). The scale had a

good internal consistency in the present study (α = .89).

Data Cleaning.

Screening for Invalid Data. Throughout data collection, the number of participants with valid data was assessed to ensure the desired sample size was collected. Final data analyses were not conducted until the full sample was collected. First, participants were removed if they did not complete the survey (e.g., most of their data was missing), did not remain on the webpage with the video for a long enough duration to watch the full video, or completed the study twice. After removing the participants described above, 44 more participants were removed. First, participants were screened for insufficient effort responding (IER) by examining the six items that were intended to detect IER. Five of the six items had at least 90% of participants provide the correct response. There was more variability related to a question that asked participants whether ‘‘I can teleport across time and space’’, as only 84% of participants responded accurately (i.e., gave a score of 1 on the Likert scale). Participants may have considered the question metaphorically and interpreted it to be about whether they could travel across space and time through virtual means (e.g., a video). Since the videos went to different places in nature on Earth (i.e., Earth nature vastness video) or in the universe (i.e., cosmic vastness video), and rating this item higher is not considered unreasonable, this item was not considered for gauging IER. Thus, participants who answered at least four out of five IER questions correctly were included. Only 22 participants did not meet this cut-off and were removed from the dataset. Second, satwo participants were removed because they completed the survey at a rate faster than 30 items per minute (2 seconds per item). Third, seven participants that took longer than two hours to complete the survey were removed because if participants took an extended break, they may not have accurately recalled their experience while watching the videos. Fourth, three

participants were removed because they stated they used a mobile phone to watch the video, which was contrary to instructions at the beginning of the survey. Finally, 10 participants were removed because they scored 5 or lower on a 7-point Likert scale on an item that stated, "I watched the full video".

Screening for Parametric Assumptions. Similar to Study 1, all variables were examined for univariate outliers and normality. Each video condition was examined independently. For univariate outliers, recommendations by Tabachnick and Fidell (2007) were used for considering fairly large sample sizes (i.e., greater than 100 people). Thus, a raw score with a z-score greater than the absolute value 3.29 was considered an outlier. When there was an outlier, Winsorization was used to adjust participants' scores to the next most extreme score. Skewness and kurtosis were examined to assess the normality of each variable. There were a few instances where skewness or kurtosis were above a commonly recommended cut-off of +/- 2.0 (George & Mallery, 2019; Ryu, 2011). However, these instances were only present when examining variables assessing engagement while watching the videos and negative experiences for the neutral control video and Earth nature vastness video. Skewness and kurtosis were expected to be higher for engagement because it was intended to be a manipulation check (i.e., creating a ceiling effect and a negative skew). Behavioural engagement exceeded cut off of +/- 2 for skewness once (cosmic vastness condition = -2.18) and kurtosis twice (neutral control video = 2.24; cosmic vastness video = 3.73). Negative experiences never exceeded a skewness of +/- 2. Both fear and negative affect exceeded a kurtosis of +/- 2 for the neutral control (kurtosis = 2.78, 3.10 respectively) and Earth nature vastness (kurtosis = 2.25, 2.03 respectively) conditions. Overall, since there were only a few instances of skewness and kurtosis exceeding a cut-off of +/- 2, all variables were kept unchanged to keep consistency across all analyses. Outliers and

normality were also assessed for variables being used in the mediation and moderation analyses. For these analyses, the cosmic vastness and neutral control conditions were combined, and no issues related to outliers or normality were detected.

The assumption of homogeneity of variance was tested before conducting one-way ANOVAs examining the differences between the videos on several different outcomes. Levene's statistic was significant for many variables, suggesting that there may be heterogeneity of variances. However, according to Field (2018), Levene's statistic with large samples sizes can find minor differences between groups to be significant, even when it may not be a violation of the assumption of homogeneity of variances. In addition, according to Tabachnik and Fidell (2007), ANOVA is robust to violating homogeneity of variances assumption when there are no outliers, when sample sizes are large and equal across groups, and when an F_{max} ratio is no greater than 10 (all of these are present in the current study). Therefore, heterogeneity of variances was not considered to be an issue for the one-way ANOVAs conducted.

Assumptions for regression were also assessed before conducting the mediation and moderation analyses described below. Residual outliers were assessed for each regression involved in every one of the analyses and no residual outliers (i.e., *z score* > 3.29) were detected. Next, assumptions of linearity, normality of errors, and homoscedasticity were tested by examining the histogram of the residual errors and the scatterplot of the relationship between the standardized residuals and the standardized predicted residuals. All analyses had no or minor violations of the assumptions of linearity and normality of estimation errors. Although the assumption of homoscedasticity was met for all analyses examining elevating experience as an outcome, most analyses examining existential distress appeared to display heteroscedasticity. Therefore, for the mediation and moderation analyses examining existential distress as an

outcome, the Criberi-Neto heteroskedasticity-consistent standard error (HCSE) estimator of OLS parameter estimates (HC4) was used, as derived by Cribari-Neto (2004) and recommended by Hayes and Cai (2007).

Analysis Strategy. To test Hypotheses 1a (cosmic vastness will elicit both positive and negative experiences), 1b (elevating experience and existential distress will be particularly relevant to cosmic vastness), and 3 (cosmic vastness will elicit highest levels of cognitive responses), several one-way ANOVAs were conducted to compare the three videos on positive experiences, negative experiences, and cognitive responses. Given the number of comparisons being conducted, Scheffe's post hoc test was chosen because it provides a good balance between the most flexible and the most conservative post hoc tests (Tabachnick and Fidell, 2007). In addition, Dunnett C post hoc tests (recommended for comparisons with heterogeneity of variances; Tabachnick and Fidell, 2007) were conducted for comparisons that had heterogeneity of variances. There were no notable changes in significance level when conducting Dunnett C post hoc tests. Thus, Scheffe's post hoc test will be reported throughout.

To test Hypothesis 2a (that there will be substantial polarization of people who experience more elevating experience and more existential distress), the bipolar question was used to compare the percentage of participants who reported more elevating experience to the percentage of people with more existential distress across the three videos. Parallel to Study 1, four groups were created with the multi-item scales representing elevating experience (ELE) and existential distress (EXD), including: 1) High ELE/Low EXD; 2) High EXD/Low ELE; 3) High Both ELE/EXD; 4) Low Both ELE/EXD. A score of 4 or higher on either variable was considered high, whereas a score 3 or lower on either variable was considered low. In Hypothesis 2b, the cosmic vastness condition was expected to elicit more variability in elevating

experience, existential distress, and the bipolar question compared to the neutral control and Earth nature vastness conditions, further indicating that the cosmic vastness elicits more polarizing reactions. To test this hypothesis, Levene's statistic for homogeneity of variance was examined when performing the one-way ANOVAs. When the result was significant, Levene's Test for Equality of Variances was conducted two times, once between the cosmic vastness and neutral control condition and once between the cosmic vastness and Earth nature vastness condition.

Eight simple mediation analyses were conducted to test Hypothesis 4 that each of the cognitive responses measured (small self, need for accommodation, experience of the unknown, need for accommodation) would mediate the positive relationship between cosmic vastness and both elevating experience and existential distress. In addition, two parallel multiple mediation analyses were conducted to test whether all four mediators together would mediate the positive relationship between cosmic vastness and both elevating experience and existential distress. The parallel multiple mediation analyses were also conducted to further understand whether each mediator plays a role when controlling for the other mediators, as well as to determine which subset of mediators does as good of a job as all the mediators together in predicting elevating experience and existential distress respectively. All mediation analyses were conducted using an ordinary least squares regression method and bootstrap method through the macro PROCESS (version 3.5.3) developed by Hayes (2017). Model 4 in the PROCESS add-on in the IBM SPSS software was used. For the simple mediation models, each mediator was examined in a separate analysis. For the parallel multiple mediation models, all four mediators were entered as mediators simultaneously. Statistical significance of the mediating variable was examined on 10,000 bootstrap samples and using 95% confidence intervals. The Criberi-Neto

heteroskedasticity-consistent standard error (HCSE) estimator of OLS parameter estimates (HC4) was used for the analyses examining existential distress as an outcome.

To assess Hypothesis 5**,** ten moderation analyses were conducted assessing self-esteem, humility, intellective processing style, big picture thinking, and meaning in life as moderators of the relationship between cosmic vastness and either elevating experience (five analyses) or existential distress (five analyses). For each regression, the cosmic vastness condition (i.e., cosmic vastness video vs. neutral control video), the moderator being examined (mean centered), and the interaction term (cosmic vastness condition X moderator) were entered as predictors of the outcome (elevating experience or existential distress). If the interaction term was significant, simple slope analyses were conducted to assess the moderator at high (+1 *SD*) and low (-1 *SD*) levels. These simple slopes demonstrated the relationship between the cosmic vastness condition and the outcome being examined (elevating experience or existential distress) when a participant has low levels of the moderator (when the z-score of the moderator is one standard deviation below the average) and high levels of the moderator (when the z-score of the moderator is one standard deviation above the average). A correlation table of all participants included in the mediation and moderation analyses (i.e., when excluding the Earth nature vastness condition) is included in Appendix L.

Study 2 Results

Comparing the Means of Experiences Between the Three Video Conditions

As displayed in Table 9, the cosmic vastness condition elicited the highest levels of perceived vastness, behavioural engagement, and subjective engagement (manipulation checks). The Earth nature vastness condition also elicited higher levels of perceived vastness compared to the neutral control condition, but there was no significant difference between the two conditions

Table 9

One-way ANOVAs Comparing the Three Videos in Study 2

Variable	Neutral Control Condition Mean (SD)	Earth Nature Vastness Condition Mean (SD)	Cosmic Vastness Condition Mean (SD)	F (2, 616) [1]	Partial Eta Squared[2]
Manipulation Checks					
Perceived Vastness	2.35_a (1.52)	4.95_b (1.68)	**5.71_c** (1.43)	266.05***	.46
Behavioural Engagement	6.46_a (.95)	6.35_a (.97)	**6.80_b** (.42)	17.36***	.05
Subjective Engagement	5.10_a (1.74)	5.45_a (1.61)	**6.11_b** (1.29)	22.61***	.07
Positive Experiences					
Elevating Experience (ELE)	2.68_a (1.32)	**4.77_c** (1.38)	4.27_b (1.35)	134.14***	.30
Positive Affect	3.25_a (1.55)	**4.96_b** (1.45)	3.46_a (1.50)	79.26***	.21
Negative Experiences					
Existential Distress (EXD)	1.55_a (.67)	2.15_b (1.01)	**3.23_c** (1.58)	113.39***	.27
Fear	1.40_a (.66)	1.89_b (1.08)	**2.94_c** (1.77)	80.74***	.21
Negative Affect	1.31_a (.55)	1.44_a (.65)	**2.11_b** (1.31)	47.64***	.13
Single Item Bipolar Measure					
EXD vs. ELE[3]	5.17_b (1.10)	**5.87_c (1.45)**	4.51_a (2.00)	39.08***	.11
Cognitive Responses					
Small Self	1.82_a (1.16)	4.00_b (1.99)	**5.47_c** (1.65)	260.70***	.46
Need for Accommodation	3.36_a (1.39)	3.47_a (1.34)	**4.28_b** (1.56)	25.07***	.08
Experience of the Unknown	2.98_a (1.55)	3.74_b (1.49)	**4.94_c** (1.52)	87.75***	.22
Existential Contemplation	2.41_a (1.43)	4.17_b (1.57)	**4.67_c** (1.44)	132.65***	.30

Note. [1] F and Partial Eta Squared are based on a comparison of means across the three conditions. [2]See Appendix K for Cohen's d between specific videos.[3] EXD vs. ELE is the bipolar item that forces participants to choose between experiencing more existential distress or more elevating experience. Bolded values represent the highest level of an experience. Underlined values represent significant difference from neutral control condition. Means within rows that do not share subscripts are significantly different from each other according to Scheffé's post hoc test, $p < .05$.

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

for behavioural or subjective engagement. Although the cosmic vastness condition was the most engaging, all three videos had average scores significantly above the midpoint of the scale for behavioural engagement (cosmic vastness: $t = 96.60$, $p < .001$; Earth nature vastness: $t = 34.86$, $p < .001$, neutral control: $t = 37.00$, $p < .001$) and subjective engagement (cosmic vastness: $t = 23.56$, $p < .001$; Earth nature vastness: $t = 12.88$, $p < .001$, neutral control: $t = 9.07$, $p < .001$), suggesting all videos did a good job at capturing the participant's attention.

Next, analyses were conducted to test the prediction that the cosmic vastness condition would elicit both more positive experiences and negative experiences compared to the neutral control condition (Hypothesis 1a). As shown in Table 9 and in partial support of Hypothesis 1a, the cosmic vastness condition had higher levels of elevating experience than the neutral control condition, but not higher levels of positive affect. In support of Hypothesis 1a, the cosmic vastness condition had higher levels of existential distress, fear, and negative affect than the neutral control condition.

Analyses were also conducted to examine the prediction that the cosmic vastness condition would elicit similar levels of elevating experience and more existential distress than the Earth nature vastness condition (Hypothesis 1b). As shown in Table 9, Hypothesis 1b was supported when examining existential distress, as the cosmic vastness condition elicited more existential distress than Earth nature vastness condition. However, Earth nature vastness evoked more elevating experience than the cosmic vastness condition.

Finally, analyses tested the prediction that all cognitive responses measured would be elicited to a higher degree in the cosmic vastness condition than both the neutral control and the Earth nature vastness conditions (Hypothesis 3). In support of Hypothesis 3, cosmic vastness evoked the highest levels of small self, need for accommodation, experience of the unknown,

and existential contemplation.

Examining the Variability of Elevating Experience and Existential Distress

In support of Hypothesis 2a, when examining the bipolar item in the cosmic vastness condition, about half of participants reported more existential distress (49%) and about half of participants reported more elevating experience (51%), demonstrating polarizing reactions. When examining the other video conditions, both the Earth nature vastness and neutral control conditions elicited much higher levels of elevating experience than existential distress (see Table 10). As shown in Figure 2, the histogram for the scores for the cosmic vastness video is more

Table 10

Frequency of Existential Distress (EXD) and Elevating Experience (ELE) Groups in Study 2

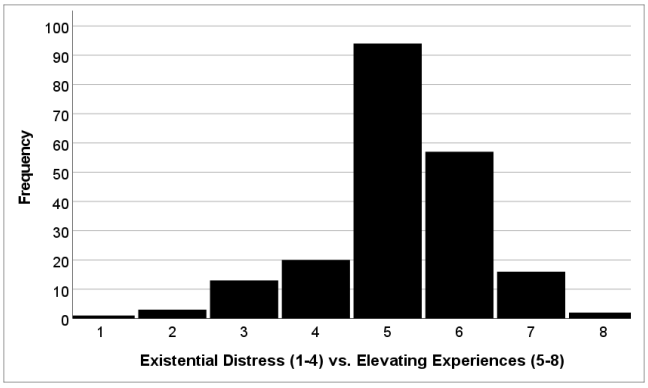
	Neutral Control Video (n = 206) % (f)	Earth Nature Vastness video (n = 206) % (f)	Cosmic Vastness Video (n = 207) % (f)
EXD vs. ELE split: 2 groups[1]			
More EXD	18% (37_a)	15% (31_a)	**49% (101_b)**
More ELE	**82% (169_b)**	**85% (175_b)**	51% (106_a)
Combinations of EXD and ELE using multi-item scales[2]			
Low Both	**82% (68_b)**	21% (43_a)	23% (47_a)
High EXD and Low ELE	0% (0_a)	2% (3_a)	**17% (35_b)**
High ELE and Low EXD	18% (38_a)	**72% (148_c)**	44% (90_b)
High Both	0% (0_a)	6% (12_b)	**17% (35_c)**

Note. Proportions within rows that do not share subscripts are significantly different from each other according to two proportion z-tests, $p < .05$. Bolded values represent the highest frequency. Underlined values represent significant difference from neutral control video.[1] The EXD vs. ELE split is based on the bipolar item that forces participants to choose between experiencing more existential distress or more elevating experience. [2]Participants were considered high on ELE or EXD if they score at or above the midpoint of the scale (4 on a 1-7 Likert scale) and low on ELE or EXD if they scored below the midpoint of the scale.

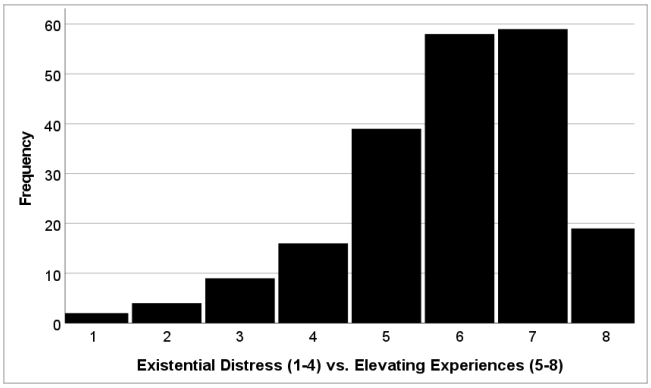
Figure 2

Histograms of the Bipolar Question for Each Video Condition in Study 2

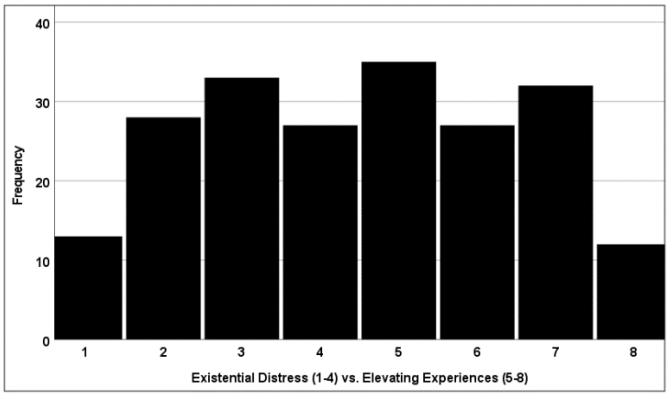
A) Neutral Control Condition



B) Earth Nature Vastness Condition



C) Cosmic Vastness Condition



Note. The bipolar question forced participants to choose between more existential distress or more elevating experience for each condition. The Likert scale was labeled as follows: extremely (1), very (2), somewhat (3), slightly (4) diminished/insignificant/undermined (existential distress) and slightly (5), somewhat (6), very (7), extremely (8) elevated/inspired/uplifted (elevating experience).

spread out and balanced compared to the neutral control and Earth nature vastness videos.

Similar to Study 1, there was evidence that elevating experience and existential distress are not mutually exclusive experiences and are worth examining separately. Specifically, the Pearson correlation between elevating experience and existential distress was not large (i.e., $r > .50$), regardless of what condition was examined (all participants $r = .19$, $p < .001$; neutral control: $r = .40$, $p < .001$; Earth nature vastness: $r = .06$, $p = 40$; cosmic vastness: $r = -.17$, $p < .05$; see Table 11 for correlation table of all participants and Appendix L for correlations within each condition). Thus, the multi-item measures of elevating experience and existential distress were each used to create four groups that examined combinations of high and low levels of elevating experience and existential distress (using the midpoint of the scale as a cut-off). Participants who scored exactly on the midpoint (i.e., 4 on the 7-point Likert scale) were considered "high". As displayed in Table 10, the cosmic vastness condition had a higher percentage of people who scored high on elevating experience and low on existential distress compared to people who scored high on existential distress and low on elevating experience. However, the proportion of people who scored high on existential distress, or high on both existential distress and elevating experience, was significantly larger for the cosmic vastness condition compared to the other two conditions. This supports Hypothesis 2a that there is a greater polarization of people who experience predominately existential distress or elevating experience in the cosmic vastness condition compared to the neutral control and Earth nature vastness condition.

Hypothesis 2b, which suggested that there would be greater levels of variability in scores of elevating experience, existential distress, and the bipolar question in the cosmic vastness condition was partially supported. Results from Levene's statistic for homogeneity of variance

Table 11

Zero-order correlations for all participants (n = 619) for Study 2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Manipulation Check																		
1. Perceived Vastness	-																	
2. Behavioural Engagement	**.10**	-																
3. Subjective Engagement	**.36**	**.44**	-															
Positive Experiences																		
4. Elevating Experience	**.62**	**.11**	**.43**	-														
5. Positive Affect	**.33**	**.10**	**.36**	**.78**	-													
Negative Experiences																		
6. Existential Distress	**.45**	-.02	**.14**	**.19**	**-.16**	-												
7. Fear	**.35**	.00	**.16**	**.11**	**-.22**	**.80**	-											
8. Negative Affect	**.22**	-.06	**.18**	-.03	**-.31**	**.74**	**.77**	-										
Single Item Measure																		
9. EXD vs. ELE[a]	.04	.08	**.18**	**.44**	**.64**	**-.57**	**-.49**	**-.54**	-									
Cognitive Responses																		
10. Small Self	**.62**	**.12**	**.26**	**.45**	**.14**	**.66**	**.53**	**.38**	**-.21**	-								
11. Need for Accommodation	**.31**	-.02	.05	**.18**	-.05	**.44**	**.44**	**.36**	**-.21**	**.34**	-							
12. Experience of the Unknown	**.58**	**.08**	**.24**	**.41**	**.12**	**.47**	**.40**	**.28**	**-.12**	**.51**	**.46**	-						
13. Existential Contemplation	**.65**	**.14**	**.38**	**.70**	**.42**	**.43**	**.37**	**.24**	**.09**	**.53**	**.33**	**.49**	-					
Moderators																		
14. Self Esteem	.02	.07	.08	**.15**	**.21**	**-.23**	**-.20**	**-.19**	**.26**	-.07	**-.09**	**-.10**	**.09**	-				
15. Humility	.01	**.09**	.06	-.03	-.02	-.01	.01	-.03	.00	.06	-.07	.01	-.07	**-.16**	-			
16. Intellective Processing Style	**.12**	.00	**.09**	**.17**	**.10**	.04	.01	.02	**.10**	.00	**.11**	.04	**.24**	**.10**	-.02	-		
17. Big Picture Thinking	**.17**	.05	**.18**	**.31**	**.20**	.04	.08	.03	**.15**	.03	**.15**	**.11**	**.42**	.01	.02	**.52**	-	
18. Meaning in Life	.00	**.11**	**.11**	**.17**	**.20**	**-.16**	**-.14**	**-.11**	**.20**	**-.10**	-.03	-.07	**.17**	**.44**	**-.09**	**.31**	**.13**	-

Note. [a]EXD vs. ELE represents bipolar item with existential distress at one end (0) and elevating experience at the other (8). The p-value was below .05 when $r = .080$, below .01 when $r = .11$, and below .001 when $r = .14$. Bolded values indicate significance at $p < .05$.

indicated that there were no significant differences in variances observed for elevating experience (Levene's statistic = .14, $p = .866$). However, there was a significant difference in variance between the videos when examining existential distress (Levene's statistic = 85.48, $p < .001$) and the bipolar question (Levene's statistic = 57.47, $p < .001$). In support of Hypothesis 2b, Levene's Test for Equality of Variances indicated that the cosmic vastness video elicited greater levels of variance in existential distress than the neutral control and the Earth nature vastness videos for existential distress ($F = 160.41$, $p < .001$; $F = 54.93$, $p < .001$ respectively) and the bipolar question ($F = 113.34$, $p < .001$; $F = 42.01$, $p < .001$ respectively).

Mediation Analyses.

Simple Mediation Analyses. As displayed in Table 12, small self, need for accommodation, experience of the unknown, and existential contemplation all individually positively mediated the relationship between witnessing cosmic vastness and elevating experience. The cosmic vastness condition (compared to the neutral control condition) elicited higher levels of all four mediators, and each mediator was positively related to elevating experience. Furthermore, small self, need for accommodation, experience of the unknown, and existential contemplation all independently positively mediated the relationship witnessing between cosmic vastness and existential distress. As was the case when predicting elevating experience, each of the four mediators related positively to existential distress. Therefore, these simple mediation analyses supported Hypothesis 4 that each of the proposed mediators would positively mediate the relationship between witnessing cosmic vastness and both elevating experience and existential distress.

Parallel Multiple Mediation Analyses. As shown in panel A of Figure 3, results from the parallel multiple mediation analysis indicate that cosmic vastness is indirectly related to

Table 12

Simple Mediation Analyses with Each Cognitive Response as a Mediator Between Cosmic Vastness Condition and Each Outcome

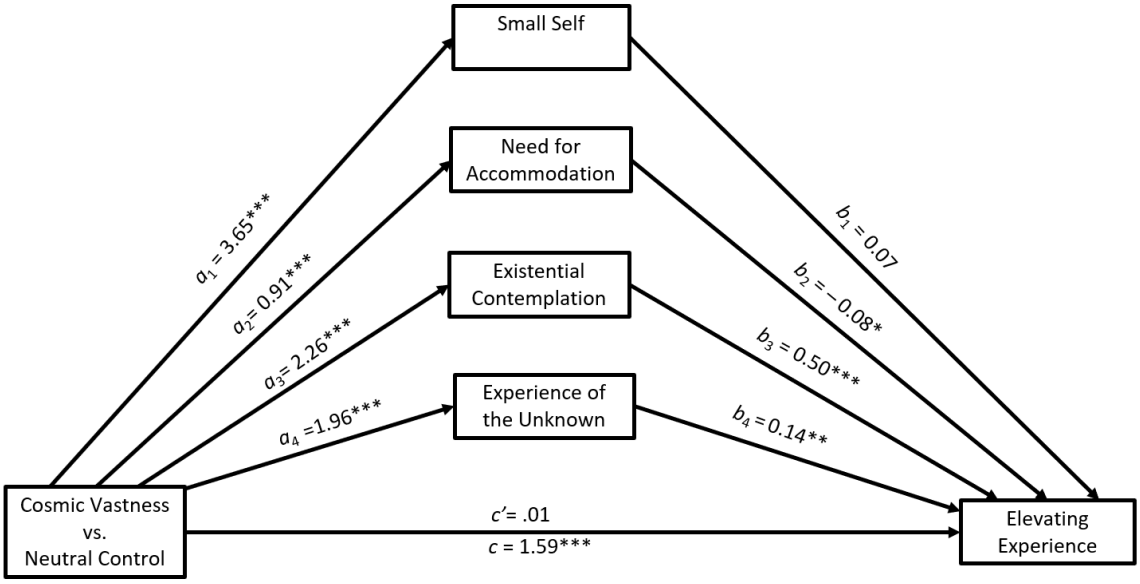
Mediator	Effects of Cosmic Vastness on Mediator (a)	Effects of Mediator on Outcome (b)	Indirect Effect on Outcome (ab) with 95% CI	Total Effect of Cosmic Vastness on Outcome (c)	Direct Effect of Cosmic Vastness on Outcome (c')
Elevating Experience as Outcome					
Small Self	3.65***	.27***	.98 [.58, 1.37]	1.59***	.62**
Need for Accommodation	.91***	.11*	.10 [.01, .20]	1.59***	1.50***
Existential Contemplation	2.26***	.55***	1.24 [1.03, 1.47]	1.59***	.34*
Experience of the Unknown	1.96***	.28***	.55 [.36, .76]	1.59***	1.04***
Existential Distress as Outcome					
Small Self	3.65***	.47***	1.72 [1.46, 2.00]	1.68***	-.04
Need for Accommodation	.91***	.29***	.26 [.16, .38]	1.68***	1.42***
Existential Contemplation	2.26***	.21***	.48 [.29, .70]	1.68***	1.20***
Experience of the Unknown	1.96***	.24***	.47 [.32, .62]	1.68***	1.22***

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

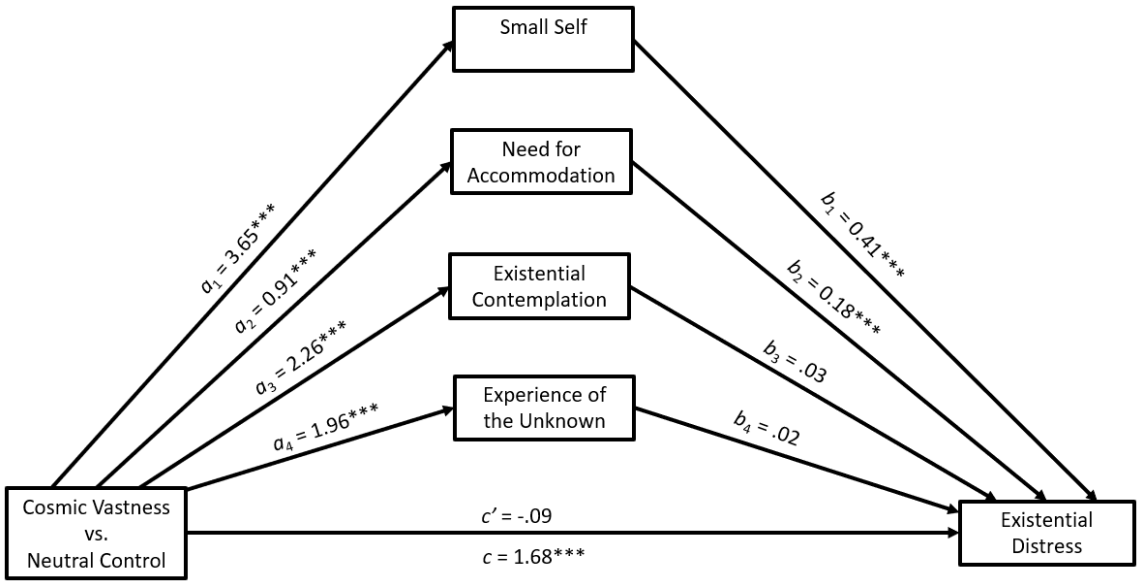
Figure 3

Parallel Multiple Mediation Models

A) Elevating Experience as Outcome



B) Existential Distress as Outcome



Note. Parallel multiple mediation models examining small self, need for accommodation, existential contemplation, and experience of the unknown as mediators between cosmic vastness and elevating experience (Panel A) and existential distress (Panel B).
* $p < .05$; ** $p < .01$; *** $p < .001$.

elevating experience through existential contemplation, experience of the unknown, and need for accommodation. The indirect effects through existential contemplation (a_3b_3 = 1.12, 95% CI = .88 to 1.37) and experience of the unknown (a_4b_4 = .27, 95% CI = .11 to .45) were significantly positive, whereas the indirect path through need for accommodation (a_2b_2 = -.08, 95% CI = -.16 to -.002) was significantly negative. The indirect effect through experience of small self was non-significant (a_1b_1 = .27, 95% CI = -.06 to .61). Cosmic vastness also did not relate to elevating experience when taking into account the indirect effect through all four mediators.

As shown in panel B of Figure 3, results from the parallel multiple mediation analysis indicated that cosmic vastness is indirectly related to existential distress through small self and need for accommodation. The indirect effects through small self (a_1b_1 = 1.50, 95% CI = 1.22 to 1.80) and need for accommodation (a_2b_2 = 0.17, 95% CI = .09 to .27) were significantly positive, whereas the indirect effects through existential contemplation and experience of the unknown were not significant (a_3b_3 = .08, 95% CI = -.09. to .25; a_4b_4 = .04, 95% CI = -.11. to .18). Moreover, cosmic vastness did not relate to existential distress when taking into account the indirect effect through all four mediators.

Supplemental Mediation Analyses. All mediation analyses were re-run while controlling for behavioural and subjective engagement because engagement was found to differ between the neutral control and cosmic vastness conditions. Specifically, subjective or behavioural engagement were entered as a covariate in predicting each of the mediators and each of the outcomes. There was little that changed with these supplemental analyses except for the significance of the indirect effect of need for accommodation in the parallel multiple mediation analysis when examining elevating experience as an outcome. If the analysis controls for engagement when watching the video (either subjective engagement or behavioural engagement

entered as a covariate), the indirect effect of need for accommodation becomes non-significant (controlling for behavioural engagement: a_2b_2 = -.08, 95% CI = -.17 to .00; controlling for subjective engagement: a_2b_2 = -.04, 95% CI = -.14 to .03). In addition, the analyses using elevating experience as an outcome were performed again when excluding the transcendence items from elevating experience (e.g., "connected with a greater whole", "part of something greater than myself"). These supplemental analyses were performed because the transcendence items may be confounded with the cosmic vastness condition, given that cosmic vastness includes witnessing something inherently greater than oneself. If the analyses are performed when excluding the transcendence items from elevating experience (e.g., "connected with a greater whole", "part of something greater than myself"), the only change in significance was the indirect effect through need for accommodation in the parallel multiple mediation analysis (a_2b_2 = -.08, 95% CI = -.16 to .01). All of these slight differences in results are likely because the significance of the indirect effect of need for accommodation was very close to the p value cut-off of .05.

Moderation Analyses

As displayed in Table 13 and 14, the interaction term between the cosmic vastness condition (cosmic vastness video vs. neutral control video) and self-esteem was significant in predicting elevating experience and existential distress. In addition, Table 14 demonstrates that the interaction between the cosmic vastness condition and meaning in life was significant in predicting existential distress.

As shown in Figure 4, simple slope analyses revealed that the cosmic vastness condition (cosmic vastness condition vs. neutral control condition) positively and significantly associated with elevating experience for people who have high levels of self-esteem (β = .63, p < .001) and

Table 13

Moderated Regression Analyses Predicting Elevating Experience

Moderator	Cosmic Vastness[1]	Moderator	Cosmic vastness[1] X moderator
Self-Esteem			
β	.51	-.02	**.16**
t	12.25	-.36	**2.70**
p	< .001	.721	**.007**
η_p^2	.268	.000	**.017**
Humility			
β	.52	-.16	.11
t	12.24	-2.64	1.78
p	< .001	.009	.075
η_p^2	.268	.017	.008
Intellective Processing Style			
β	.51	.10	.09
t	12.36	1.75	1.48
p	< .001	.080	.140
η_p^2	.272	.007	.005
Big Picture Thinking			
β	.51	.22	.09
t	12.65	3.82	1.57
p	< .001	< .001	.118
η_p^2	.281	.034	.006
Meaning in Life			
β	.53	.13	.08
t	12.67	2.04	1.25
p	< .001	.042	.213
η_p^2	.282	.010	.004

Note. [1]Cosmic vastness = cosmic vastness condition vs. neutral control condition. The interaction terms that are significant at a $p < .05$ level are in boldface. The slope reported is standardized.

Table 14

Moderated Regression Analyses Predicting Existential Distress

Moderator	Cosmic Vastness[1]	Moderator	Cosmic Vastness[1] X Moderator
Self-Esteem			
β	.57	-.13	**.15**
t	14.79	-4.12	**-2.44**
p	< .001	< .001	**.015**
η_p^2	.348	.040	**.014**
Humility			
β	.57	-.09	.08
t	14.05	-2.35	1.10
p	< .001	.019	.271
η_p^2	.326	.013	.003
Intellective Processing Style			
β	.57	.08	-.03
t	14.10	2.74	-.44
p	< .001	.007	.658
η_p^2	.327	.018	.000
Big Picture Thinking			
β	.57	.05	-.03
t	14.07	1.65	-.46
p	< .001	.100	.647
η_p^2	.326	.007	.001
Meaning in Life			
β	.56	.00	**-.16**
t	14.19	-.09	**-.277**
p	< .001	.928	**.006**
η_p^2	.330	.000	**.018**

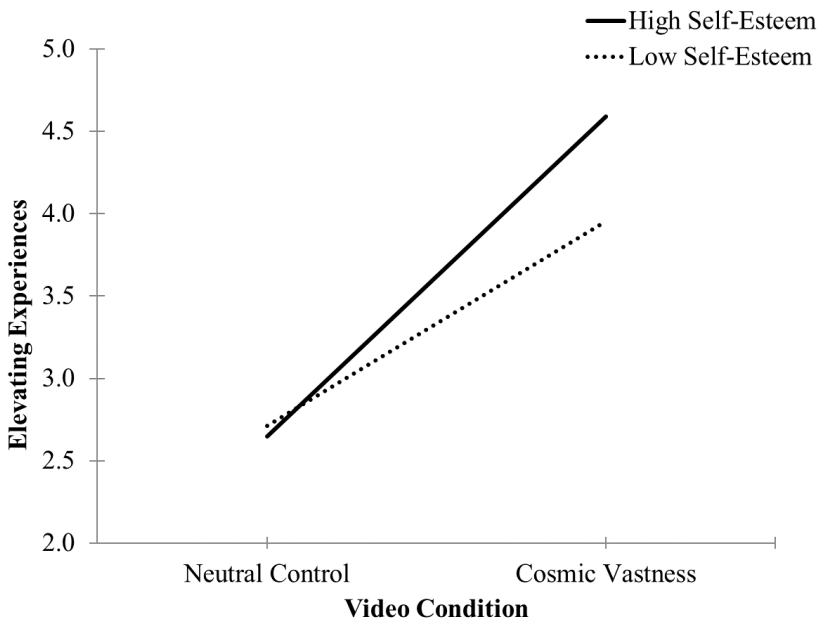
Note. [1]Cosmic vastness = cosmic vastness video versus neutral control video. The interaction terms that are significant at a $p < .05$ level are in boldface. The slope reported is standardized.

low levels of self-esteem (β = .40, p < .001). This indicates that witnessing cosmic vastness results in greater increases in elevating experience for people with high self-esteem compared to people with low self-esteem. Additional simple slopes were examined to test the linear relation between self-esteem and elevating experience for each condition. For participants watching the cosmic vastness video, higher levels of self-esteem was positively and significantly associated with higher levels of elevating experience (β = .20, p < .001). However, for the neutral control condition there was no significant relationship between self-esteem and elevating experience (β = -.02, p = .721).

As shown in Figures 5 and 6 when examining existential distress as an outcome, simple slope analyses revealed that the cosmic vastness condition was positively and significantly

Figure 4

Self-esteem as a Moderator in the Relationship Between Cosmic Vastness Condition and Elevating Experience

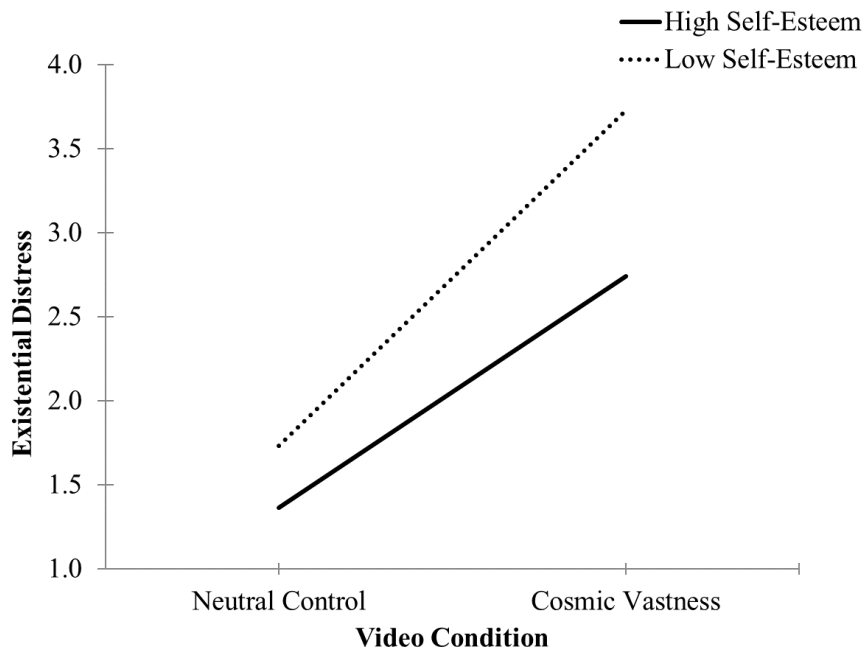


Note. Simple slopes estimated at –1 *SD* and +1 *SD* of self-esteem.

associated with existential distress for people who have high levels self esteem (β = .47, p < .001) or meaning in life (β = .45, p < .001), and low levels of self-esteem (β = .68, p < .001) or meaning in life (β = .67, p < .001). This indicates that high self-esteem or meaning in life attenuates the degree of existential distress elicited by cosmic vastness. Additional simple slopes were examined to test the linear relation between self esteem and existential distress within the neutral control and cosmic vastness conditions. Higher levels of self esteem were significantly and negatively associated with lower levels of existential distress in both the cosmic vastness (β = -.34, p < .001) and neutral control (β = -.13, p < .001) conditions. However, meaning in life was significantly negatively related to existential distress in the cosmic vastness condition (β = -.22, p = .002) but not the neutral control condition (β = .00, p = .928).

Figure 5

Moderating Role of Self Esteem in the Relationship Between Cosmic Vastness Condition and Existential Distress

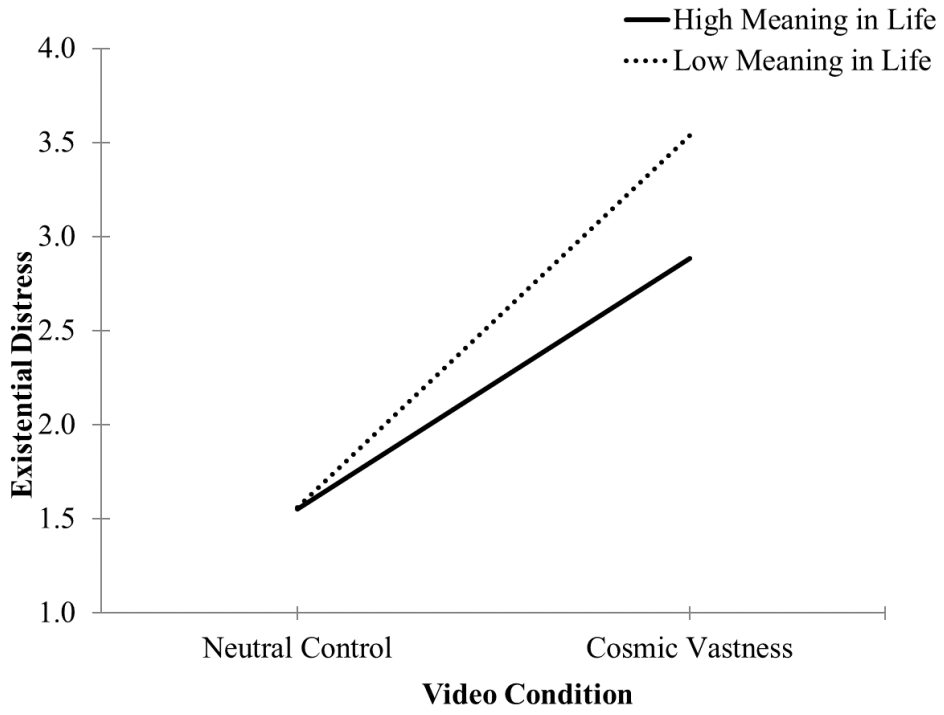


Note. Simple slopes estimated at –1 *SD* and +1 *SD* of meaning in life.

Supplemental Moderation Analyses. Similar to mediation analyses, all moderation analyses were re-run while controlling for behavioural and subjective engagement (separately). The significance of the interaction terms (cosmic vastness condition X moderator) did not change for any of the analyses when controlling for either behavioural or subjective engagement. In addition, the analyses using elevating experience as an outcome were performed again when excluding the transcendence items. The significance of the interaction terms remained unchanged with one exception. The interaction between the cosmic vastness condition and humility became significant (β = .12, t = 1.976, p = .049) in predicting elevating experience

Figure 6

Moderating Role of Meaning in Life in the Relationship Between Cosmic Vastness Condition and Existential Distress

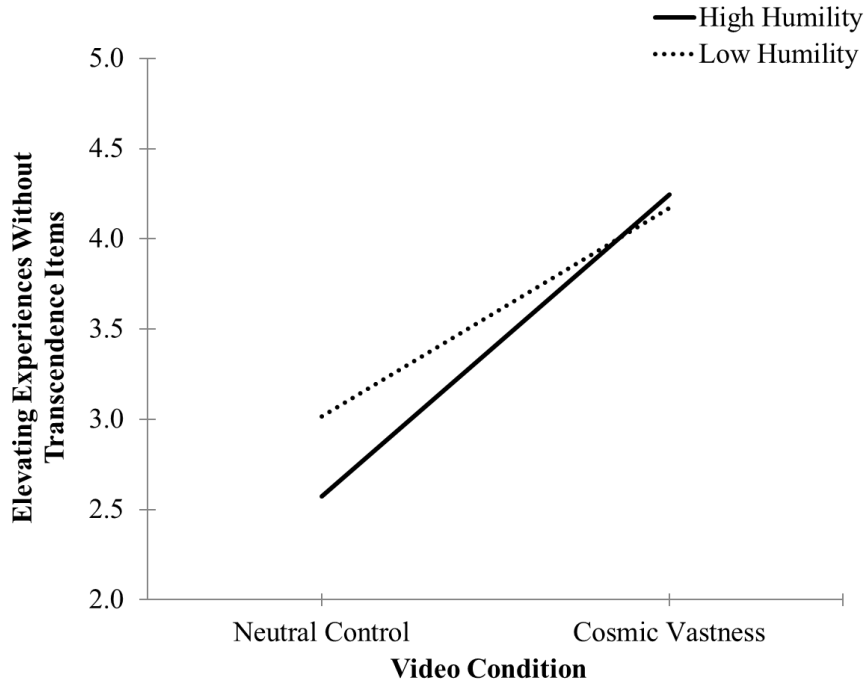


Note. Simple slopes estimated at –1 *SD* and +1 *SD* of meaning in life**.**

when excluding transcendence items. As shown in Figure 7, simple slope analyses revealed that the cosmic vastness condition was positively and significantly associated with elevating experience for participants who had both high levels of humility ($\beta = .55$, $p < .001$) and low levels of humility ($\beta = .38$, $p < .001$). Thus, higher levels of humility appeared to accentuate the degree of elevating experience a participant reports. Additional simple slopes were examined to test the linear relation between humility and elevating experience (without the transcendence items) within the neutral control and cosmic vastness conditions. Higher levels of humility were significantly and negatively associated with elevating experience in the neutral control video ($\beta = -.15$, $p = .019$), but not the cosmic vastness video ($\beta = .03$, $p = .674$).

Figure 7

Moderating Role of Humility in the Relationship Between Cosmic Vastness Condition and Elevating Experience without the Transcendence Items



Note. Simple slopes estimated at –1 *SD* and +1 *SD* of humility.

Study 2 Discussion

The purpose of Study 2 was to further understand how people react to cosmic vastness, especially in comparison to a neutral control video and an Earth nature vastness video. The aim of this study was thus to determine mediators in the positive relationship between cosmic vastness and both existential distress and elevating experience, and to determine what individual traits moderate the degree that individuals have these distinct existential experiences.

Considering the existential nature of witnessing the vastness of the universe, positive and negative existential experiences (i.e., elevating experience and existential distress) were a major focus in the present study. Since these experiences were expected to be particularly important to cosmic vastness, exploratory factor analyses tested whether elevating experience and existential distress were distinct from positive (e.g., joy, contentment) and negative (e.g. sadness, fear) affect. Elevating experience formed its own factor and was found to be distinct from positive affect, which supports previous research (Huta & Ryan, 2010) and research distinguishing various forms of elevating experience from other positive emotions (e.g, Stellar et al., 2017; Yaden et al., 2017). In addition, existential distress also formed its own factor and was distinct from negative affect and fear. This was particularly important because the state-level measure of existential distress was created ad hoc for the present study and this finding provides preliminary evidence that existential distress is a unique experience worth examining on its own.

The present study provided evidence to support Hypothesis 1a that exposure to cosmic vastness elicits both positive and negative experiences. First, cosmic vastness elicited greater levels of elevating experience than the neutral control video. However, cosmic vastness elicited lower levels of both elevating experience and positive affect than an Earth nature vastness video, which contrasted with the prediction made in Hypothesis 1b (i.e., that elevating experience

would be elicited to the same degree). Cosmic vastness may not have elicited elevating experience as strongly as Earth nature vastness because participants endorsed more negative experiences in the cosmic vastness video. Specifically, the cosmic vastness condition evoked higher levels negative affect, fear, and existential distress than the neutral control and Earth nature vastness videos. Existential distress has a small negative relationship with elevating experience in the cosmic vastness condition, but not in the neutral control (moderate positive relationship) and Earth nature vastness conditions (no relationship; see correlations in Appendix L). Thus, it is possible that the experience of existential distress attenuated or lessened the amount of elevating experience possible when watching the cosmic vastness video. Overall, these results provide further evidence that cosmic vastness elicits polarizing experiences, given that both positive and negative experiences were present.

In support of Hypothesis 2a, Study 2 replicated the findings of Study 1. Specifically, there were polarizing responses to cosmic vastness, such that a substantial number of people report predominantly elevating experience or predominantly existential distress. Specifically, when examining a bipolar question that forced participants to choose between elevating experience and existential distress, there was an almost an identical number of people who chose elevating experience and existential distress when watching the cosmic vastness video. Cosmic vastness also had significantly more variability in the degree of existential distress that people reported experiencing compared to participants who watched the neutral control video and the Earth nature vastness video. However, there was no significant difference in variability for elevating experience. These further demonstrates the polarizing reactions that people can have when witnessing cosmic vastness, especially with respect to existential distress.

Several cognitive responses were measured to determine what aspects of cosmic vastness

may account for the polarizing reactions to the video. Small self, need for accommodation, existential contemplation, and experience of the unknown were all evoked to a greater degree in the cosmic vastness video condition compared to the neutral control and Earth nature vastness video conditions. This supported Hypothesis 3 which predicted that these cognitive responses would be particularly relevant to cosmic vastness. Mediation analyses demonstrated that these cognitive responses were partly responsible for both the elevating experience and the existential distress elicited by witnessing cosmic vastness. In support of Hypothesis 4, each of these experiences significantly mediated the positive relationship between cosmic vastness and both elevating experience and existential distress. Thus, higher degrees of small self, need for accommodation, existential contemplation, and experience of the unknown resulted in higher levels of elevating experience and existential distress. When all of these mediators were put into the same analysis (i.e., parallel multiple mediations), only higher levels of existential contemplation and experience of the unknown resulted in higher levels of elevating experience (higher levels of need for accommodation resulted in lower levels of elevating experience). Conversely, only higher levels of need for accommodation and small self resulted in higher levels of existential distress. This suggests that when accounting for the role of the other potential mediators, experience of the unknown and existential contemplation were most responsible for eliciting elevating experience, whereas experience of small self and need for accommodation was most responsible for eliciting existential distress.

Study 2 also examined individual characteristics that may influence how people react to the vastness of the universe. In support of Hypothesis 5, self-esteem was a significant moderator in the relationship between witnessing cosmic vastness (compared to a neutral control condition) and both elevating experience and existential distress. People with high self esteem had greater

increases in elevating experience and smaller increases in existential distress when witnessing the vastness of the universe compared to people with low self esteem. This replicates past research demonstrating that self-esteem buffers negative experiences when witnessing cosmic vastness (Hornsey et al., 2018) and encountering existential concerns, such as one's own mortality (Routledge et al., 2010). Meaning in life also significantly moderated the relationship between the cosmic vastness condition and existential distress, such that people with high levels of meaning in life reported a smaller increase in existential distress when exposed to cosmic vastness compared to people with low levels of meaning in life. This also supports past research showing that more meaning in life can attenuate the negative effects of encountering existential stimuli that could be threatening (e.g., thoughts about one's own death, Routledge and Juhl, 2010). In contrast to Hypothesis 5, humility, intellective processing style, and big picture thinking were not significant moderators.

General Discussion

It has been said that contemplating the vastness of our universe can elicit deep feelings of inspiration, awe, wonder, and transcendence (Hornsey et al., 2018; White, 2014; Yaden et al., 2016). However, confronting such an expansive and near-infinite physical perspective can also evoke feelings of insignificance, powerlessness, and existential distress (Kahane, 2014; Nagel, 1971). The purpose of the present research was to empirically test the types of experiences people have when facing cosmic vastness and to determine why people react differently. To do this, I aimed to answer three questions: First, how do people react to cosmic vastness? In other words, what affective and cognitive responses are elicited by the vastness of the universe? Second, what is it about witnessing cosmic vastness that makes people react differently?

Specifically, what are the mediators that can explain why facing cosmic vastness elicits positive and negative existential experiences, such as elevating experience and existential distress? Third, what individual characteristics moderate the relationship between witnessing cosmic vastness and both elevating experience and existential distress? Two studies were conducted to answer these questions. The first study was primarily a qualitative study aimed to capture the experiences of participants in their own words when faced with cosmic vastness. The purpose of this study was to help identify the most relevant experiences that occur when people witness cosmic vastness. The second study was a quantitative study that investigated people's reactions to a cosmic vastness compared to two control conditions. This second experiment aimed to determine what factors mediate and moderate people's positive and negative existential experiences when witnessing cosmic vastness.

The Distinctiveness of Existential Experiences

Both studies conducted in this thesis provided evidence that existential experiences, positive or negative, were distinct from basic affect. In Study 1, categories emerged from the qualitative data that appeared to distinguish between existential experiences (i.e., elevating experience and existential distress) and basic affect (i.e., positive and negative affect). The qualitative data from this study provided valuable subjective descriptions of how elevating experience (e.g., "I was *amazed*, I felt some kind of *admiration* for how gigantic the universe is"), existential distress (e.g., "I just had a feeling of *inferiority* and *insignificance*"), positive affect (e.g., "I felt a sense of *happiness*."), and negative affect (e.g., "I felt *scared*, *nervous*, and *worried* about our planet and how small it is compared to the milky way") were experienced in response to witnessing to cosmic vastness. While past empirical studies have examined aspects of elevating experience in relation to cosmic and Earth nature vastness (e.g., awe and wonder),

the explicit examination of existential distress in this context is rare, despite theoretical and philosophical discussions that acknowledge negative existential reactions to vastness (e.g., meaninglessness, powerlessness; Kahane, 2014; Pelowski et al., 2019).

In Study 2, exploratory factor analyses were used to investigate whether elevating experience and existential distress differentiated from positive and negative affect, as it would provide further evidence that existential experiences are worth examining on their own. Using the qualitative descriptions from Study 1 as a starting point, appropriate measures of each of these experiences were selected. Since there was no measure in the literature that assessed state level existential distress in a way that encompassed the breadth of experiences reported in the qualitative data, a scale was created ad hoc for Study 2. Consistent with past theory and research (e.g., Huta & Ryan, 2010; Shiota et al., 2017), exploratory factor analyses in Study 2 demonstrated that elevating experience was distinct from positive affect. Exploratory factor analyses also showed that the multi-item measure of existential distress was distinct from factors of negative affect and fear. This appears to be a novel contribution to the literature, especially at the state level.

It is particularly interesting that existential distress formed a distinct factor from a measure of fear (including items of fear and anxiety), given how closely negative existential experiences are associated with anxiety and fear in past literature (e.g., Glas 2003, 2007; van Bruggen, 2015, 2017). Researchers often discuss fear and anxiety *of* existential experiences (e.g., meaningless, fragility, death; Glas 2003; van Bruggen 2015, 2017). However, when internal resources for coping with these situations break down (Clarke & Kissane, 2002), people can experience deeper existential feelings of meaninglessness, powerlessness, and hopelessness beneath the anxiety. In other words, fear and anxiety can be considered a “multi-layered”

experience, where they can be understood as a basic biological response to an external threat, or to be associated with deeper existential experiences, such as feelings of disconnection, powerlessness, and absurdity (Glas, 2003). Specifically, Glas argues that this deeper level of anxiety does not just represent being conscious of these existential concerns, but the way that these concerns are "embodied and lived" subjectively. Specifically, existential distress may represent a more cognitive-affective integration compared to basic emotions such as sadness, fear, and anger. Even if there is a subtle distinction and a high correlation between fear and existential distress, the present research provides evidence that existential distress is important to examine in contexts that are more existential in nature, whether it is measured on its own or with other relevant negative experiences.

The Presence and Polarization of Elevating Experience and Existential Distress

Both studies in this research provided evidence that the vastness of the universe elicited both positive and negative experiences, including existential experiences (i.e., elevating experience and existential distress), to a substantial degree. First, the qualitative data in Study 1 demonstrated that large proportions of participants experienced positive (93%) and negative experiences (68%), and that a considerable number of participants reported elevating experience (58%) and existential distress (46%). In Study 2, participants watching a cosmic vastness video experienced significantly more elevating experience than a neutral control video and more existential distress than neutral control and Earth nature vastness videos. These results helped demonstrate that these existential experiences are particularly relevant to cosmic vastness, perhaps because exposure to the vastness of the universe forces individuals to confront the nature of reality and existence at broadest physical scale possible.

Not only were both elevating experience and existential distress present, but both studies

provided evidence that there was substantial variability in the degree that cosmic vastness elicited these experiences for people. Both studies used a bipolar question that forced participants to choose between whether they experienced more elevating experience or more existential distress. Across both studies, nearly an identical number of people reported more elevating experience compared to people who reported more existential distress. In other words, there was an even split between elevating experience and existential distress. When using two unipolar measures representing elevating experience and existential distress separately, Study 1 found that the sample reported high levels of elevating experience and high levels of existential distress almost equally. Although Study 2 appeared to have more people who reported higher levels of elevating experience, the proportion of people endorsing one experience over the other was more balanced when compared with the neutral control and Earth nature vastness conditions. Study 2 also found that there was significantly more variability in the degree of existential distress reported in the cosmic vastness condition compared to the other two conditions.

Overall, both studies support philosophical and theoretical accounts that the immense size of the universe can elicit seemingly intense and polarizing existential reactions (Cochrane, 2012; Kahane, 2014; Nagel, 1971; Pelowski et al., 2019). It also further contributes to the emerging empirical research on the "dark side" of awe and the sublime (Gordon et al., 2017; Chaudhury et al., 2022). Research on the dark side of awe has typically used stimuli that are consistent with Kant's (1764/2011) description of the *dynamical* sublime, which includes overwhelming and powerful stimuli such as storms and volcanic eruptions, rather than the *mathematical* sublime, which includes stimuli of immense magnitude and size that are incomprehensible and beyond the scope of reason (e.g., the vastness of the universe). The present research demonstrates that cosmic vastness, a seemingly neutral stimulus, can be threatening due its enormous physical and

conceptual vastness, thus challenging one's self-concept relative to the grand scheme of things.

The detection of polarizing responses to the vastness of the universe was likely facilitated by some important methodological choices in the present studies. The experiments, especially the in-lab study (Study 1), were designed to encourage an atmosphere that was more conducive to existential experiences, such as solitude, silence, sufficient time, and freedom from distractions (Yalom, 1980, pg. 8). In particular, the experimental videos did not include music, which can significantly impact affective reactions (e.g., Pilgrim, et al., 2017; Zentner et al., 2008) and is often included in previous studies depicting the vastness of the universe. While there is good reason to have accompanying music when the purpose of the video is to elicit positive experiences of awe (e.g., Dai et al., 2022), the purpose of the present study was to minimize other influences beyond the content of the video. This research thus makes a contribution to the literature in that it highlights the effectiveness of these methodological choices in successfully eliciting existential experiences.

Understanding Why Cosmic Vastness Elicits Polarizing Experiences

Naturally, it was important to understand what could result in these polarizing responses to cosmic vastness. Both studies confirmed that there are cognitive responses particularly relevant to cosmic vastness. Across the two studies, cosmic vastness made people feel small (small self; e.g., "I was at a loss of words to how small I really am to the universe") and people reported having difficulty processing the content of video (need for accommodation; e.g., "it was difficult to truly acknowledge and appreciate the size of the universe"). These findings are consistent with the assertion that small self and a need for accommodation are integral experiences when facing vastness (Keltner & Haidt, 2003; Yaden et al., 2019). In addition, the present research showed that small self and need for accommodation were elicited by cosmic vastness to an even greater

degree than witnessing vast nature landscapes on Earth.

The qualitative data in the first study also revealed two cognitive responses that have not been empirically examined in past research focusing on vast stimuli. Participants appeared to engage in existential contemplation about a wide range of concerns, such as the meaning and purpose of the self and the world, spiritual beliefs, and the nature of reality and existence (e.g., "it made me really begin to question my place in the universe"). They also reported contemplating these concerns to a greater degree when watching a cosmic vastness video compared to an Earth nature vastness video. This demonstrates the existential nature of cosmic vastness, as it is the largest physical perspective that a person can consider. The cosmic vastness condition thus appeared to make participants think about what matters in life and to grapple with an awareness that there are many aspects of the universe that cannot be known or seen. Thus, it is not surprising that participants also described an experience of the unknown when witnessing the vastness of the universe. After all, this type of vastness probably elicited an awareness of unanswered questions, undiscovered places, and the amount of things that are left to be discovered (e.g., "There are so many unanswered questions or unknown questions"). Participants also reported experiencing the unknown more strongly when witnessing cosmic vastness compared to watching the Earth nature vastness video, likely because the vastness of the universe contains more unfamiliar information and places compared to the vast landscapes on Earth.

Simple mediation analyses demonstrated that these four cognitive responses accounted for why cosmic vastness elicited both elevating experience and existential distress. Specifically, each of these cognitive responses significantly mediated the positive relationship between cosmic vastness and both elevating experience and existential distress. These findings are unique

because they demonstrate how the same variables can be associated with two outcomes of opposite valence. Although the simple mediation analyses indicated that all of the cognitive responses were associated with both positive and negative outcomes, their relationship with elevating experience and existential distress changed when accounting for the variance of the each of the mediators. When parallel mediation analyses were conducted, only experience of the unknown and existential contemplation were responsible for the positive relationship between cosmic vastness and elevating experience, whereas small self and need for accommodation were responsible for the positive relationship between cosmic vastness and existential distress.

The mediation analyses in the present research demonstrated that when self small is measured in a way that exclusively focused on whether people *felt* small (e.g., metaphorical small self, Tyson et al., 2021), it related to both positive and negative experiences, even if small self appeared to have stronger relationship with existential distress than elevating experience (see zero-order correlations in Table 11 and Appendix L). These results are consistent with Hornsey and colleagues (2018) findings that small self (i.e., "self-diminishment") significantly mediated the relationship between witnessing cosmic vastness and both positive and negative affect. Thus, the ability for small self to mediate the positive relationship between cosmic vastness and elevating experience indicates that people who allow themselves to feel small, even if it is a vulnerable experience, can end up feeling more connected, elevated, and in awe of a bigger picture. This is consistent with research and theory that suggests feeling small allows a person to focus more on the surrounding world, which is more conducive to embracing, appreciating, and savoring the grandeur in an enlivening way (Bai et al., 2017; Perlin & Li, 2020; Piff et al., 2015; Stellar et al., 2018; Stellar, 2021). This finding also outlines the importance of measuring small self without making assumptions about its associations, as the most commonly used scales of

small self include items about feeling insignificant (part of existential distress) or experiences that overlap with elevating experience (e.g., feeling in the presence of something grand; see Tyson et al., 2021 for a review). As Nagel (1971) pointed out, we seem to associate size with a sense of meaning and significance. However, is it appropriate to assume that when someone feels small that they feel insignificant? For example, researchers (Stellar, 2021; Yaden et al., 2017) and philosophers (Cochrane, 2012) often associate experiences of small self with elevating experience, especially in the context of a person losing their sense of self when connecting to something greater than themselves. Whether the relationship between small self and elevating experience involves a sense of self-loss, or if people still maintain their sense of self in these moments, is unclear. However, the distinction between feeling small and self loss is important and should be examined in future research, as some believe that the experience of self-loss is a vital part of elevating experience, especially self-transcendent experiences (e.g., Dai et al., 2022; Stellar, 2021).

The experience of small self is likely the strongest mediator responsible for higher levels of existential distress because feeling small can instinctually make someone feel powerless and helpless in the face of vastness, impacting one's belief of their ability to make a difference in such a large framework. From an evolutionary perspective, feeling small likely has a relationship to primal feelings of weakness and vulnerability, as many animals attempt to make themselves appear bigger to assert social dominance (Schubert, 2005) or to startle predators when they feel threated (Drinkwater et al., 2022). This process is consistent with the findings of one past study showing that images intended to invoke fear (e.g., dangerous shark, man holding a gun) evoked similar levels of self-diminishment as images depicting vastness (e.g., a galaxy, Niagra Falls; Chaudhury et al., 2022, experiment 2).

The mediating roles of need for accommodation, existential contemplation, and experience of the unknown must also be considered to fully understand the relation between facing cosmic vastness and both elevating experience and existential distress. These factors likely reflect how they each challenge individuals in distinctive ways. Need for accommodation likely mediated the relationship between cosmic vastness and elevating experience because engaging with challenging experiences can allow people connect with something awe-inspiring. For example, when an individual is challenged to make sense of the vastness of the universe, it forces them to grapple with it and find a resolution. In order to resolve the discrepancies between one's expectations (e.g., about the size of the universe or one's relative size, importance, and impact) and the reality that they are experiencing (e.g., the sheer size of the universe), they might transform the experience using a sense of exploration (e.g., wonder), or through an expansion of their understanding (e.g., awe and feeling a part of the bigger picture), akin to "a-ha" moments (Cuzzolino, 2021; Valdesolo et al., 2017). Although need for accommodation consists of adjusting one's mental structures to accommodate new information, its small negative association with elevating experience and positive relationship with existential distress when accounting for other mediators may be due to the fact that this concept inherently measured people's *difficulty* accommodating the experience. Thus, experiencing a need for accommodation above and beyond the experience of the unknown, existential contemplation, and small self can understandably make someone feel overwhelmed. Therefore, a need for accommodation may only relate to elevating experience when it provokes a sense of challenge in a way that expands a person's perspective and transcends their current understanding in a non-threatening and fulfilling way. Conversely, need for accommodation's role in mediating the relationship between witnessing cosmic vastness and existential distress was likely due to people being unable to

make sense of the grandeur of the universe. If people are destabilized by the experience of cosmic vastness, or cannot find a way to makes sense of their experience in a satisfying way, they may feel powerlessness, meaninglessness, and confusion, especially if it is threating to one's sense of self or significance (Sundararajan, 2002; Valdesolo et al., 2017; Weger & Wagemann, 2018). It is important to note that the current study only measured the *need for* accommodation, but not whether people were *able to* accommodate the experience, which may be a valuable endeavor for future research.

Moreover, existential contemplation and experience of the unknown both mediated the relationship between witnessing cosmic vastness and elevating experience, even when controlling for other mediators. This is likely because they both reflect processes that help the individual reach beyond one's current frame of reference into areas that are mysterious and do not have clear answers. Existential contemplation evokes deeper questions about life and what is true and meaningful. This can potentially align people with their authentic selves (Jiang & Sedikides, 2021), and perspectives about the bigger picture that may remind them of their intrinsic values (e.g., "B-values" such as truth, beauty, unity, and meaningfulness; Maslow, 1971) that are typically outside of awareness in everyday activities. Being in touch with meaningful values, whether in relation to one's authentic self or to the surrounding world, can result in intense elevating experience (e.g., peak experiences, Maslow 1971). Experience of the unknown causes people to wonder what else is out there and what cannot be known, which can lead to a sense of "ineffable wonder" about the possibilities (Bonner & Friedman, 2011). It makes people conscious of what they do not know. However, existential contemplation brings up questions about spirituality, meaning, and existence that are hard to grapple with, whereas experience of the unknown makes people conscious of what they do not know. Human beings

have a need for meaning, coherence, and certainty (Heine et al., 2006; Park, 2010; Proulx & Inzlicht, 2012). If these experiences bring awareness to aspects of life and the universe that are unclear and uncertain, and if these experiences are too far outside one's comfort zone, they can lead to anxious uncertainty (Valdesolo & Graham 2014) and be destabilizing.

Understanding Individual Characteristics that Impact Reactions to Cosmic Vastness

Another integral objective to the present research was to understand what individual traits impact the degree to which people have elevating experience and existential distress when witnessing the vastness of the universe. Only self-esteem was found to significantly moderate the relationship between the cosmic vastness condition (compared to a neutral control condition) and elevating experience. Specifically, people with higher levels of self-esteem had a greater increase in elevating experience when witnessing cosmic vastness compared to people with lower levels of self esteem. This is consistent with the only other study that has examined moderators in the relationship between cosmic vastness and affective experiences (Hornsey et al., 2018). Hornsey and colleagues (2018) found that high self-esteem, but not low self-esteem, resulted in higher levels of positive affect.

In the present research, self-esteem also significantly moderated the relationship between a cosmic vastness condition and existential distress. Results indicated that high levels of self-esteem related to smaller increases in existential distress when witnessing cosmic vastness compared to low levels of self-esteem. This is also consistent with findings from Hornsey and colleagues (2018) which showed self-esteem was a significant moderator between a cosmic vastness condition and negative affect, such that there was an increase in negative affect for those with low self-esteem, but not high self-esteem. These findings are also not surprising given findings from studies examining other existentially threatening stimuli, such as facing one's

mortality (Greenberg et al., 1992; Routledge et al., 2010) and violations of one's meaning systems (Heine et al., 2006; Proulx & Inzlicht, 2012). These studies suggest that high levels of self-esteem help buffer the negative effects of existentially threatening stimuli.

Overall, the present study suggests that self-esteem bolsters the ability to have elevating experience and attenuates the amount of existential distress experienced. People with greater self-esteem ultimately have a more positive view of themselves and more emotional safety to engage with the world, especially with stimuli that can be threatening to one's self-concept, such as the vastness of the universe (e.g., potential to make someone feel small and irrelevant). Having this safe place within the self is extremely important from a developmental perspective. Research from attachment theory demonstrates that having a secure attachment and "safe base" allows people to explore the world, even when it can be threatening, because they know they have a comforting place to return to (Fraley & Shaver, 2021). This allows them to participate in the surrounding world and embrace the opportunity to engage with the vastness of the universe in a way that does not threaten their sense of worth (e.g., insignificance), competence (e.g., powerlessness), or identity (e.g., lost and destabilized), and welcomes elevating experience. This is consistent with Hornsey and colleagues (2018) suggested model, where they argue that people with high self-esteem are able to embrace feelings of self-diminishment, whereas people with low self-esteem attempt to resist these feelings.

The only other significant moderator in the present study was meaning in life when examining the relationship between cosmic vastness and existential distress. Meaning in life had a similar effect as self-esteem. Meaning in life attenuated the degree of existential distress people experienced when witnessing cosmic vastness. This further supports the hypothesis that meaning in life can serve to buffer negatives experiences related to existential threats, whether it is

experimentally induced through thoughts about death (Routledge & Juhl, 2010), or related to coping with medical conditions (e.g., cancer; Winger et al., 2016). A strong sense of meaning in life likely buffers existential distress because it is a framework that helps people make sense of one's life in the face of existential threats. Having a strong meaning in life, regardless of the source (e.g., spiritual or religious beliefs, life goals, values to live by, relationships), provides a way for someone to assimilate a potential threat into their existing framework, or affirm other aspects of their life that provide meaning outside of what the vastness of the universe may threaten. For example, the vastness of the universe may make someone feel powerless and insignificant in the grand scheme of things, but they may use spiritual beliefs to assimilate this framework (e.g., "God created this universe and everyone has a role to play") or affirm other values that are the basis of a person's meaning in life (e.g., "The universe may be vast but I am grateful to have meaningful relationships with those that I love").

The other three moderators measured – humility, intellective processing style, and trait existential thinking – were not significant moderators of the relationship between cosmic vastness and elevating experience or existential distress. Humility may not have been a significant moderator because people in the present study who scored high on humility had lower self-esteem, which seems to play an important role in how people react to the vastness of the universe. One study found that there may be a "dark side" to humility (Weidman et al., 2018). They found two different forms of humility, which they labelled as "appreciative" humility (e.g., appreciation for the self and others) and "self-abasing" humility (e.g., an increased awareness of perceived inferiority compared with others). It has been noted how difficult in can be to measure the construct of humility well (McElroy-Heltzel et al., 2018) and the scale used for the present study (Modesty facet of the Honesty-Humility Subscale of the HEXACO-PI; Lee & Ashton,

2004) had items that all focus on one's comparison to other people, which may be capturing self-abasing humility unintentionally. In addition, the psychometric properties of the scale had lower than optimal internal consistency (α = .64).

Intellective processing style and big picture thinking may not have been significant moderators because they are both more representative of cognitive processes, rather than evaluations of the self. For example, self-esteem and meaning in life reflect how one feels about one's self (e.g., "Do I feel worthy, competent, and significant") and life (e.g., "Does my life make sense and have meaning and purpose"). In contrast, intellective processing style and big picture thinking reflects one's preference in engaging with content that is abstract, challenging, deeper, and has a broader scope. Intellective processing style was predicted to be a moderator because cosmic vastness is an abstract and complex entity to contemplate and requires people to face something beyond their day-to-day life. However, the cosmic vastness video could be experienced in a more intellectual (e.g., contemplating the complexity of the universe and the implications of its size) or concrete way (e.g., finding pleasure in learning that there are lots of galaxies and places without thinking deeply about the implications). Although the former process may be more stimulating intellectually, the affective experience of witnessing the vastness of the universe may not depend as strongly on one's epistemic style as predicted. It might be more important how people emotionally engage with cosmic vastness when predicting elevating experience and existential distress. For example, it is worth examining closely related concepts to intellective processing style that have been shown to have a positive relationship with elevating experience, such as openness to experience (McCrae, 2007; Nusbaum & Silvia, 2011; Silvia et al., 2015; Yaden et al., 2019). In addition to intellectual curiosity, openness to experience encompasses open-mindedness (e.g., seeking variety) and receptiveness to a wide

range of experiences, such as being appreciative and sensitive to art and beauty, as well as openness to subtle, complex, and aesthetic emotions (Christensen et al., 2019). Hornsey and colleagues (2018) did not find that openness to experience was a significant moderator in their study, but it is worth examining with the elevating experience and existential distress as outcomes.

Big picture thinking was expected to be a moderator because it reflects a tendency to consider broader and deeper themes in life and the universe. However, perhaps some people who contemplate existential and bigger picture themes too frequently may be compensating for underlying concerns about their worth or role in the grand scheme of things. For example, searching for meaning has been associated with lower well-being and higher negative affect, unless the person has strong pre-existing levels of meaning in life (Cohen & Cairns, 2012; Park et al., 2010).

The Broader Implications of Reactions to the Vastness of the Universe

Is Existential Distress a Maladaptive Reaction?

Although the present research characterizes elevating experience as a positive experience and existential distress as a negative experience, both can be appropriate and adaptive depending on the specific context of the individual. Elevating experience, such as awe, wonder, and transcendence, are intense experiences that can result in prosocial tendencies (Piff et al., 2015), greater levels of humility (Stellar et al., 2018), an increased concern for and connection to others (Shiota et al., 2007; Van Cappellen & Saroglou, 2012), and reorient people toward pursuits that are more authentic (Jiang & Sedikides, 2021). Thus, it is clear why elevating experience is often considered beneficial. However, is there value to experiencing existential distress too? There are many experienced clinicians (e.g., Yalom, 1980) and areas of research (Calhoun & Tedeschi,

2014; Lomas & Ivtzan, 2016; Vail et al., 2012) that demonstrate that confronting negative experiences and existential concerns can lead to meaning making and psychological growth. Genuine reflection regarding the immensity of the universe provides an opportunity to face an existential challenge about the significance of human beings when considering the grand scheme of things. When reflecting on an image demonstrating how small Earth is, Carl Sagan eloquently pointed out that the advent of astronomy led to a series of "great demotions" for human beings, which provides us the opportunity to focus on what really matters:

> "Our posturing, our imagined self-importance, the delusion that we have some privileged position in the Universe, are challenged by this point of pale light. Our planet is a lonely speck in the great enveloping cosmic dark. In our obscurity, in all this vastness, there is no hint that help will come from elsewhere to save us from ourselves.
>
> The Earth is the only world known so far to harbor life. There is nowhere else, at least in the near future, to which our species could migrate. Visit, yes. Settle, not yet. Like it or not, for the moment the Earth is where we make our stand.
>
> It has been said that astronomy is a humbling and character building experience. There is perhaps no better demonstration of the folly of human conceits than this distant image of our tiny world. To me, it underscores our responsibility to deal more kindly with one another, and to preserve and cherish the pale blue dot, the only home we've ever known." – Carl Sagan (1994, p. 7)

Towards the end of the quote, Carl Sagan shared how the existential reality of the smallness and fragility of Earth emphasized to him the importance of being more kind and caring of others and the Earth. This is similar to a recent experience described by William Shatner who briefly traveled to space in a private commercial rocket. Although he saw the beauty of Earth, he

also described unsettling experiences that led to a more grounded perspective.

> "That beauty [of Earth], that magnificence of the evolutionary process, struck me so hard in that moment because when I looked in the opposite direction, into space, there was no mystery, no majestic awe to behold… all I saw was death.
>
> I saw a cold, dark, black emptiness. It was unlike any blackness you can see or feel on Earth. It was deep, enveloping, all-encompassing. I turned back toward the light of home. I could see the curvature of Earth, the beige of the desert, the white of the clouds and the blue of the sky. It was life. Nurturing, sustaining, life. Mother Earth. Gaia. And I was leaving her.
>
> … I had thought that going into space would be the ultimate catharsis of that connection I had been looking for between all living things—that being up there would be the next beautiful step to understanding the harmony of the universe… I discovered that the beauty isn't out there, it's down here, with all of us. Leaving that behind made my connection to our tiny planet even more profound." – William Shatner (2022)

Based on this description alone, William Shatner did not seem to experience a connection with the universe, but a sense of existential dread. However, this experience of existential distress helped ground him and connect him to what he values – a greater connection to Earth. Although it is helpful to have elevating experience in the face of cosmic vastness, it is important to not make assumptions about whether negative experiences, like existential distress, are judged as good or bad. Frequent experiences of existential distress over extended periods are not conducive to well-being and adaptive behaviours (e.g., van Bruggen et al., 2017), but growth from occasional experiences of existential distress can potentially lead people to live more fulfilling lives and act in ways that benefit others.

How Cosmic Vastness Relates to Other Vast and Existential Threats

Understanding how and why people react differently to the vastness of the universe can potentially inform how people react to other vast stimuli or existential threats, such as the threat of climate change. While the vastness of the universe is an existential threat to our perceived significance in the grand scheme of things, the climate crisis is a vast existential threat to our survival and has much more tangible consequences. The climate crisis naturally makes many people feel threatened and evokes existential distress, which can lead to denial, apathy, demoralization, and pessimism (e.g., Doherty & Clayton, 2011; Salomon et al., 2017). Although the crisis itself may not elevate people, there are reactions that can lead to positive existential thinking (e.g., feeling connected to the world, acknowledging the responsibility and power people have when they make choices) and feelings of inspiration and wonder (e.g., the potential of renewable energy, a more sustainable culture, and collective action).

The cognitive responses that significantly mediated the relationship between facing cosmic vastness and existential distress may be helpful for understanding how to mitigate the degree of existential distress in the face of the climate crisis. For example, the enormity and complexity of the climate crisis elicits feelings of uncertainty about the future (i.e., experience of the unknown) and existential concerns (i.e., existential contemplation; Budziszewska & Jonsson, 2021). The climate crisis likely also makes people feel small compared to a global crisis and feel challenged to grasp the scope of the problem (i.e., need for accommodation) to a degree that can be overwhelming and destabilizing. Thus, the aim of communication about the climate crisis should consider if these experiences are elicited to an extreme degree that could result in people feeling too overwhelmed by the scale of the problem, which could lead to too much existential distress and inaction. Research on climate change messaging provides some support for this, as it has emphasized the importance of providing messaging to people about the climate crisis that not

only addresses the urgency of the problem but offers potential solutions and opportunities that makes people feel capable in doing something about the climate crisis (e.g., increasing climate efficacy; Hornsey et al., 2022). Although research has demonstrated that the experience of threat and distress related to climate crisis can paradoxically increase climate efficacy (Horsney & Fielding, 2020; Hornsey et al., 2015), it may be important to understand if the climate crisis can be presented in a way that is too vast or challenging that makes people feel too small and overwhelmed when facing the problem. This is especially important for those who are vulnerable to feeling existential distress, such as people with low self esteem and low meaning in life. Thus, having people aware of the vastness of the problem and eliciting experiences of small self, need for accommodation, existential contemplation, and experience of the unknown may stimulate greater connection to the issue itself, which may motivate intentions and actions, as long as the stimulus (e.g., messaging) is not too overwhelming and without reason for hope or efficacy.

The mediators and moderators examined in the present study may also be relevant to existential distress experienced in the face of chronic and terminal illnesses. For example, having conditions that threatens one's life or creates more restrictions can make them feel smaller in life (e.g., narrowing of opportunities, less time to live), experience the unknown (e.g., uncertainty about what the future holds), contemplate existential concerns (e.g., re-evaluate goals and what is meaningful in life), and have difficulty processing their new reality (e.g., need for accommodation). Psychotherapy with patients with chronic and terminal illnesses often include existential themes, especially meaning in life (Breitbart et al., 2004). However, the way in which people respond to existential themes clearly varies. The present research shows that individual factors have an impact on whether people experience more distress or more elevation when faced with existential concepts. Therefore, for some patients, exploring existential themes in therapy

may be overwhelming and result in further demoralization. The current research thus further highlights the important role of self-esteem and meaning in life when faced with existential content, which has been found to be important in these populations (e.g., Niveau et al., 2021; Winger et al., 2016). Therefore, the assessment of these traits in patients may prove helpful for choosing appropriate interventions in therapy.

Is a Cosmic Perspective Helpful for Everyone?

It appears that there are many potential benefits of contemplating and witnessing the vastness of the universe, even when existential distress is initially present, and especially when elevating experience is elicited. Some people, including astrophysicist, author, and science communicator Neil de Grasse Tyson, encourage bringing a cosmic perspective to everyday life to remind us about what is important and to enliven people's curiosity about the universe, the bigger picture, and our place within it (de Grasse Tyson, 2017, chapter 12). With the advent of technology through virtual reality and the development of space tourism where citizens can fly briefly to space, opportunities to experience a cosmic perspective may become more and more common. While eliciting a cosmic perspective can facilitate psychological growth, it is important to understand that bringing up this perspective with everyone may not be wise. Therefore, people wanting to help others by bringing up a cosmic perspective should not only consider *what* they sharing (e.g., a cosmic perspective via the vastness of the universe) but consider *who* it can be helpful or harmful for (e.g., is the person vulnerable to feeling worthless or insignificant?), *when* it is shared with a person (e.g., is the person in a stable or vulnerable situation in their life?), and *how* it is shared (e.g., is it being forced or does the person want to engage with this discussion?).

Limitations and Future Directions

Several limitations in the present research are important to address. First, the sample

consisted of undergraduate students in Canada, which limits the generalizability of the results to other populations. In particular, it would be interesting to determine whether these results can generalize to more representative samples with a broader age range and more balanced gender ratio. It would also be particularly interesting to consider how these results may be different for people of different age groups and whether people have different types of reactions during different stages of life. Erik Erikson's psychosocial developmental theory emphasizes different challenges and milestones at different stages of life, such as the focus on generativity versus stagnation, or integrity versus despair (Marcia, 2010; 2014). For example, do people with more life experience have the capacity to have a broader perspective on life and feel less affected by the threatening nature of the vastness of the universe? It would also be interesting to examine cross-cultural variations in how people react to the vastness of the universe and whether different values, ways of living, or spiritual inclinations have an impact. For example, differences in the meaning and the experience of awe has been noted between North Americans and Japanese samples (Nakayama & Uchida, 2020). In one study, North Americans were more likely to feel positive aspects of awe than Japanese, and awe appeared to be more of a mixed emotion for Japanese compared to North Americans (Nakayama et al., 2020).

Qualitative research can be conducted in many different ways and there are some limitations to the methods chosen. Although participants provided their responses by typing them on a computer to provide more confidentiality and privacy, this method could limit the depth of responses when an interviewer is unable to ask follow-up questions, especially if participants misunderstood the question. There were also up to two people in the room (with dividers) to balance privacy and efficiency of data collection. It is worth considering having one participant at a time to provide even more privacy and space that allow existential experiences and

contemplation to be present (Yalom, 1980).

One limitation of the second study was that it was conducted online, in part due to the COVID-19 pandemic. While the results of the study are consistent with many of the predictions, there are several factors that could impact the degree that participants were fully engaged in the study, especially since it required attending to an eight-minute video. Despite validity checks and instructions that provided encouragement to watch the video in a private space with limited distractions, some people's living conditions may contain distractions that could affect the participants' immersion in the video. Future research could attempt to replicate several of these results while bringing participants into the lab and providing them with privacy, time, and freedom from distractions. It would also be interesting to explore whether similar polarizing existential experiences are present with more immersive technology that depicts the vastness of the universe, such as virtual reality or an experience at a planetarium in a museum.

In the second study, several of the scales used were created ad-hoc and were not tested in previous research. This included existential distress, small self, experience of the unknown, and existential contemplation. Although exploratory factor analyses were conducted to ensure the concepts were distinct and the scales had good internal and face validity, their psychometric properties will need to be further tested if they are used in the future.

The present research did not focus on how cosmic vastness, and these polarizing experiences, lead to shifts in values, perspectives, and priorities in life. For example, past studies that presented a video of the vastness of the universe (compared to a control video) elicited greater willingness to pursue purpose in life (Dai et al., 2022), stronger pursuit of one's authentic self (Jiang & Seikides, 2021), more humility by disclosing fewer personal strengths before sharing weaknesses (Stellar, 2018), valuing nature, and demonstrating willingness to vote for

pro-environmental initiatives (Johnson et al., 2017). In addition, Hornsey and colleagues (2018) did not find differences between a cosmic vastness video and other videos with respect to identification with others, empathy towards victims of a humanitarian crisis, and donation intentions. However, they found that self esteem moderated the relationship between witnessing cosmic vastness and these outcomes, such that people with low self-esteem had a lower identification with others, less empathy towards victims of a humanitarian crisis, and less endorsement of egalitarianism. Thus, future research should investigate how the polarizing emotional responses to cosmic vastness different lead to different motives (e.g., pro-environmental and pro-social intentions), cognitive shifts (e.g., pro-environmental and pro-social attitudes and concerns), and values (e.g., benevolence and universalism). For example, do increased concerns, motives, and values towards improving the well-being of our planet and other human beings relate stronger to feelings of existential distress about the fragility our planet and the importance to act, or to feeling elevated and uplifted to help other people? Perhaps aspects of both experiences play a role.

Future research when examining reactions to vastness and existential threats should continue to explore the role of existential distress. While the focus in past research on vast stimuli has focused predominantly on positive experiences, researchers who are interested in negative experiences need to consider the most relevant affect to measure, as this can have an impact on whether negative experiences are detected (Lambert et al., 2014). Future research could also provide further insight into the role of cognitive responses when witnessing vastness, as well as how they relate to different positive or negative experiences. The present research examined need for accommodation, small self, existential contemplation, and experience of the unknown as independent or parallel mediators. However, witnessing the vastness of the universe

is likely a much more complex psychological experience. For example, whether people are able to accommodate what they are experiencing is often considered important for determining whether a person has positive or negative experiences (e.g., Keltner & Haidt, 2003; Sundararajan, 2002). Need for accommodation is a broad concept and does not specify *what* is being accommodated or *how* it is being accommodated. It is likely that people have varying degrees in their ability to accommodate feeling small, dealing with existential questions, or coping with the unknown. For example, does feeling small lead to existential contemplation about the universe, which requires a need for accommodation? Or does existential contemplation lead to experience of the unknown and feeling small, which requires need for accommodation? Future experiments that focus on these experiences can potentially use qualitative research to provide the groundwork to elucidate how different cognitive responses relate to each other and existential experiences.

Future research could also use research on meaning-making and coping with existential threats (Park, 2010; Park and George, 2018; Proulx & Inzlicht, 2012) to examine *how* people accommodate and make sense of the vastness of the universe, as this could have a significant impact on people's emotional reactions to cosmic vastness. This could include examining the impacts of different ways of making sense of cosmic vastness, such as through acceptance of the situation, emotional processing of negative affect, pursuit of meaningful goals, and cognitive processes, such as using existing belief structures (assimilation; e.g., understanding threat through spiritual beliefs), creating a new understanding (accommodation; e.g., changing one's worldview, understanding, or beliefs), or affirming an unrelated meaning framework (affirmation; e.g., affirming a value, such as importance of being kind to others).

Future research can also continue to investigate moderators that may impact how people

react to cosmic vastness or other forms of vastness. This can include replicating findings related to self-esteem or meaning in life from the present research. For example, different aspects of self-esteem (e.g., self-liking compared to feelings of competence; Tafarodi & Swann, 2001) or meaning in life (e.g., purpose, significance, or coherence; Martela & Steger 2016) could have unique roles. Future research can also look at other moderators that may play a significant role due to their relationship with awe, such as openness to experience (Silvia et al., 2015) and need for cognitive closure (Pilgram et al., 2017). It would also be interesting to investigate what types of beliefs or worldviews might moderate the relationship between witnessing cosmic vastness and both elevating experience and existential distress. Understanding what beliefs are helpful might provide some guidance on how support others when they struggle to make meaning out of existential issues. For example, beliefs that the world is safe (e.g., comfortable, stable, fair), enticing (e.g., beautiful, meaningful, worth exploring), and alive (animated, interacts with you, needs your help) may be helpful (Clifton et al., 2019; Clifton and Yaden 2021).

Conclusion

The present research found that people can have polarizing reactions to the vastness of the universe. Participants described a range of positive and negative experiences, including reported intense existential experiences, such as elevating experience (awe, wonder, inspiration, and transcendence) and existential distress (insignificance, powerlessness, hopelessness, destabilization, vulnerability, and isolation). A substantial proportion of people experienced each of these existential reactions, and the present research provided some clues to why people have these different reactions. When facing cosmic vastness, it appears experiences of small self, need for accommodation, existential contemplation, and the unknown all have the potential to elicit

both positive and negative reactions, while small self and need for accommodation seem to be most responsible for existential distress, and existential contemplation and experience of the unknown are most responsible for elevating experience. When facing cosmic vastness, participants with high self esteem appeared to experience more elevating experience, whereas participants with low self esteem and low meaning in life appeared to experience more existential distress. Thus, the vastness of the universe has the potential to evoke powerful positive and negative existential reactions depending on the individual traits and cognitive responses present.

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Appendix A

Demographic and Background Questions

Please tell us about your background

Age _____

Gender ☐ Male
☐ Female
☐ I do not identify as male or female. I identify as_____

Religious or spiritual inclination(s) (not necessarily your official affiliation) (choose up to four)

☐ Baha'i
☐ Buddhism
☐ Christianity (Western, e.g., Catholic, Protestant)
☐ Christianity (Eastern orthodox)
☐ Confucianism
☐ Existentialism
☐ Hinduism
☐ Islam
☐ Jainism
☐ Judaism
☐ Mysticism
☐ Occult and Magic
☐ Paganism
☐ Polytheism
☐ Shinto
☐ Sikhism
☐ Spirituality
☐ Sufism
☐ Taoism
☐ Zoroastrianism
Other — Specify: _____
☐ Not religious or spiritual in any way
☐ Atheist
☐ Agnostic
☐ Unsure where I stand on religion/spirituality

Ethnic origin (check all that apply)

☐ White

☐ Chinese
☐ South Asian (*e.g., East Indian, Pakistani, Sri Lankan, etc.*)
☐ Black
☐ Filipino
☐ Hispanic
☐ Southeast Asian (*e.g., Vietnamese, Cambodian, Malaysian, Laotian, etc.*)
☐ Arab
☐ West Asian (*e.g., Iranian, Afghan, etc.*)
☐ Korean
☐ Japanese
☐ Indigenous, First Nations
Other — Specify:_____

Undergraduate year, if you're a student:

☐ 1
☐ 2
☐ 3
☐ 4
☐ 5 or higher

Primary major or program of study _____

Appendix B

Online Postings and Recruitment Texts

Study 1 Online Posting and Recruitment Text

Title: Feedback on a short video (LAB STUDY)

Description: Participants will come into the INSPIRE lab to watch a short video and answer some questions. People can have a wide range of reactions and thoughts about the same stimulus (video) and we want your feedback. The study will be one hour, and you will be granted 1 ISPR point for your participation. This study will also count as a lab study.

Please be on time for the experiment. If you arrive late you may not be able to participate in the study.

The study is being conducted by Mr. Arthur Braaten (PhD student) and Dr. Veronika Huta, associate professor from the University of Ottawa.

Your help with this project is greatly appreciated!

This study will only be conducted in English

Study 2 Online Posting and Recruitment Text

Title: Experience watching a short video

Description: Participants will watch a short video online. Participants will also answer questions about their personality and their experience watching the video. People can have a wide range of reactions and thoughts about the same stimulus (video) and we want to know your experience! The study will take approximately 45 to 60 minutes long and you will be granted 1 ISPR point for your participation.

The study is being conducted by Mr. Arthur Braaten (PhD student) and Dr. Veronika Huta, associate professor from the University of Ottawa.

Your help with this project is greatly appreciated!

This study will only be conducted in English

Appendix C

Consent Forms

Study 1 Consent Form

You are invited to participate in a study titled "Feedback On A Short Video". This research is being conducted by the principal investigator Arthur Braaten (Ph.D. student), in the context of a PhD thesis, under the supervision of Dr. Veronika Huta, associate professor at the University of Ottawa. The purpose of the study is to get feedback regarding a short video. Your participation will consist of watching the video and completing a questionnaire in the INSPIRE lab. This will take up to 60 minutes and you will receive 1 ISPR point.

There are no graphic or mature themes, images, or content in video. Therefore, we don't expect the video to cause any significant distress. However, there is a possibility that the video may cause psychological or emotional discomfort. Therefore, you are allowed to withdraw from the study at any time and you do not have to answer any questions that make you feel uncomfortable without penalty. If you decide to withdraw from the study, your data will be securely destroyed and will not be included in the study.

If for some reason you should remain distressed after the study, please note that there are always people you can talk to. The Student Academic Success Service (SASS) is available on campus for career and personal counselling, http://www.sass.uottawa.ca/about/our-services.php. The Centre for Psychological Services and Research (CPSR), provides psychological services in both French and English, [*insert address, phone number, and email].* Please note that there is a waiting-list and a fee (on a sliding scale based on your income) to obtain services from the Centre for Psychological Services and Research.

The information we obtain from you will remain strictly anonymous. You will only be asked to provide your ISPR number in the questionnaire. No other identifying information will be collected. The survey presented is hosted by an online survey company called Qualtrics. Data will be published in scientific journals and all data will be conserved for a minimum of five years after publication, after which it will be securely disposed. The digital files will be stored in a password-protected database. The consent forms will be kept in a locked room and in a locked cabinet. Only Arthur Braaten and Dr. Veronika Huta will have access to the data. This research is designed to give us insight into general patterns across many individuals and is not intended to provide direct benefits to individual participants.

For additional information about this study, you can contact the principal investigators. You can contact Arthur Braaten at [*insert email*]. You can contact Dr. Veronika Huta, at [*insert mailing address, work phone number, and email*]. If you have any general questions about your rights as a research participant, please contact the Protocol Officer for Ethics in Research, [*insert address, phone number, and email*] This information will also be provided at the end of the study. There are two copies of this consent form. One for the participant to keep and one for the research team to complete.

Study 2 Consent Form

You are invited to participate in a study titled “Experience Watching A Short Video”. This research is being conducted by the principal investigator Arthur Braaten (Ph.D. student), in the context of a PhD thesis, under the supervision of Dr. Veronika Huta, associate professor at the University of Ottawa. The purpose of the study is understand your experience watching a short video. Your participation will consist of watching the video and completing a questionnaire about your experiences and your personality. This will take approximately between 45-60 minutes of you time and you will receive 1 ISPR point.

There are no graphic or mature themes, images, or content in video. A person of any age could watch the video you will see. You are allowed to withdraw from the study at any time and you do not have to answer any questions that make you feel uncomfortable without penalty. If you decide to withdraw from the study, your data will be securely destroyed and will not be included in the study.

The information we obtain from you will remain strictly anonymous. You will only be asked to provide your ISPR number in the questionnaire. No other identifying information will be collected. The survey presented is hosted by an online survey company called Qualtrics. Data will be published in scientific journals and all data will be conserved for a minimum of five years after publication, after which it will be securely disposed. The digital files will be stored in a password-protected database. Only Arthur Braaten and Dr. Veronika Huta will have access to the data. This research is designed to give us insight into general patterns across many individuals and is not intended to provide direct benefits to individual participants.

For additional information about this study, you can contact the principal investigators. You can contact Arthur Braaten at [*insert email*]. You can contact Dr. Veronika Huta, at [*insert mailing address, phone number, and email*]. If you have any general questions about your rights as a research participant, please contact the Protocol Officer for Ethics in Research, [*insert address, phone number, and email*]. This information will also be provided at the end of the study. There are two copies of this consent form. One for the participant to keep and one for the research team to complete.

Appendix D

Instructions for Participants in Study 1

Instructions provided verbally to participants

- We are going to show you a video. It has NO sound and is less than 10 minutes long.
- The video is factual and accurate in its information
- You will **NOT** be tested or quizzed about the video.
- We are not trying to deceive or trick you either.
- We are also not video-taping or recording you during the experiment (mentioned because there are cameras in the room).
- Just let yourself be immersed in the video as much as you can and let it be a personal experience.
- There may be several of you in the room, we're simply trying to run as many participants as we can.
- We will turn the lights off on ceiling, but lights behind you and in one of the change rooms will be on
- Once the video is complete please open the survey (**show them how to**)
- If you have any questions or concerns at any time press the white button below the computer monitor on the left-hand side
- Please turn off your phone's sound and vibration, and put it away, to remove any distractions
- Remove any unnecessary things from the desk **(including phone!)**
- Tell them to get comfortable and to press the space bar once the experimenter leaves the room and the door closes.

Appendix E

Debriefing Form

***Identical for both studies*

Feedback on A short Video

Researchers:

Dr. Veronika Huta
Project Supervisor
[*insert email*]
[*insert phone number*]

Arthur Braaten
Principal Investigator
[*insert email*]

Thank you for completing our study. Your participation is greatly appreciated.

Purpose of the Study:
Let us give you more information about the purpose of the study. We are examining how people react when they are exposed to the vastness of the universe. More specifically, we are interested in whether people have different reactions, what types of reactions people do have, and why people may have these different reactions. Psychological and philosophical literature has suggested that people can react in different ways. For example, some may feel elevated and inspired, whereas other may feel diminished and sad. There is no right or wrong way to react to this video. We are simply interested in what the different reactions are and learning why.

Please do not share these details about the study's purpose with anyone else who might participate in the study in the future. People's responses can be biased if they know the exact nature of the study.

Useful Contact Information
If you have any questions or concerns regarding this study, you can contact Dr. Veronika Huta at [*insert phone number and email*]

If you have any questions concerning your rights as a research subject, you may contact the following:
University of Ottawa Office of Research Ethics and Integrity
[*insert address*]
[*insert phone number*]
[*email*]

As researchers, we are not qualified to provide counselling services and we will not be following up with you after this study. If you feel upset after completing the study, or find that some questions or aspects of the study triggered distress, talking with a qualified counsellor or clinician may help. The Student Academic Success Service (SASS) is available on campus for career and personal counselling, http://www.sass.uottawa.ca/about/our-services.php. The Centre for Psychological Services and Research (CPSR), provides psychological services in both French and English, [*insert address, phone number, and email*]. Please note that there is a waiting-list

and a fee (on a sliding scale based on your income) to obtain services from the Centre for Psychological Services and Research.

In a serious emergency, remember that you can also call 911 for immediate assistance

Appendix F

Links to Experimental Videos

Videos for Study 1

Cosmic Voyage (Video 1)

- https://vimeo.com/434173483/76a1d7e1b3?embedded=true&source=vimeo_logo&owner=116297652

Star Size Comparison (Video 2)

- https://vimeo.com/434174622/59e01a5f14?embedded=true&source=vimeo_logo&owner=116297652

Videos for Study 2

Cosmic Vastness Video
This is a slightly revised version of Video 2 (Star Size Comparison Video) in Study 1

- https://vimeo.com/427825111/e8eff3875b?embedded=true&source=vimeo_logo&owner=116297652

Earth Nature Vastness Video

- https://vimeo.com/435188563/77b2ede355?embedded=true&source=vimeo_logo&owner=116297652

Neutral Control Video

- https://vimeo.com/435189844/ad6267ac8c?embedded=true&source=vimeo_logo&owner=116297652

Appendix G

Study 1 Questionnaire

Qualitative Questions

For each open-ended question, participants will be required to write the minimum number of words, but they will be able to go beyond the maximum number of words.

1. Please describe what **feelings, thoughts, and experiences** you had during or after the video. People can have very different and unique reactions. Feel free to describe everything you experienced. (minimum 50 words)

Now that you have described your experience in your own words, we have more specific questions. Please complete each question below (1-25 words each, but you can write more if you wish). Think of these questions as reminders of things you might have experienced; your answers don't have to fit neatly into each category.

2. Did you experience any **negative or uncomfortable emotions or feelings** during or after the video? If so, what emotions and feelings did you have?

3. Did you experience any **positive emotions or feelings** during or after the video? If so, what emotions and feelings did you have?

4. Was there a point during the video when your feelings changed? If so, please describe the moment in the video when that happened. Also, describe how your feelings changed.

5. Did you experience any physical sensations or changes during or after the video? If so, what physical sensations did you have? (e.g., faster/slower breathing, goosebumps, tension, chills, etc)

6. What **spiritual, existential, or aesthetic** experiences did you have during or after the video, if any?

7. Is there anything that we did not ask about that you would like to share with us? For example, how do you think the video can be improved? (0-100 words)

Quantitative Questions

1 = Not at All, 7 = Extremely

1. Overall, how negative or uncomfortable was the experience for you?	1	2	3	4	5	6	7
2. Overall, how positive was the experience for you?	1	2	3	4	5	6	7

3. How much did the video make you feel that you were **experiencing or perceiving something vast**?	1	2	3	4	5	6	7
4. How much did the video make you feel **small**?	1	2	3	4	5	6	7
5. Overall, how much did the video make you feel diminished, insignificant, and/or undermined?	1	2	3	4	5	6	7
6. Overall, how much did the video make you feel elevated, inspired, and/or uplifted?	1	2	3	4	5	6	7

7. If you had to choose, where would you place yourself on the scale below between feeling diminished/insignificant/undermined and elevated/inspired/uplifted during or after the video
   1= extremely diminished/insignificant/undermined
   2 = much diminished/insignificant/undermined
   3 = somewhat diminished/insignificant/undermined
   4 = slightly diminished/insignificant/undermined
   5 = slightly elevated/inspired/uplifted
   6 = somewhat elevated/inspired/uplifted
   7 = much elevated/inspired/uplifted
   8 = extremely elevated/inspired/uplifted

8. Overall, how immersed and absorbed were you in the video?	1	2	3	4	5	6	7
9. How much did the video get you thinking?	1	2	3	4	5	6	7
10. How much did the content of the video differ from the things you usually think about?	1	2	3	4	5	6	7
11. How surprising was the information in the video to you?	1	2	3	4	5	6	7
12. How much did you **try** to make sense of the content of the video?	1	2	3	4	5	6	7
13. How much were you **able to** make sense of the content of the video?	1	2	3	4	5	6	7

Appendix H

Qualitative Themes and Coding Guidelines for Study 1

Category	Coding Guidelines
Manipulation Checks	
Engagement	• Descriptions of engagement, including feeling fascinated, curious, interested, intrigued, captivated, concentrated, or focused. • Descriptions of immersion, including feeling mesmerised, absorbed, drawn in, "in" the experience (e.g., "involved" with everything being experienced, seeing it "first hand", as if "I was actually there"), or a dream-like/hypnotic state (e.g., felt as if "I was dreaming or flying").
Perceived Vastness	• Descriptions of the content of the video (e.g., stars, galaxy, space, the universe) as vast, including large, big, huge, massive, long, infinite, endless, never ending, complex, ancient, or something much greater. • Descriptions of vast concepts when referring to the content of the video, including the magnitude, extent, amount, spectrum, expanse, full extent, quantity, or the sheer size or scale of something witnessed (e.g., planets, stares, galaxies, space, the universe). • Descriptions of large quantities of the content of the video, including the million/billions/trillions, infinite, innumerable, abundance, amount, many, a lot, or seeing all of something witnessed (e.g., planets, stars, galaxies, space). • Descriptions of participants acknowledging or knowing how much is out there or outside Earth, our solar system, galaxy, etc.
All Positive Experiences	• Includes responses in *positive affect* and *elevating experience.*
Positive Affect	• Includes responses in *joy and associated experiences* and *calmness.*

Joy and associated experiences	• Descriptions of joy (e.g., happiness, enjoyment, delight, cheerfulness, feeling "warmer"), excitement, pride, feeling impressed, hope and optimism (e.g., feeling encouraged, that there's potential, that things are more attainable), and aesthetic pleasure (e.g., it was beautiful, pretty).
	• Descriptions of positive responses that did not have a clear category.
	  ○ Includes answering "yes" to positive emotion question or feeling "positive" or "good" but not sharing a specific feeling
	  ○ Descriptions of enjoyment of the video (e.g., "loved", "liked," "enjoyed" video, describing it as a "nice" experience).

Category	Coding Guidelines
Calmness	• Descriptions of calmness, including feeling calm, comfort, relaxed, relief, peaceful, soothed, serene, reassured or assured, and less intimidated. • Descriptions of carefreeness, including feeling carefree, light or lightweight, freed, no tension, stress or tension gone, problems and stress gone, and worries or concerns irrelevant (if it is clear this was in a positive way).
Elevating Experience	• Descriptions of feeling in awe/awestruck, in wonder, spiritually uplifted, inspired, admiration, transcendent, blown away (e.g., mind blown, mind boggled), speechless (e.g., at a loss of words), connection with surrounding world (e.g., belonging, love for universe, how everyone/world can be together). • Description of the video or specific content of the video (e.g., number of stars, size of galaxy, etc) being amazing, exceptional, incredible, magnificent, extraordinary, astonishing, astounding, remarkable, unbelievable, jaw-dropping, magical, or wonderful. • Descriptions of associated experiences such as feeling appreciation, gratitude, empowerment, enlightenment, or a sense of meaning or purpose.
All Negative Experiences	• Includes responses in *negative affect* and *existential distress.*
Negative Affect	• Included responses from *general negative experiences*, *anxiety and fear*, and *sadness*
General Negative Experiences	• Descriptions of feeling negative, bad, uncomfortable, distressed, unsettled, overwhelmed, distraught, discomfort, disappointed, disturbed, uneasy, tense, uncertain, that the content is unnerving, or other terms that have negative connotations (e.g., strange, creepy).
Fear	• Descriptions of feeling fear, including feeling afraid, scared, terrified, fearful, or unsafe. • Descriptions of feeling anxiety, including feeling anxious, stressed, worried.
Sadness	• Descriptions of feeling sad, grief, or depressed.
Existential Distress	• Descriptions of meaninglessness, including feeling that the self, life, humans, Earth is insignificant, meaningless, worthless, irrelevant, inconsequential, unimportant, less significant/important, or that life, humans, our accomplishments, or our actions mean nothing or very little. • Descriptions of feeling powerlessness, including feeling useless, helpless, inferior, intimidated, or feeling little impact on surroundings

Category	Coding Guidelines
	• Descriptions of other related experiences such as feeling hopeless, lost, alone/lonely, an existential crisis, or a sense of absurdity.
Cognitive Responses	
Small Self	• Descriptions of the self or a personally relevant concept (e.g., humans, Earth, our solar system, milky way) as small, including miniscule, microscopic, tiny, little, a speck, a particle, or a blink. • Descriptions of feeling smaller compared to something else (e.g., planets, stars, galaxies, universe).
Existential Contemplation	• Included responses from *general existential contemplation* and *extraterrestrial life contemplation.*
General Existential Contemplation	• Contemplating one's own meaning, purpose, role, or place in life, the world, the universe, or the bigger picture. • Contemplating the meaning or purpose of life, humanity, the world, the universe, or the bigger picture (i.e., the meaning or purpose of some bigger framework). • Contemplating one's own beliefs about spirituality (e.g., religion, God, the afterlife) or the nature of reality or the universe. • Contemplating the nature of existence (e.g., of self, life, the world, the universe), including the meaning of existence (e.g., "why are we here"), the nature of existence (e.g., spiritual or scientific explanation), and the chance of existence (e.g., "it is a coincidence we are here"). • Contemplating mortality, death, and the end of things (e.g., humanity, Earth, galaxy, universe). • Contemplating one's philosophy of life and what is important in life. • Descriptions of having "existential" thoughts.
Extraterrestrial Life Contemplation	• Contemplation about the existence of life beyond Earth and whether we (i.e., life on Earth) are alone in the universe.
Experience of the Unknown	• Descriptions of experiencing the unknown, including the unexplored, unfamiliar, undiscovered, unanswered and unknown questions, mysteries of the universe, or places that have not been seen or experienced before. • Descriptions from participants acknowledging how much is still not known, including feeling there is so much we (humans) do not know, have very little knowledge about, of have yet to discover, learn, or know; that we don't know what else is out there or exists; awareness of the infinite or endless possibilities; or that there are things we cannot reach, see, visit, or explore. • Questioning or imagining what else could be out there (e.g., beyond Earth, in space, the universe, etc.).

Category	Coding Guidelines
Need for Accommodation	• Descriptions of having trouble grasping or understanding the content, including trouble with believing, appreciating, grasping, imagining, fathoming, making sense of, gathering thoughts about, or wrapping their head around the content (e.g., the size, scope, or scale). • Acknowledging being pulled out of one's normal limits, such as acknowledging one's own imagination as small or that it was more than they could comprehend, fathom, understand, or that it was incomprehensible. • Descriptions of processes such as the mind working at a fast pace to keep up and taking time to gather thoughts. • Descriptions of feeling confused or bewildered by the content of the video. • Descriptions of feeling surprised, including feeling shocked, disbelief, being caught off guard, or that the content is "crazy" or "insane."

Appendix I

Study 2 Questionnaire

Multi-item Measures of Positive and Negative Experiences

How much did the video MAKE YOU FEEL…
1 = Not at All, 7 = Extremely
**Note. All items will be randomized. The question and anchor will be repeated every 15 items.*

Positive Affect – SPANE-P (Diener et al., 2009) and ad hoc items based on Study 1

1. Positive	1	2	3	4	5	6	7
2. Good	1	2	3	4	5	6	7
3. Pleasant	1	2	3	4	5	6	7
4. Happy	1	2	3	4	5	6	7
5. Joyful	1	2	3	4	5	6	7
6. Contented	1	2	3	4	5	6	7

Negative Affect – SPANE-N (Diener et al., 2009) and ad hoc items based on Study 1

1. Negative	1	2	3	4	5	6	7
2. Bad	1	2	3	4	5	6	7
3. Unpleasant	1	2	3	4	5	6	7
4. Sad	1	2	3	4	5	6	7
5. Afraid	1	2	3	4	5	6	7
6. Scared	1	2	3	4	5	6	7
7. Frightened	1	2	3	4	5	6	7
8. Fearful	1	2	3	4	5	6	7
9. Anxious	1	2	3	4	5	6	7
10. Nervous	1	2	3	4	5	6	7
11. Worried	1	2	3	4	5	6	7
12. Angry	1	2	3	4	5	6	7

Elevating Experience – Elevating Experience Scale (Huta & Ryan, 2010)

1. Inspired	1	2	3	4	5	6	7
2. In awe	1	2	3	4	5	6	7
3. Deeply appreciating	1	2	3	4	5	6	7
4. In wonder	1	2	3	4	5	6	7
5. Enriched	1	2	3	4	5	6	7
6. Profoundly touched by the experience	1	2	3	4	5	6	7
7. Spiritually uplifted	1	2	3	4	5	6	7
8. Like I'm in the presence of something grand	1	2	3	4	5	6	7
9. Part of something greater than myself	1	2	3	4	5	6	7
10. Morally elevated	1	2	3	4	5	6	7
11. Emotionally moved	1	2	3	4	5	6	7
12. Connected with a greater whole	1	2	3	4	5	6	7
13. Part of some greater entity	1	2	3	4	5	6	7

Existential Distress – Ad hoc scale based on Study 1 and literature review

1. Diminished	1	2	3	4	5	6	7
2. Insignificant	1	2	3	4	5	6	7
3. Irrelevant	1	2	3	4	5	6	7
4. Meaningless	1	2	3	4	5	6	7
5. Worthless	1	2	3	4	5	6	7
6. Powerless	1	2	3	4	5	6	7
7. Helpless	1	2	3	4	5	6	7
8. Useless	1	2	3	4	5	6	7
9. Demoralized	1	2	3	4	5	6	7
10. Discouraged	1	2	3	4	5	6	7
11. Hopeless	1	2	3	4	5	6	7
12. Undermined	1	2	3	4	5	6	7
13. Vulnerable	1	2	3	4	5	6	7
14. Weak	1	2	3	4	5	6	7
15. Destabilized	1	2	3	4	5	6	7
16. Unsteady	1	2	3	4	5	6	7
17. Lost	1	2	3	4	5	6	7
18. Alone	1	2	3	4	5	6	7
19. Solitary	1	2	3	4	5	6	7
20. Isolated	1	2	3	4	5	6	7

Single Item Measures of Elevating Experience and Existential Distress

Elevating Experience

1 = Not at All, 7 = Extremely

1. Overall, how much did the video make you feel elevated, inspired, and/or uplifted?	1	2	3	4	5	6	7

Existential Distress

1 = Not at All, 7 = Extremely

2. Overall, how much did the video make you feel diminished, insignificant, and/or undermined?	1	2	3	4	5	6	7

Existential Distress vs. Elevating Experience

3. If you had to choose, where would you place yourself on the scale below between feeling diminished/insignificant/undermined and elevated/inspired/uplifted during or after the video

1 = extremely diminished/insignificant/undermined
2 = very diminished/insignificant/undermined
3 = somewhat diminished/insignificant/undermined
4 = slightly diminished/insignificant/undermined
5 = slightly elevated/inspired/uplifted
6 = somewhat elevated/inspired/uplifted
7 = very elevated/inspired/uplifted
8 = extremely elevated/inspired/uplifted

Manipulation Checks

Subjective Engagement
1 = Not at All, 7 = Extremely

1. How much did you feel attentive, engaged, and immersed with the video?	1	2	3	4	5	6	7

Behavioural Engagement
1 = Not at All, 7 = Extremely

1. I was doing something else while the video was playing	1	2	3	4	5	6	7
2. I was distracted while the video was playing"	1	2	3	4	5	6	7

Perceived Vastness – Ad hoc scale based on Study 1 and literature review
How much did the video make you feel like you were EXPERIENCING OR PERCEIVING SOMETHING:
1 = Not at All, 7 = Extremely
**Note. These items will be randomly interspersed with items from Experience of the Unknown because they have the same question and anchors.*

1. Vast	1	2	3	4	5	6	7
2. Immense	1	2	3	4	5	6	7
3. Enormous	1	2	3	4	5	6	7
4. Immeasurable	1	2	3	4	5	6	7
5. Huge	1	2	3	4	5	6	7

Predicted Mediators

Experience of Small self – Ad hoc scale based on Study 1 and literature review
How much did the video make YOU feel…
1 = Not at All, 7 = Extremely
**Note. These items will be randomly interspersed with items measuring positive and negative experiences because they have the same question and anchors.*

1. Small	1	2	3	4	5	6	7
2. Tiny	1	2	3	4	5	6	7
3. Miniscule	1	2	3	4	5	6	7
4. Little	1	2	3	4	5	6	7
5. Miniature	1	2	3	4	5	6	7

Need for Accommodation – Need for Accommodation Subscale from Awe Experience Scale (AWE-S, Yaden et al., 2019)
Please rate how much do you agree with each of the following statements. DURING the video…

1 = Strongly Disagree, 2 = Moderately Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Moderately Agree, 7 = Strongly Agree

1. I felt challenged to mentally process what I was experiencing	1	2	3	4	5	6	7
2. I found it hard to comprehend the experience in full.	1	2	3	4	5	6	7
3. I felt challenged to understand the experience.	1	2	3	4	5	6	7
4. I struggled to take in all that I was experiencing at once	1	2	3	4	5	6	7
5. I tried to understand the magnitude of what I was experiencing.	1	2	3	4	5	6	7

Experience of the Unknown – Ad hoc scale based on Study 1
How much did the video make YOU feel like you were EXPERIENCING OR PERCEIVING SOMETHING:
1 = Not at All, 7 = Extremely
**Note. These items will be randomly interspersed with items from Perceived Vastness*

1. Unfamiliar	1	2	3	4	5	6	7
2. Unknown to you	1	2	3	4	5	6	7
3. You knew little about	1	2	3	4	5	6	7
4. Mysterious to you	1	2	3	4	5	6	7
5. You were unaware of	1	2	3	4	5	6	7

State Existential Contemplation – Ad hoc scale based on Study 1 and literature review
How much did the VIDEO make YOU THINK ABOUT…
1 = Not at All, 7 = Extremely

1. The meaning of MY life	1	2	3	4	5	6	7
2. My purpose in life	1	2	3	4	5	6	7
3. My role in the world	1	2	3	4	5	6	7
4. My importance in the world	1	2	3	4	5	6	7
5. How to live my life and what to live for	1	2	3	4	5	6	7
6. What matters in my life	1	2	3	4	5	6	7
7. The meaning and purpose of life, the universe, or the grand scheme of things	1	2	3	4	5	6	7
8. How everything came to exist	1	2	3	4	5	6	7
9. The nature of reality or the universe	1	2	3	4	5	6	7
10. Whether there is an explanation for everything	1	2	3	4	5	6	7
11. Why we are here and the meaning of our existence	1	2	3	4	5	6	7
12. My beliefs about reality, the big picture, or spirituality	1	2	3	4	5	6	7

Predicted Moderators

Self-Esteem – Rosenberg Self-esteem Scale (Rosenberg, 1965)
Below is a list of statements dealing with your general feelings about yourself. Please indicate how strongly you agree or disagree with each statement.
1 = Strongly Disagree, 5 = Strongly Agree
**Note. The scores on items that have (-) are reversed*

1. On the whole, I am satisfied with myself.	1	2	3	4	5	6	7
2. At times I think I am no good at all. (-)	1	2	3	4	5	6	7
3. I feel that I have a number of good qualities.	1	2	3	4	5	6	7
4. I am able to do things as well as most other people.	1	2	3	4	5	6	7
5. I feel I do not have much to be proud of. (-)	1	2	3	4	5	6	7
6. I certainly feel useless at times. (-)	1	2	3	4	5	6	7
7. I feel that I'm a person of worth, at least on an equal plane with others.	1	2	3	4	5	6	7
8. I wish I could have more respect for myself.	1	2	3	4	5	6	7
9. All in all, I am inclined to feel that I am a failure. (-)	1	2	3	4	5	6	7
10. I take a positive attitude toward myself. (-)	1	2	3	4	5	6	7

Humility – Modesty Facet of the Honesty-Humility Subscale of the HEXACO-PI (Lee & Ashton, 2004)
Please read each statement and decide how much you agree or disagree with that statement.
1 = Strongly Disagree, 5 = Strongly Agree

1. I am an ordinary person who is no better than others.	1	2	3	4	5	6	7
2. I wouldn't want people to treat me as though I were superior to them.	1	2	3	4	5	6	7
3. I think that I am entitled to more respect than the average person is.	1	2	3	4	5	6	7
4. I want people to know that I am an important person of high status.	1	2	3	4	5	6	7

Intellectual Epistemic Style – Epistemic Preference Indicator (Eigenberger, Critchley, & Sealander, 2007)
The items below are organized in pairs and have to do with your preferred ways of dealing with certain questions, problems, or issues. Compare the 'a' and 'b' options, then indicate the degree to which **each** statement reflects the way you generally believe, feel, or act. Respond to **BOTH** options using the following scale:
1 = If you completely disagree with the statement
2 = If You mostly disagree with the statement
3 = If you are in between
4 = If you mostly agree with the statement
5 = If you completely agree with the statement

1. In most learning situations I like it better if:							
a. Topics are concrete and provide valuable information that is obvious and useful…	1	2	3	4	5	6	7
b. Topics involve theories and open questions that have no sure answer	1	2	3	4	5	6	7
2. Topics are concrete and provide valuable information that is obvious and useful…I prefer to invest my time in:							
a. Finding explanations for historical, natural, or human conditions…	1	2	3	4	5	6	7
b. Getting just the right information to solve my practical problems	1	2	3	4	5	6	7
3. I generally consider myself to be more:							
a. Philosophical – evaluating many diverse ideas…	1	2	3	4	5	6	7
b. Practical – finding the answer that works for me right now	1	2	3	4	5	6	7
4. The <u>most</u> valuable for the survival of society is:							
a. Using philosophy and science to question our beliefs…	1	2	3	4	5	6	7
b. Standing firm on our core beliefs and values	1	2	3	4	5	6	7
5. When it comes to deciding what to believe, I usually:							
a. Stick to the basics = the ‘tried and true’…	1	2	3	4	5	6	7
a. Experiment with different theories and beliefs	1	2	3	4	5	6	7
6. When confronting the philosophical issues of life I am more inclined to:							
a. Go into them deeply, constantly looking at different explanations…	1	2	3	4	5	6	7
b. Just deal with it, get the job done and move on	1	2	3	4	5	6	7
7. To be perfectly honest:							
a. I have very little interest in subjects like philosophy or world history…	1	2	3	4	5	6	7
b. I have a strong need to understand the past and the ideas people had	1	2	3	4	5	6	7
8. True knowledge							
a. Is basically impossible – nothing is really the way you think it is…	1	2	3	4	5	6	7
b. Is completely possible – just open your eyes and ears	1	2	3	4	5	6	7

9. It is better to be:							
a. A solid, true believer with a firm set of values…	1	2	3	4	5	6	7
b. A critical thinking who doubts everything until it's been tested and verified	1	2	3	4	5	6	7
10. I mostly have a need for:							
a. A no-nonsense, bottom-line approach to life, where I can get definite answer to my questions…	1	2	3	4	5	6	7
b. Exploring theoretical and novel questions – even if there are no definite answers	1	2	3	4	5	6	7
11. Which quote do you identify with the most?							
a. "The unexamined life is not worth living"	1	2	3	4	5	6	7
b. "Just do it"	1	2	3	4	5	6	7
12. In discussions:							
a. I become impatient when people turn simple questions of right and wrong into complicated ethical issues…	1	2	3	4	5	6	7
b. I enjoy exploring the ethical and philosophical problems I find in the world around me	1	2	3	4	5	6	7
13. Very often:							
a. I get tired of hearing scientific or theoretical explanations for everything in the world…	1	2	3	4	5	6	7
b. I try to find a variety of theoretical explanations for events and things in the world	1	2	3	4	5	6	7
14. In the simplest terms:							
a. I don't need a deep explanation for why a lot of things happen…	1	2	3	4	5	6	7
b. I have a strong need to study just *how* and *why* things happen	1	2	3	4	5	6	7
15. In general:							
a. I am most satisfied when I am working on a challenging intellectual issue…	1	2	3	4	5	6	7
b. I am more satisfied by other activities, or just relaxing	1	2	3	4	5	6	7
16. When it comes to developing a philosophy of life I have always:							
a. Done alright with just the basic guidance I received when I was young…	1	2	3	4	5	6	7
b. Tried to consider a wide range of different ideologies	1	2	3	4	5	6	7

17. If given a choice I prefer to:							
a. Deal with smaller, concrete projects that have immediate results…	1	2	3	4	5	6	7
b. Deal with global, conceptual projects with uncertain outcomes	1	2	3	4	5	6	7
18. When it comes to reading, studying and other academic work:							
a. I like to finish it up quickly and move on to other kinds of things…	1	2	3	4	5	6	7
b. I tend to become immersed, following a number of related thoughts	1	2	3	4	5	6	7

Big Picture Thinking - Scale for Existential Thinking (Allan and Shearer, 2012)
Please rate the degree to which you agree with each of the following statements
1 = Not at All, 5 = Extremely

1. Do you ever reflect on your purpose in life?	1	2	3	4	5	6	7
2. Do you ever think about the human spirit or what happens to life after death?	1	2	3	4	5	6	7
3. Have you ever spent time reading, thinking about, or discussing philosophy or beliefs?	1	2	3	4	5	6	7
4. Do you have a philosophy of life that helps you to manage stress or make important decisions?	1	2	3	4	5	6	7
5. Do you think about ideas such as eternity, truth, justice and goodness?	1	2	3	4	5	6	7
6. Do you spend time in meditation, prayer, or reflecting on the mysteries of life?	1	2	3	4	5	6	7
7. Do you discuss or ask questions to probe deeply into the meaning of life?	1	2	3	4	5	6	7
8. Do you ever think about a “grand plan” or process that human beings are a part of?	1	2	3	4	5	6	7
9. Have you ever thought about what is beyond the “here and now” of your daily life?	1	2	3	4	5	6	7
10. Do you ever think about life’s Big Questions?	1	2	3	4	5	6	7
11. Have you ever reflected on the nature of reality or the universe?							

Meaning in Life – Presence of meaning subscale from Meaning in Life Questionnaire (Steger et al., 2006)
Please take a moment to think about what makes your life feel important to you. Please respond to the following statements as truthfully and accurately as you can, and also please remember that these are very subjective questions and that there are no right or wrong answers.

Absolutely Untrue	Mostly Untrue	Somewhat Untrue	Can't Say True or False	Somewhat True	Mostly True	Absolutely True
1	2	3	4	5	6	7

1.	I understand my life's meaning.	1	2	3	4	5	6	7
2.	My life has a clear sense of purpose.	1	2	3	4	5	6	7
3.	I have a good sense of what makes my life meaningful.	1	2	3	4	5	6	7
4.	I have discovered a satisfying life purpose.	1	2	3	4	5	6	7
5.	My life has no clear purpose.							

End of Survey Verification Questions

We are interested in your experience watching the video. Please let us know if you were able to meet the following criteria while you were watching the video. Do not worry if you could not meet each requirement. This helps us understand if anything about the environment impacted your experience watching the video.

1. I was able to watch this video on a desktop computer, laptop, or screen of similar size or larger.
   □ Yes □ No, I used a mobile phone/cellphone □ Other (Please explain) _____
2. I was able to watch the video in a private room without other people present.
   □ Yes □ No □ Other (Please explain) _____
3. I was able to watch the video in silence.
   □ Yes □ No □ Other (Please explain) _____
4. I was able to watch the video without distractions from my environment.
   □ Yes □ No □ Other (Please explain) _____

Appendix J

Instructions for Participants in Study 2

Beginning of survey (after consent form)

PLEASE READ!

1) Before starting this survey please make sure that you are using a desktop computer, laptop, or a screen of similar size. PLEASE DO NOT USE A MOBILE PHONE.

This survey involves you watching a video and we would like you to be as immersed as possible in the video.

2) Sprinkled throughout the survey are several ATTENTION-CHECK QUESTIONS that test whether you are carefully reading the items. There is only one correct response for each of these questions. For example, a rating of 1 (not at all) for "I can fly by flapping my arms" or a rating of 6 for "Please select option 6 to show you are paying attention".

This helps us know if we are collecting good quality data for our study.

If you do not answer the attention-check questions correctly, we will assume your responses to the whole survey are inaccurate and we will unfortunately not be able to use your survey in our research.

Before the video

PLEASE READ!

You are about to watch a video that is less than 10 minutes long. Please do your best to minimize any distractions.

- If possible, please move yourself to a private room.
- Please turn off your phone or make sure it is on silent (no sound or vibration).
- If there are any distracting sounds around you, please consider putting headphones on (if comfortable).

Important things to know about the video

- The video you will watch has NO sound. There is nothing wrong with the video if you do not hear any anything.
- The video does NOT contain mature content. It can be watched by someone of any age.
- The video is intended to be factual and accurate in its information.
- There will NOT be any tests or quizzes about the content of the video. We are NOT studying how much people know about the video. Just let yourself be immersed in the video as much as you can and allow it to be a personal experience.

Appendix K

Cohen's d for Comparisons of Three Videos in Study 2

Table 15

Cohen's d for Comparisons between Three Videos in Study 2

Variable	Cosmic Vastness vs. Neutral Control	Earth Nature Vastness vs. Neutral Control	Cosmic Vastness vs. Earth Nature Vastness
Manipulation Checks			
Perceived Vastness	2.27	1.62	.49
Behavioural Engagement	.47	-.11	.61
Subjective Engagement	.66	.21	.46
Positive Experiences			
Elevating Experience (ELE)	1.19	1.54	-.36
Positive Affect	.14	1.14	-1.02
Negative Experiences			
Existential Distress (EXD)	1.39	.70	.82
Fear	1.15	.54	.72
Negative Affect	.80	.21	.66
Single Item Bipolar Measure			
EXD vs. ELE	-.41	.54	-.78
Cognitive Responses			
Small Self	2.57	1.34	.80
Need for Accommodation	.62	.08	.56
Experience of the Unknown	1.28	.51	.80
Existential Contemplation	1.58	1.17	.34

Appendix L

Supplemental Correlation Tables

Table 16

Zero-order Correlations in Neutral Control Video (n = 206) in Study 2.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Manipulation Check																		
1. Perceived Vastness	-																	
2. Behavioural Engagement	-.04	-																
3. Subjective Engagement	**.28**	**.35**	-															
Positive Experiences																		
4. Elevating Experience	**.68**	.03	**.38**	-														
5. Positive Affect	**.56**	**.16**	**.45**	**.81**	-													
Negative Experiences																		
6. Existential Distress	**.41**	**-.28**	-.07	**.40**	**.19**	-												
7. Fear	**.21**	**-.24**	-.04	**.22**	.06	**.74**	-											
8. Negative Affect	**.16**	**-.26**	-.13	.09	-.05	**.66**	**.61**	-										
Single Item Measure																		
9. EXD vs. ELE[a]	**.31**	**.14**	**.34**	**.50**	**.55**	**-.18**	**-.19**	**-.31**	-									
Cognitive Responses																		
10. Small Self	**.47**	.06	.11	**.54**	**.38**	**.65**	**.41**	**.34**	.04	-								
11. Need for Accommodation	**.28**	-.11	-.10	**.21**	.07	**.27**	**.17**	.12	-.02	**.18**	-							
12. Experience of the Unknown	**.51**	-.08	.08	**.45**	**.25**	**.41**	**.24**	**.20**	.02	**.39**	**.39**	-						
13. Existential Contemplation	**.69**	-.02	**.22**	**.69**	**.49**	**.45**	**.30**	**.24**	**.22**	**.40**	**.33**	**.46**	-					
Moderators																		
14. Self Esteem	-.04	.09	.01	-.03	.04	**-.28**	**-.29**	**-.20**	**.16**	**-.19**	-.05	-.07	-.04	-				
15. Humility	**-.23**	**.16**	.04	**-.19**	**-.14**	**-.20**	-.06	**-.19**	-.02	-.14	-.08	-.05	**-.21**	**-.17**	-			
16. Intellective Processing Style	.08	-.06	-.01	.12	.02	**.18**	.11	.06	-.02	.14	**.18**	**.18**	**.23**	**.21**	.01	-		
17. Big Picture Thinking	**.23**	.05	**.18**	**.25**	**.18**	.11	.10	.00	.10	**.18**	**.18**	**.21**	**.36**	.06	.07	**.51**	-	
18. Meaning in Life	**.22**	.02	.13	**.14**	**.16**	-.01	-.04	-.04	**.17**	-.02	**.11**	**.12**	**.21**	**.39**	-.04	**.36**	.10	-

Note. [a]EXD vs. ELE represents bipolar item with existential distress at one end (0) and elevating experience at the other (8). The p-value was below .05 when $r = .14$ below .01 when $r = .19$, and below .001 when $r = .23$. Bolded values indicate significance at $p < .05$.

Table 17

Zero-order Correlations in Earth Nature Vastness Video (n = 206) in Study 2.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Manipulation Check																		
1. Perceived Vastness	-																	
2. Behavioural Engagement	.12	-																
3. Subjective Engagement	**.32**	**.52**	-															
Positive Experiences																		
4. Elevating Experience	**.47**	**.22**	**.54**	-														
5. Positive Affect	**.28**	**.24**	**.56**	.84	-													
Negative Experiences																		
6. Existential Distress	**.23**	**-.17**	.02	.06	**-.15**	-												
7. Fear	.13	-.13	.05	.00	**-.22**	**.60**	-											
8. Negative Affect	-.01	**-.25**	-.11	-.13	**-.31**	**.53**	**.63**	-										
Single Item Measure																		
9. EXD vs. ELE[a]	**.17**	**.24**	**.35**	**.59**	**.67**	**-.41**	**-.32**	**-.37**	-									
Cognitive Responses																		
10. Small Self	**.25**	.11	**.17**	**.20**	**.14**	**.50**	**.31**	.14	-.05	-								
11. Need for Accommodation	**.25**	-.06	.11	**.23**	.07	**.42**	**.39**	**.37**	-.05	**.29**	-							
12. Experience of the Unknown	**.35**	.09	**.18**	**.36**	**.23**	**.29**	**.15**	.01	.10	**.30**	**.29**	-						
13. Existential Contemplation	**.42**	**.21**	**.43**	**.65**	**.48**	**.23**	**.22**	-.01	**.30**	**.20**	**.35**	**.37**	-					
Moderators																		
14. Self Esteem	.02	.06	.12	**.22**	**.24**	**-.25**	**-.15**	-.08	**.23**	-.11	-.04	-.11	**-.18**	-				
15. Humility	**.18**	.06	.04	.04	.07	.04	-.01	-.01	.01	.09	-.06	.09	-.01	-.17	-			
16. Intellective Processing Style	**.14**	-.01	.08	**.21**	**.16**	-.02	-.05	.00	**.16**	-.11	**-.14**	-.04	**.30**	**.21**	.01	-		
17. Big Picture Thinking	**.23**	.06	**.17**	**.36**	**.24**	.02	.07	-.03	**.19**	-.08	**.18**	.04	**.54**	.06	.07	**.51**	-	
18. Meaning in Life	-.02	.05	**.19**	**.23**	**.20**	**-.15**	-.02	-.02	**.16**	**-.17**	-.06	-.09	**.31**	**.39**	-.04	**.36**	.10	-

Note. [a]EXD vs. ELE represents bipolar item with existential distress at one end (0) and elevating experience at the other (8). The p-value was below .05 when $r = .14$ below .01 when $r = .19$, and below .001 when $r = .23$. Bolded values indicate significance at $p < .05$.

Table 18

Zero-Order Correlations in Cosmic Vastness Video (n = 207) in Study 2.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Manipulation Check																		
1. Perceived Vastness	-																	
2. Behavioural Engagement	-.01	-																
3. Subjective Engagement	**.24**	**.41**	-															
Positive Experiences																		
4. Elevating Experience	**.24**	**.17**	**.36**	-														
5. Positive Affect	.10	**.19**	**.26**	**.72**	-													
Negative Experiences																		
6. Existential Distress	**.16**	-.11	.04	**-.17**	**-.42**	-												
7. Fear	.11	-.02	.11	**-.18**	**-.43**	**.80**	-											
8. Negative Affect	.01	-.07	.04	**-.28**	**-.48**	**.75**	**.79**	-										
Single Item Measure																		
9. EXD vs. ELE[a]	.01	**.19**	**.18**	**.47**	**.64**	**-.74**	**-.59**	**-.62**	-									
Cognitive Responses																		
10. Small Self	**.28**	-.07	.08	.11	-.11	**.54**	**.42**	**.31**	**-.38**	-								
11. Need for Accommodation	**.21**	-.11	-.04	.04	**-.15**	**.41**	**.47**	**.34**	**-.27**	**.27**	-							
12. Experience of the Unknown	**.48**	-.07	**.15**	**.20**	.00	**.29**	**.32**	**.18**	**-.14**	**.30**	**.51**	-						
13. Existential Contemplation	**.23**	-.12	**.29**	**.49**	**.31**	**.20**	**.19**	.13	.04	**.29**	.13	**.21**	-					
Moderators																		
14. Self Esteem	.02	**.15**	.13	**.24**	**.35**	**-.31**	**.27**	**-.29**	**.35**	-.07	**-.16**	**.17**	.11	-				
15. Humility	.04	.04	.13	-.01	.02	.01	.02	-.01	.00	**.16**	-.10	-.03	-.07	-.09	-			
16. Intellective Processing Style	**.27**	**.15**	**.27**	**.26**	.13	.04	.02	.03	.12	.05	.03	-.01	**.34**	-.01	-.07	-		
17. Big Picture Thinking	**.15**	.07	**.23**	**.40**	**.19**	.01	.09	.07	**.16**	.04	.11	.09	**.53**	.11	-.11	**.56**	-	
18. Meaning in Life	-.06	.09	.07	**.28**	**.26**	**-.22**	**-.22**	**-.16**	**.21**	-.05	-.07	**-.15**	**.17**	**.51**	-.10	**.20**	**.32**	-

Note. [a]EXD vs. ELE represents bipolar item with existential distress at one end (0) and elevating experience at the other (8). The p-value was below .05 when $r = .14$ below .01 when $r = .19$, and below .001 when $r = .23$. Bolded values indicate significance at $p < .05$.

Table 19

Zero-Order Correlations for Participants in Neutral Control and Cosmic Vastness Video (n = 413) in Study 2

	1	2	3	4	5	6	7	8	9	12	13	14	15				
Manipulation Check																	
1. Perceived Vastness	-																
2. Behavioural Engagement	**.15**	-															
3. Subjective Engagement	**.40**	**.40**	-														
Positive Experiences																	
4. Elevating Experience	**.65**	**.18**	**.46**	-													
5. Positive Affect	**.38**	**.17**	**.37**	**.69**	-												
Negative Experiences																	
6. Existential Distress	**.55**	.02	**.18**	**.29**	**-.14**	-											
7. Fear	**.35**	.04	**.20**	**.21**	**-.19**	**.85**	-										
8. Negative Affect	**.22**	-.02	**.10**	.06	**-.28**	**.78**	**.80**	-									
Single Item Measure																	
9. EXD vs. ELE[a]	-.08	.08	**.15**	**.29**	**.56**	**-.62**	**-.54**	**-.58**	-								
Cognitive Responses																	
10. Small Self	**.74**	**.15**	**.30**	**.56**	**.11**	**.73**	**.61**	**.47**	**-.32**	-							
11. Need for Accommodation	**.38**	-.03	.03	**.25**	-.03	**.45**	**.45**	**.35**	**-.23**	**.37**	-						
12. Experience of the Unknown	**.68**	.07	**.26**	**.51**	**.14**	**.52**	**.47**	**.34**	**-.18**	**.60**	**.52**	-					
13. Existential Contemplation	**.71**	**.16**	**.38**	**.72**	**.35**	**.52**	**.45**	**.34**	-.05	**.65**	**.35**	**.56**	-				
Moderators																	
14. Self Esteem	.00	**.10**	.06	**.10**	**.19**	**-.22**	**-.21**	**-.22**	**.26**	-.06	**-.10**	-.09	.04	-			
15. Humility	-.05	**.12**	.08	-.07	-.06	-.02	.01	-.04	-.01	.05	-.08	-.02	-.09	**-.16**	-		
16. Intellective Processing Style	**.11**	.01	**.10**	**.16**	.08	.06	.04	.03	.07	.05	**.10**	.07	**.22**	-.02	-.01	-	
17. Big Picture Thinking	**.14**	.06	**.20**	**.29**	**.18**	.05	.09	.06	**.13**	.08	**.14**	**.14**	**.36**	.04	-.04	**.52**	-
18. Meaning in Life	.00	.02	.07	**.14**	**.21**	**-.16**	**-.18**	**-.14**	**.20**	-.08	-.01	-.06	**.10**	**.46**	**-.11**	**-.15**	**.28**	-

Note. [a]EXD vs. ELE represents bipolar item with existential distress at one end (0) and elevating experience at the other (8). The p-value was below .05 when $r = .10$, below .01 when $r = .14$, and below .001 when $r = .16$. Bolded values indicate significance at $p < .05$.