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Conceptualizing Positive versus Negative Awe: Do Connection and Self-Significance Interact to Determine Awe's Valence?

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Conceptualizing Positive versus Negative Awe:

Do Connection and Self-Significance Interact to Determine Awe's Valence?

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Biography

The author was born in New York, New York, on July 6, 1993. He graduated from New Canaan High School, in New Canaan, Connecticut, in 2011. He received his Bachelor of Arts degree in Psychology from University of Maryland, College Park, in 2015. In 2020, he received his Master of Arts degree in Psychological Science at DePaul University in Chicago, Illinois.

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Abstract

In this dissertation, I adopted an appraisal theory approach to differentiating positive and negative experiences of awe. In addition to assessing traditional appraisal dimensions, I focused on self-diminishment and connectedness as the appraisals hypothesized to best differentiate awe by valence. I predicted that self-diminishment and connectedness would interact to determine whether awe is experienced as positive or negative, arguing that feeling "small" can be positive if paired with feeling connected but that feeling small can be negative if paired with feeling isolated. An exploratory study (n = 742) induced participants to feel an emotion (positive awe, negative awe, joy, or fear) before rating the descriptiveness of 24 appraisals of the emotion-inducing experience (including self-diminishment and connectedness). Compared to positive awe, negative awe was associated with greater appraisals of need for accommodation, self-diminishment, and isolation, and lower appraisals of connectedness and certainty. Five pilot studies were conducted to validate a video awe induction of awe and essay-based manipulations of self-diminishment and connectedness manipulations. Finally, Experiment 2 (n = 309) tested the theorized model that self-significance and connectedness interact to differentiate positive and negative awe; Experiment 2 also included an exploratory eye-tracking sample (n = 62). Although the predicted interaction was not significant, connectedness was associated with experiencing awe as more positive and less negative. Additional analyses suggested that whether one feels connected or isolated may change whether feelings of significance are experienced positively or negatively. Together, the studies are a further step in using appraisal theory to understand awe's variants.

Keywords: awe, self-diminishment, connection, appraisals

Conceptualizing Positive versus Negative Awe: Connection and Self-Significance's Relationship with Awe's Valence

Extraordinary works of art, music, theater, natural wonders like the Grand Canyon, and performances that push the human limits such as in Cirque du Soleil are all sights that can create the fleeting and rare experience of awe. These examples reflect the kinds of experiences that individuals tend to report when asked to describe their awe experiences, in that they are overwhelmingly positive in nature (Shiota et al., 2007). But although awe might often be wondrous, it can also be tinged with fear, and even dictionary definitions reflect awe's bi-valenced nature (e.g., "an overwhelming feeling of reverence, admiration, and fear, produced by that which is grand, sublime, extremely powerful, or the like;" https://www.dictionary.com/browse/awe). Philosophical, religious, sociological, and even psychological treatments of awe also reflect its capacity to be experienced negatively (Keltner & Haidt, 2003), and yet relatively little empirical work in psychology has been directed toward understanding awe's mixed nature. The goal of this dissertation is to differentiate positive and negative[1] awe through the lens of appraisal theory. Attempts will be made to identify appraisals and appraisal themes that differentiate the variants qualitatively (i.e., appraisals that differentiate one but not both variants from baseline, or that differentiate the variants from baseline in opposite ways) and quantitatively (i.e., appraisals that differentiate the two variants from one another).

[1] The existing literature tends to use the term "threat-based awe" instead of "negative awe" (Chaudhury et al., 2021; Gordon et al., 2017). Because there is no clear label that applies to all positive awe experiences (which could be based in beauty, spirituality, innovation, achievement, and more), I prefer the term "negative awe" simply to provide a parallel.

A Brief History of Awe: Religious and Philosophical Perspectives

Awe in Religion

Throughout history, awe has been associated with experiences of the divine or supernatural and has been a central aspect of religious practice and ritual. In ancient cultures, natural phenomena such as thunder, lightning, and earthquakes were often seen as manifestations of powerful gods, inspiring awe and fear in those who witness them. In many religious traditions, awe has been linked to experiences of transcendence or mystical states of consciousness. For example, in some forms of Hinduism, awe-inspiring experiences are seen as a means of connecting with the divine and achieving spiritual enlightenment. Similarly, in many forms of Buddhism, awe-inspiring experiences such as those encountered by bodhisattvas (people on the path toward Buddhahood) are seen as important milestones in the spiritual journey towards enlightenment.

In Judaism, awe is closely associated with the concept of yirat shamayim, or "fear of heaven", refers to a profound sense of reverence for God and a recognition of one's own smallness in the face of the divine (Artson, 2001). In Christianity, awe is often associated with experiences of grace and the majesty of God, and is expressed through practices such as worship, prayer, and meditation. Awe-inspiring experiences such as those encountered during religious pilgrimage are also seen as important ways of connecting with the divine.

In religious contexts, awe-inspiring experiences are often associated with a sense of connection to something greater than oneself and may play an important role in promoting feelings of spirituality (Keltner & Haidt, 2003). By inspiring feelings of humility and reverence, awe can also signal the presence of a higher power and serve to

remind the individual of their relative status. From a religious perspective, awe has played an important role in human history and continues to be an important aspect of spiritual practice today.

Awe in Philosophy

Awe has also been the subject of philosophical inquiry since ancient times. For instance, Aristotle thought that awe and wonder were the beginning of philosophy, as it leads one to question the nature of reality and existence (Pecorino, n.d.). Philosophers such as Plato and Aristotle saw awe as an important aspect of the human experience and a key element in developing a sense of reverence for the world. In modern times, philosopher such as Martha Nussbaum have argued that awe is a crucial element of aesthetic experience and that when we experience awe in response to art, we are recognizing the intrinsic value of the work and engaging with it in a deep and meaningful way (Nussbaum, 2003). Overall, philosophers have historically seen awe as a complex emotion that can reveal fundamental truths about the world and our place in it.

The sublime has been another central theme in philosophical discussion, with both the sublime and awe being associated with experiences of overwhelming vastness or power and positive and negative emotions (Arcangeli et al., 2020). The concept of the sublime can be traced back to ancient Greek philosophy, where it was used to describe the transcendent power of the gods. Later, in the 18th century, the philosopher Edmund Burke wrote extensively on the sublime, arguing that it involved feelings of terror or fear in the face of overwhelming power or vastness, tempered by a sense of pleasure or delight (Burke, 1757/1759). Burke theorized that two properties grant stimuli the ability to elicit the sublime experience. Power, understood as the capability to destroy and

control the perceiver's will, is the first property. Power differentiates the sublime from aesthetic-based awe, and thus, is more akin to threat-based awe, which calls the perceiver's wellbeing into jeopardy. Obscurity, understood as something that is unexpected and does not fit into our current view of the world, is the second property of stimuli that produces the sublime experience (Keltner & Haidt, 2003). The connection that power and obscurity have to the central themes of awe that I will discuss in later sections of this dissertation—vastness and need for accommodation—becomes more apparent.

Just as the sublime contains positive and negative elements, awe can also present itself with different "flavors," some of which are threat-based, which will be the focus of this examination. A possible approach to disentangling the different variants of awe is through an appraisal-based approach, which is discussed in more detail in the following sections.

Awe from a Psychological Perspective: An Appraisal Theory Approach to Awe

The appraisal theory of emotion proposes that emotions derive from subjective evaluations of an environment or event (Arnold, 1945; Lazarus, 1966). Theorists in this domain, including Smith and Ellsworth (1985) and Scherer (1982), propose that certain appraisals, and patterns of appraisals, differentiate emotional experiences. The combination of values on appraisals give rise to physiological responses, action tendencies (i.e., a motivation to engage in approach or avoidance behaviors), and subjective feelings, which together define discrete emotions. Using a positive and a negative emotion as examples, happiness derives from appraisals high on *certainty* about how predictable the event is, and appraisals high on *personal control* such that they can

exert influence over the event. On the other hand, fear derives from appraisals low on *certainty* about the event and low on *personal control* such that they have little power over the event, and appraisals high on *situational control* such that the event was directed by circumstances beyond anyone's control (Smith & Ellsworth, 1985). The differences in levels on each appraisal bring about different subjective experiences.

Two recent studies have taken an appraisal approach in examining positive and negative awe.[2] Gordon et al. (2017) conducted five studies. Study 1 assessed the prevalence of negative awe by coding narratives written by participants provided with a definition of awe during an emotion recall task, and results showed that approximately one in five awe experiences were threat-based. Study 2a and 2b examined whether positive and negative awe were associated with different appraisals and subjective experiences; in Study 2a, participants described any awe experience, whereas in Study 2b participants were assigned to describe either a positive or negative awe experience. In Study 3, all participants watched the same awe-inducing video while physiological data on sympathetic nervous system activity was recorded. Studies 4 and 5 employed daily diaries and video-based inductions, respectively, to test the association between positive and negative awe and wellbeing.

Chaudhury et al. (2021) also reported five studies, two of which were replications of Gordon et al. (2017). Studies 1–3 all assessed the same appraisals as those assessed by

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[2] A third study (Taylor & Uchida, 2019) also used an appraisal approach, but one aspect of the procedure makes the findings unclear for the current analysis. Specifically, participants wrote about a time where they felt that someone or something was "amazing or sublime" (awe) or "harmed or damaged" (horror)—but negative awe does not necessarily involve harm or damage, and harm or damage may transform negative awe into fear. Nonetheless, because of the similarity between horror and negative awe, I will acknowledge Taylor and Uchida's findings where appropriate.

Gordon et al., and Studies 4–5 extended the research to assess risk inclinations. Study 1 included inductions of positive awe, pride, and happiness, whereas Studies 2–5 included inductions of positive awe, negative awe, fear, and neutral affect. Finally, Study 2 used an image exposure task to induce affective states, whereas the remaining studies used the same essay-writing task used by Gordon et al. (2019).

Both sets of studies compared awe-specific appraisals of *vastness*, *need for accommodation*, and *self-diminishment*, as well as more traditional appraisals of *valence*, *certainty*, and *responsibility/control* (personal, situational, and other).

Awe-Specific Appraisals

Four appraisal themes have been identified in the awe literature. In an integrative review of religious, sociological, philosophical, and psychological conceptions of awe, Keltner and Haidt (2003) identified two core appraisal themes supporting awe: perceived vastness and a need for accommodation. In short, they asserted that awe results from an individual perceiving something as so vast that is difficult to comprehend. The work that has followed from Keltner and Haidt's (2003) analysis has led to the identification of two additional core appraisal themes: self-diminishment and connectedness. Perceiving vastness makes people feel relatively "small" and awe experiences—at least positive awe experiences—make people feel connected to others and their environment (Piff et al., 2015; Shiota et al., 2007).

Keltner and Haidt's (2003) analysis acknowledges that awe experiences can be "flavored" by additional themes such as threat, beauty, ability, virtue, and the supernatural. For example, perceptions of beauty elicited by a grand vista and threat elicited by a tornado would be associated with positive awe and negative awe,

respectively. However, these differences were not systematically explored by Keltner and Haidt, and nothing in their analysis suggests how or whether core appraisal themes might differentiate positive and negative awe.

Perceived Vastness. Perceived vastness refers to the individual perceiving something much larger than the self, or beyond the scale of their current understanding of the world. Elicitors do not necessarily need to be vast in physical size; they can be conceptually vast and imply that, in some manner, the stimulus has consequences far beyond what was initially understood. For example, a theory of physics may induce vastness such that its explanatory power stretches outside of an individual's concept of a theory. Vastness can refer to social import, such as when an individual's actions or abilities have far-reaching impact on the world. For something to be perceived as vast, it must push the limit of the individual's concept of the world and attempt to expand one's frame of reference (Shiota et al., 2007).

As it is defined in the literature, awe is associated with greater feelings of perceived vastness compared to a neutral state. Within the awe variants, based on valence alone, positive awe should be associated with greater appraisals of vastness than negative awe because positive emotions are theorized to broaden mental schemas and expand one's worldview (Fredrickson, 1998, 2001). This reasoning has been supported by research: Chaudhury et al. (2021) demonstrated that participants experiencing either variant of awe reported greater vastness compared to a neutral condition; and Chaudhury et al. (2021) and Gordon et al. (2017) demonstrated that participants experiencing positive awe report greater vastness than participants experiencing negative awe. Perceived vastness, then, distinguishes negative from positive awe quantitatively rather

than qualitatively: Both positive and negative awe differ in the *same* direction from baseline. Perceptions of vastness alone do not differentiate between positive and negative awe but differentiate both from a neutral state.

Need for Accommodation. Accommodation is defined as the process in which an individual changes their frame of reference to integrate an experience into their worldview (Keltner & Haidt, 2003; Shiota et al., 2007). A need for accommodation, in the context of awe, occurs when an individual is unable to make sense of an experience with vast qualities, thereby motivating them to resolve the failed integration by altering their cognitive structures. A need for accommodation is characterized by a difficulty in comprehending the experience and feeling challenged to take in and process the situation (Yaden et al., 2019). For example, after viewing a cosmos exhibit at a planetarium, an individual may feel driven to change how expansive they understand the universe to be. Additionally, witnessing a remarkable act of altruism or a monstrous act of immorality, exceeding the viewer's expectations, creates a motivation to adjust how they view what humans are capable of. After experiencing these "mind-bending" situations, individuals are driven to change their existing mental schemas so to process and integrate the incoming information (Yaden et al., 2019).

Since the overwhelming vastness of a situation drives the need for accommodation, these factors should be directly positively associated with one another. Thus, people experiencing awe should have higher levels of need for accommodation than people in a neutral state. And since positive awe should be associated with greater perceived vastness than negative awe, this pattern should hold true for need for accommodation as well (i.e., a quantitative difference). Chaudhury et al. (2021)

demonstrated that participants experiencing either awe variant reported greater need for accommodation than participants in neutral conditions; however, Gordon et al. (2017) and Chaudhury et al. (2021) found no evidence that participants experiencing positive awe reported greater need for accommodation than participants experiencing negative awe.

Self-Diminishment. Self-diminishment, or feeling "small," refers to perceiving that some aspect of the self has diminished relative to a vaster entity. Self-diminishment is considered key to awe experiences and can be experienced as physical diminishment as well as psychological diminishment (Bai et al., 2017; Campos et al., 2013; Keltner & Haidt, 2003; Piff et al., 2015; van Elk et al., 2016); That is, it can involve feeling physically smaller or feeling insignificant. Extraordinary vastness that transcends our current frame of the world can change how an individual perceives themselves in relation to the world (Keltner & Haidt, 2003; Shiota et al., 2007). These experiences can shift the individual's focus outward on the unexplored frontiers that have just been exposed to them and change how they view their own significance (Piff et al., 2015; Shiota et al., 2007). A change in scope and a shift toward the "bigger picture" can make daily concerns seem less important to the individual who realizes that they are in the presence of something much greater than themself (Piff et al., 2015).

The vast nature of awe's elicitors ties in self-diminishment as an expected consequence of the awe experience. Therefore, self-diminishment should be greater in awe experiences than neutral experiences. Similar to need for accommodation, the degree of self-diminishment one experiences should correspond with the degree of vastness perceived. Thus, if greater vastness is perceived in positive awe compared to negative

awe, then self-diminishment should also be stronger in positive than negative awe.

Additionally, I suspect self-diminishment to be lower in negative awe, compared to positive awe, because of how people feel threatened when experiencing negative awe. If an individual feels threatened, they are placing a notable level of significance and priority on their wellbeing, translating to lesser self-diminishment; this is because the individual is focusing on themselves, distracting from the vastness of the awe elicitor. The literature on this is mixed: Gordon et al.'s (2017) results supported this prediction, finding positive awe to be associated with greater feelings of self-diminishment compared to negative awe (which were both greater than fear and neutral conditions; see also Rivera et al., 2018). However, Chaudhury et al. (2021) found that participants experiencing positive or negative awe reported similar levels of self-diminishment (which were both greater than neutral conditions; see also Krenzer et al., 2020).

Connectedness. Connectedness is characterized by reduced self-boundaries and feeling psychologically and/or physically closer to entities beyond the self (Krenzer et al., 2020; Shiota et al., 2007; Yaden et al., 2017). Perceived vastness in awe experiences pushes individuals to expand their frame of reference (due to the elicited need for accommodation), and this expansion is assumed to implicate a reflection on the significance of the self within and beyond the awe experience. It is not clear a priori, however, whether this reflection should produce a feeling of greater connectedness.

The literature is also unclear on this issue. Connectedness was not examined by Gordon et al. (2017) or Chaudhury et al. (2021), but other researchers have examined connectedness in the context of positive awe. These studies suggest that positive awe is associated with feelings of "oneness" and feeling connected to other people and the

environment (Krenzer et al., 2020; Shiota et al., 2007; Stellar et al., 2017; Yaden et al., 2017). Connectedness during experiences of self-diminishment has been described as the extent to which the individual feels boundaries fall away between the self and the environment (Yaden et al., 2017).

To date, however, connectedness has not been studied systematically in the context of negative awe.[3] Here, insight might come from considering the opposite of connection: perceived social isolation, or loneliness. Perceived isolation is a distressing feeling accompanying the perception that one's social needs are not being met (Hawkley & Cacioppo, 2010). If the perceived vastness associated with awe leads to self-diminishment, it seems reasonable to speculate that this self-diminishment could be experienced either positively or negatively, coloring the experience of awe itself.

Thus, it is unclear whether connectedness on its own would differentiate between positive and negative awe. It seems plausible that self-diminishment could be associated with both increased and decreased connectedness. I will return to this idea when I discuss a possible framework for differentiating positive and negative awe.

Summary: Awe-Specific Appraisals. Awe is experienced when an individual witnesses something that pushes the boundaries of what they thought was possible, driving people to adapt their understanding of the world. In general, awe is associated with heightened perceptions of vastness and greater needs for accommodation compared

[3] In a lab study by Krenzer et al. (2020), participants watching videos designed to elicit positive or negative awe did not significantly differ in their feelings of connection, compared to participants watching neutral videos. In a field study by the same authors, museum guests in a positive awe-inducing space (the museum's rotunda), compared to guests in a negative awe-inducing exhibit (German U-boat from World War II), again did not differ in feelings of connection.

to neutral states. My analysis suggests that appraisals of vastness and need for accommodation should be greater for positive awe than negative awe; self-diminishment, resulting from comparing the self to the vastness of the awe elicitor, should therefore also be greater for positive than negative awe. Although feelings of connectedness have been linked to awe experiences, it is not clear whether it differentiates positive from negative awe.

General Appraisals and Awe

The appraisal themes covered in the previous section neglect the more general appraisals typically discussed in the appraisal theory literature as dimensions that distinguish emotions. In addition, the very small literature on positive versus negative awe has relied heavily on this more general appraisal theory approach.

Valence. Valence is one of the most basic appraisals that differentiates positive and negative emotions and represents an automatic evaluation of how pleasant or enjoyable a situation is (Smith & Ellsworth, 1985). In other words, eating a tasty apple has positive valence, but finding a worm inside the apple would have negative valence. Within the context of awe, people tend to report their positive awe experiences to be pleasant (Chaudhury et al., 2021; Krenzer et al., 2020; Shiota et al., 2007; Tong, 2015) and to be paired with feelings of happiness and general positive affect (Gordon et al., 2017; Griskevicius et al., 2010). People want to prolong the experience (Shiota et al., 2007) and positive awe is associated with an increase in wellbeing, whereas negative awe is not (Gordon et al., 2017). People experiencing negative awe report less positive affect, less pleasantness, more negative affect, and greater feelings of powerlessness, fear, anxiety, nervousness, and sadness compared to people experiencing positive awe

(Chaudhury et al., 2021; Gordon et al., 2017; Guan et al., 2019; Jiang et al., 2018; Krenzer et al., 2020; Piff et al., 2015).

Certainty. Certainty refers to the degree to which an individual feels that events are predictable and comprehensible. As stated earlier, certainty is one of the central dimensions that distinguishes happiness from fear (Smith & Ellsworth, 1985). High certainty emotions such as happiness signal that the individual does not need to dedicate considerable resources in evaluating their environment; conversely, low certainty emotions such as fear motivate the individual to apply cautious attention to the situation and exhibit higher risk aversion (Griskivicius et al., 2010; Lerner & Keltner, 2000a). This pattern is consistent with data showing that high uncertainty emotional states facilitate systematic processing of incoming information (Griskivicius et al., 2010; Tiedens & Linton, 2001). Feeling uncertain motivates one to apply more effort in their processing to reestablish confidence in their judgments.

The astonishing size/significance of an awe experience is difficult to comprehend, thereby creating uncertainty and driving a search for a resolution (Valdesolo & Graham, 2013). In line with this reasoning, uncertainty should be higher in awe compared to a neutral state. In addition, however, if the awe experience contains the additional element of threat, as in negative awe, the individual would need to assess whether they had the ability to mitigate the threat and avoid its potential negative impact (Grupe & Nitschke, 2013). Both positive and negative awe drive the individual to resolve uncertainty, but a failure to do so within the positive context is not perilous for the individual. In contrast, the jeopardy of one's safety/wellbeing is present in negative awe, thereby contributing to greater uncertainty. Chaudhury et al. (2021) found that both awe variants were

characterized by lower appraisals of certainty compared to neutral states. Within awe variants, both Chaudhury et al. (2021) and Gordon et al. (2017) showed that negative awe was consistently associated with lesser certainty than positive awe. Similarly, in Taylor and Uchida's (2019) study, participants in the horror condition reported lower ratings of certainty than did their positive awe counterparts.

Responsibility and Control. Broadly, responsibility refers to the degree to which one was the causal agent for initiating events and control refers to the degree to which one can influence current and proceeding events (Smith & Ellsworth, 1985). In Smith and Ellsworth's research, responsibility and control dimensions loaded onto one factor, suggesting that people combine these two appraisals when assessing agency; therefore, these dimensions will be discussed together in this review as has been done in awe research (Chaudhury et al., 2021; Gordon et al., 2017).

In the appraisal literature, control/responsibility is broken down into three components: personal, other, and situational control/responsibility, which refer to the degree to which events seem to be brought about and/or influenced by the individual's agency, somebody else's agency, or external forces outside the individual's control, respectively. For example, happiness is characterized by individuals thinking they have a strong influence on the situation (high personal control), compared to the little influence of external forces (low situational control) and other entities (e.g., people, deities). Conversely, fear is characterized by perceptions that the individual has little influence in the situation (low personal control) compared to external forces (high situational control) and others (Lerner & Keltner, 2000b; Smith & Ellsworth, 1985).

In the context of awe, perceiving something vast beyond comprehension (e.g.,

Grand Canyon, tornadoes) is associated with higher beliefs that events are being caused by impersonal forces other than the self (Gordon et al., 2017). If the situation cannot be readily understood by the individual (i.e., low certainty appraisals), it follows that the individual has little control over the situation. Indeed, appraisals of controllability and certainty are highly correlated and have even been combined into a single composite index in some appraisal studies (Lerner & Keltner, 2000b). Awe experiences highlight the myriad events that are beyond the control of the individual. Since humans are driven to identify causal agents, if they themselves are not the causal agent, then external forces remain a likely contender for being in control. Awe experiences elicit an orientation toward a "greater entity" and "feeling small relative to something more powerful than oneself" (Piff et al., 2015; Yang et al., 2016) which implies an external force has greater control than the individual. This orientation highlights the difference in power between the individual and the elicitor reflected by a difference in appraisals of personal versus situational control, compared to a neutral state.

In the research, Chaudhury et al. (2021) showed that positive awe, versus other positive emotions and neutral states, was associated with lower appraisals of personal control/responsibility and greater appraisals of situational control/responsibility (Griskevicius et al., 2010, and Tong, 2015, also demonstrated these patterns). Comparing the awe variants, both Chaudhury et al. (2021) and Gordon et al. (2017) demonstrated that negative awe was associated with lower appraisals of personal control/responsibility and higher appraisals of situational control/responsibility than positive awe. The pattern for other control/responsibility is less clear: Gordon et al. (2017) showed that positive awe and negative awe were associated with similar perceptions of other control, but

Chaudhury et al. (2021) reported one case (out of three studies) in which negative awe was associated with weaker other-control appraisals, and Taylor and Uchida (2019) reported that horror (versus positive awe) was associated with stronger other-control appraisals associated with horror versus positive awe. These findings only describe quantitative differences rather than qualitative differences between positive awe and negative awe—knowing that an awe experience features low certainty and low personal control is not enough to determine whether the experience is pleasant or unpleasant. It is possible that awe becomes negative once these appraisals exceed a certain threshold, but it may also be that other appraisals not yet explored in research contribute to awe's valence.

Summary: General Appraisals and Awe. Gordon et al. (2017) first posited that appraisals of certainty and control/responsibility (personal, situational, other) are the distinguishing factors between positive and negative awe, such that negative awe is characterized by lower appraisals of certainty and personal control, and higher appraisals of situational control. Chaudhury et al. (2021) replicated these findings further supporting how the awe variants differ. Regarding other control, Gordon et al. (2017) found no difference between the awe variants which was consistent with two out of three studies from Chaudhury et al. (2021) that examined other control. Importantly, however, knowing that an individual has lower appraisals of certainty and personal control, and higher appraisals of situational control does not differentiate positive from negative awe. These general appraisals at best provide quantitative rather than qualitative differentiation.

A Possible Framework for Differentiating Positive and Negative Awe

The foregoing analysis and the existing evidence confirm that appraisal theory is a viable approach in differentiating positive and negative awe, but this review has established that the current literature is incomplete. I suggest adopting an appraisal profile approach in conjunction with examining self-related dimensions. Positive and negative awe share many patterns of appraisals compared to a neutral state such as vastness, need for accommodation, self-diminishment, certainty, personal control, and situational control. The awe variants may differ quantitatively on these dimensions but, to date, there is no way to look at an individual's ratings on these appraisals and predict which variant of awe they experienced. Using an appraisal profile approach, I examined where these appraisals diverge when other self-related themes, such as self-diminishment and connectedness, are also considered.

Among the awe-specific appraisals, positive awe should be associated with greater perceptions of vastness and greater needs for accommodation compared to negative awe; however, this pattern is only reflected in the literature for vastness (Chaudhury et al., 2021; Gordon et al., 2017). Among the general appraisals previously studied in the context of awe, positive awe should be associated with stronger appraisals of certainty and personal control/responsibility, and weaker appraisals of situational control/responsibility. Indeed, research from Chaudhury et al. (2021) and Gordon et al. (2017) support this prediction. However, since merely low certainty, low personal control, and high situational control are not enough to necessarily elicit threat (otherwise these appraisals would not also lead to positive awe), the determining factor for which valence (positive or negative) an individual experiences must lie elsewhere.

I proposed that the different ways in which an individual feels small and connected versus small and isolated may be key in determining whether an individual experiences awe as safe or threatening. Whereas the general appraisals previously discussed only display quantitative differences—the appraisals move in the same direction for positive and negative awe—the dimensions of self-diminishment and connectedness/isolation, working together, should exhibit qualitative differences. Feeling small and insignificant can be a positive experience if it is associated with a reduction in perceived boundaries and feeling connected to one's environment and others around them. The individual is no longer facing the threat by themselves; thus they have more resources at their disposal—potentially enhancing certainty and control appraisals. However, feeling small and insignificant can also be a negative experience if the self-diminishment is associated with feeling isolated and helpless without the proper resources to approach a situation. The individual feels more vulnerable by themselves with nobody to help ameliorate any threats. Feeling connected may allow people to feel they have the personal resources they need to meet the demands of and control the situation, whereas feeling isolated might lead people to feel they lack the resources they need and feel at the mercy of something other than themselves.

The Current Research

To explore my reasoning, I began with an exploratory study in which participants were induced to feel an emotion (positive awe, negative awe, joy, or fear) before rating the descriptiveness of 24 appraisals (including self-diminishment and connectedness). The analysis provided preliminary support for the framework. However, as self-diminishment and connectedness were measured rather than manipulated, causal

inference was not appropriate. I conducted a number of pilot studies to test the effectiveness of self-diminishment and connectedness manipulations, and then a final experiment to examine the effects of these manipulations on the experienced valence of awe.

Experiment 1

The goal of Experiment 1 was to use an appraisal approach to differentiate positive and negative awe. I explored four categories of appraisals and other constructs, including the awe-specific appraisals and previously studied general appraisals reviewed in the preceding section—but also adding other dimensions taken from appraisal theories of emotion as well as other constructs that could reasonably be expected to differentiate the awe variants.

Additional General Appraisals

The existing research on positive and negative awe (Chaudry et al., 2021; Gordon et al., 2017) assessed general appraisal dimensions that they deemed most relevant. However, this work did not consider the full array of dimensions highlighted by appraisal theory. In this first experiment, I included these general appraisals to provide a more comprehensive characterization of awe and its variants.

Attentional Activity and Novelty. Attentional activity refers to the degree to which an individual is focused on an elicitor and is thought of as the first appraisal made—whether to attend to a stimulus, ignore it, or avoid it (Scherer, 1982). It is related to the novelty dimension, such that the individual evaluates the extent to which a stimulus conforms to or violates expectations, which then informs the degree of attention demanded (Smith & Ellsworth, 1985). Certainty appraisals are related to attentional

activity, such that unpredictable events require more of our attention. Our ability to detect patterns and predict future states in the world enables us to make adaptive decisions and contributes to our reproductive fitness. If an event violates our expectations, our attention is demanded so to recalibrate our model of the world (den Ouden et al., 2012).

Awe occurs in unexpected, information-rich environments in which awareness of day-to-day concerns dwindles, and attention is oriented toward the current incoming information (Griskevicius et al., 2010). Awe in general is expected to be associated with high attentional activity but competing ideas could support which variant should be associated more strongly with this appraisal dimension. Drawing from broaden-and-build theory (Fredrickson, 1998, 2001), positive emotions should expand an individual's scope of attention (the range of possible stimuli that one can attend to) and thought–action repertoires (the range of possible thoughts and actions that are available to the individual at the time of the event), whereas negative emotions should narrow this scope and thought–action repertoire. This suggests that positive emotions be associated with greater attentional activity than negative emotions. Further, Taylor and Uchida (2019) hypothesized that since horror is an aversive experience, it should shift attention away from the elicitor. However, negative awe may be higher in attentional activity due to the bias toward paying more attention to negative (versus positive) information (Baumeister et al., 2001), as well as generally higher motivation to avoid loss than to acquire a gain (Kahneman & Tversky, 1979; Tversky & Kahneman, 1987). Despite these competing accounts, I predict that negative awe will be less associated with greater attentional activity than positive awe, based on the broaden-and-build theory as well as Taylor and Uchida's (2019) reasoning on aversive emotions. Chaudhury et al. (2021) found that

positive and negative awe were associated with similar appraisals of attention, and Taylor and Uchida (2019) found that participants experiencing horror reported lower ratings of attention activity than participants experiencing positive awe.

Anticipated Effort. Anticipated effort is defined as the extent to which an individual feels mental/physical exertion is required to deal with the emotion-eliciting situation (Smith & Ellsworth, 1985). Smith and Ellsworth (1985) demonstrated that negative emotions were associated with higher appraisals of effort and that positive emotions were associated with lower appraisals of effort[4]. Negative awe is a threatening state that people want to end (Gordon et al., 2017) further suggesting an association with high ratings of anticipated effort. In other words, when a situation is bad, we try to fix it which takes effort (Smith & Ellsworth, 1985). These predictions are consistent with findings from Chaudhury et al. (2021), who found that participants in a negative awe condition reported greater appraisals of effort than a positive awe condition. Similarly, Taylor and Uchida (2019) reported that participants in the horror condition reported higher ratings of anticipated effort than participants in their positive awe condition.

Goal–Path Obstacles versus Goal Congruence. Goal–path obstacle appraisals are defined as the extent to which an individual feels there are obstacles or problems that are preventing something the individual desires (Smith & Ellsworth, 1985). Conversely, goal congruence, sometimes referred to as motive consistency, is defined as the extent to which an event is conducive to fulfilling one's goals and desires (Lazarus, 1991; Scherer,

[4] The negative emotions included fear, shame, guilt, frustration, anger, sadness, contempt, disgust, and boredom. The positive emotions included challenge, hope, interest, pride, surprise, and happiness. Boredom and challenge were the only emotions that did not fit this pattern: boredom was associated with lower appraisals of effort whereas challenge was associated with higher appraisals of effort (Smith & Ellsworth, 1985).

2001).

Because feeling threatened is a negative state people want to alleviate, I predict negative awe to be associated with higher appraisals of goal–path obstacles and lower appraisals of goal congruence, than positive awe. Consistent with this, Taylor and Uchida (2019) reported that participants in the horror (versus positive awe) condition reported higher ratings of goal-path obstacles).

Challenge versus Threat. Challenge and threat are motivational states that depend on primary and secondary appraisals (Blascovich & Mendes, 2000; Blascovich & Tomaka, 1996). When confronted with an elicitor, a primary appraisal of the situational demands (assessment of danger, uncertainty, required effort) is made, followed by a secondary appraisal of one's resources (assessment of knowledge and skills relevant to the situation). People make appraisals of challenge when they possess sufficient or nearly sufficient resources to meet the demands of the situation; challenge appraisals are associated with feeling invigorated and confident. In contrast, people make appraisals of threat when they perceive insufficient resources to meet the demands of the situation; threat appraisals are associated with anxiety and dread (Le et al., 2018).

Under this account, a particular situation may elicit challenge in one person but threat in another person. Based on this framework, challenge and threat appraisals may be tied with positive and negative awe, respectively. That is, one cannot experience positive awe without an accompanying challenge appraisal, and one cannot experience negative awe without an accompanying threat appraisal. This perspective is consistent with Gordon et al. (2017, Study 3), who induced awe in participants and then collected self-report measures of threat and positive affect, along with several physiological indicators.

They found that self-reported positive affect during awe was associated with higher respiratory sinus arrhythmia (i.e., a known marker of challenge; see also Shiota et al.., 2011) and that self-reported threat during awe was associated with higher heart rate and skin conductance (i.e., known markers of threat).

Other Related Constructs

Other constructs that may interact with the awe experience have not yet been systematically examined.

Appetitive versus Aversive Motivations. Appetitive/approach and aversive/avoidance systems describe how an individual may be motivated to engage in behaviors that either approach or avoid an elicitor (Lang & Bradley, 2013). These motivations become active in different contexts: appetitive, in situations that promote obtaining resources or relationships; aversive, in situations that present some form of threat. From this, positive awe should facilitate the appetitive system, motivating the individual to capitalize on the opportunities of the positive experience, and negative awe to facilitate aversive system, motivating the individual to mitigate threats. Indeed, this can be seen in the literature, with positive awe motivating curiosity (Coleman, 2014), creativity (Chirico et al., 2018), and a desire to explore of one's environment (Colantonio & Bonawitz, 2018). Positive awe is an enjoyable experience that people want to prolong (Shiota et al., 2007), encouraging mood maintenance strategies to continue the experience, accruing more information as they move toward the elicitor. Negative awe is an unpleasant, threatening experience that people want to end (Gordon et al., 2017), encouraging mood-repair strategies to end or escape the experience. Taken together, I expect positive awe drives the individual to approach an elicitor whereas negative awe

drives the individual to avoid an elicitor.

Safety versus Danger. Safety is defined as a state of being free from the occurrence or risk of harm, danger, or loss (https://www.dictionary.com/browse/safety). Danger is defined as feeling exposure to or liability to harm, risk, or loss (https://www.dictionary.com/browse/danger). Whereas challenge represents the presence of opportunity, safety represents an absence of danger/threat; and danger, compared to threat, is more immediate and concrete.

Gordon et al. (2017) proposed that proximity to a threat may differentiate negative awe from fear, such that the individual experiencing negative awe does not actually perceive danger until the threat closes in. Seeing the birth of a tornado from a safe distance may elicit negative awe, but as the tornado gets closer and is now dangerous to the individual the negative awe turns into fear. Not yet directly studied, I predict that negative awe has a lesser association with safety and a greater association with danger ratings compared to positive awe.

First-Person versus Third-Person Perspective. Individuals reflecting on events can experience themselves through different perspectives: a first-person (self-immersed) and third-person (self-distanced) perspective (Grossman & Kross, 2010). The perspective in which one views an experience can have either adaptive or maladaptive outcomes (Dorfman et al., 2019). The default approach is to reflect on both positive and negative events in a self-immersed perspective (versus a self-distanced one) and can be associated with maladaptive outcomes when events are negative (negative emotionality, distress, narrower thinking; Grossman & Jowhari, 2018; Tackman et al., 2019; Verduyn et al., 2012). Conversely, when people reflect on events through a self-distanced perspective,

they can experience positive outcomes (higher positive emotionality, physiological markers of challenge; Dorfman et al., 2019; Le et al., 2018).

To date, no research has examined whether positive or negative awe are associated with different types of perspectives. Le et al. (2018) conducted a study on whether the perspective people spontaneously adopt when recalling awe experiences influences subsequent tasks, and found that participants who spontaneously adopted a self-distanced perspective showed cardiovascular responses consistent with challenge, whereas participants who spontaneously adapted a self-immersed perspective showed cardiovascular responses consistent with threat. Based on this pattern (see also Grossman & Jowhari, 2018; Dorfman et al., 2019; Tackman et al., 2019; Verduyn et al., 2012), I predict that positive awe is more likely to be experienced when in a self-distanced perspective, and negative awe is more likely to be experienced when in a self-immersed perspective.

Self-Awareness versus Situational Awareness. Self-awareness is defined as the extent to which an individual is aware of one's own individuality, thoughts, and feelings, and perceives oneself as an individual entity (https://www.dictionary.com/browse/self-awareness). Situational awareness is defined as the extent to which one is conscious of their immediate environment and events occurring in it (https://dictionary.apa.org/situation-awareness).

Looking at the nature of how threat is construed may help determine how self-awareness and situational awareness differentiate positive and negative awe. Negative awe distinguishes itself from positive awe by the addition of threat—threat that involves evaluating an undesirable relationship between the environment and the individual.

Feeling threatened by a tornado highlights the individual's precarious position in the world; feeling threatened by contemplating the infinite cosmos highlights the individual's trivialness in the world. Indeed, for someone experiencing negative awe to feel powerless, they must be attending to a relative power difference (Gordon et al., 2019). In being threatened, the individual must be evaluating the environment versus the self. An individual experiencing positive awe though does not feel threatened and actually gets "lost in thought" and loses track of time (Rudd et al., 2012). This makes positive awe feel like an experience in which one is not aware of things going on around them. Because of awe's relationship with self-diminishment, both positive and negative awe should be low on self-awareness relative to a neutral state; however, negative awe will be higher on self-awareness than positive awe[5] because of the added threat. For situational awareness, both positive and negative awe should be lower than a neutral state; however, negative awe will be higher than positive awe.

Overview and Hypotheses

The goal of the current experiment was to develop appraisal profiles for positive and negative awe. Three separate samples were collected: two samples of undergraduates and one sample of MTurk participants. Participants wrote about a time they felt either positive awe or negative awe (all samples) or joy or fear (Samples 2 and 3) and then rated their experience on a series of appraisals and other constructs.

[5] I initially thought positive awe would be associated with greater self-awareness than negative awe; however, after thinking more about how threat involves evaluating a self–other relationship I revised the prediction that I included in my original proposal.

The predicted patterns are outlined in Table 1. Predictions for the awe-specific appraisals and general appraisals are based on existing theory and evidence, whereas the predictions for the other general appraisals and related constructs were more tentative. I also differentiate between qualitative and quantitative differentiators. Qualitative differentiators are expected to differentiate positive and negative awe relative to baseline; quantitative differentiators are expected to differentiate positive and negative awe.

Table 1

Predicted Appraisal Patterns (Experiment 1)

Appraisal Type	Appraisal Dimension	Positive Awe vs. Baseline	Negative Awe vs. Baseline	Positive Awe vs. Negative Awe
Awe-specific appraisals	*Vastness*	>	>	>
	Need for accommodation	>	>	>
	Self-diminishment	>	>	>
	Connectedness	>	<	>
	Isolation	<	>	<
General appraisals	***Valence***	>	<	>
	Certainty	<	<	>
	Personal control	<	<	>
	Other control	=	=	=
	Situational control	>	>	<
Additional general appraisals	*Attentional activity*	>	>	>
	Novelty	>	>	=
	Anticipated effort	>	>	<
	Goal-path obstacles	=	>	<
	Goal congruence	>	<	>
	Challenge	>	<	>
	Threat	=	>	<
Other related constructs	***Appetitive motivation***	>	<	>
	Aversive motivation	<	>	<
	Safety	=	<	<
	Danger	=	>	<
	First-person perspective	<	>	<
	Third-person perspective	>	<	>
	Self-awareness	<	<	<
	Situational awareness	<	<	<

Note. Dimensions in italicized font are hypothesized as quantitative differentiators; dimensions in bold font are hypothesized as qualitative differentiators.

Method

Participants

Seven hundred forty-two participants from three different samples described a memorable emotional experience. Sample 1 included 148 undergraduates (84 women, 61 men, 3 unidentified) from DePaul University. The sample ranged from 18 to 37 years old (M = 20.48, SD = 3.19; 75.7% not Hispanic in origin; 24.3% Hispanic in origin; 43.9% White; 14.9% LatinX/Latiné; 10.1% Mixed Race; 8.8% Black/African; 8.8% South Asian/Southeast Asian; 6.1% East Asian; 3.4% described themselves in another way; 3.4% did not report; 1% Middle Eastern/North African). Sample 2 included 301 adults (174 women, 162 men, 3 non-binary, 2 unidentified) recruited through Mechanical Turk. The sample ranged from 18 to 77 years old (M = 40.30, SD = 13.17; 88.4% not Hispanic in origin; 11.0% Hispanic in origin; 0.6% did not identify; 72.1% White; 9.0% Black/African; 5.3% Mixed Race; 4.7% East Asian; 4.3% South Asian/Southeast Asian; 3.3% LatinX/Latiné; 0.3% Native Hawaiian/Pacific Islander; 0.7% did not report; 0.3% described themselves in another way. Sample 3 included 293 undergraduates (200 women, 75 men, 2 trans men, 6 non- binary, 4 queer, 6 unidentified) from DePaul University. The sample ranged from 18 to 45 years old (M = 19.42, SD = 2.50; 74.4% not Hispanic in origin; 25.3% Hispanic in origin; 0.3% did not identify; 57.7% White; 13.3% LatinX/Latiné; 9.9% Mixed Race; 6.5% South Asian/Southeast Asian; 5.8% Black/African; 3.4% Middle Eastern/North African; 2.0% did not report; 0.7% East Asian; 0.7% described themselves in another way).

Samples 1 and 3 participated in exchange for course credit toward their Introductory Psychology requirement and Sample 2 participated in return for monetary

compensation. Twenty-six participants were excluded from Sample 1: 12 for failing the attention check, 16 for writing narratives that did not fit the instructions (e.g., defining awe or describing what awe is generally like rather than recounting an awe experience), and two for not writing anything; 13 were excluded from Sample 2: three for failing the attention check and 10 for writing narratives that did not fit the definition of the emotion provided; 35 were excluded from Sample 3: 17 for failing the attention check and 18 for writing narratives that did not fit the definition of the emotion provided, leaving a total sample of 666 participants (Sample 1: 120; Sample 2: 288; Sample 3: 258).

Procedure and Materials

All materials are presented in Appendix A. Participants completed all study procedures online via Qualtrics. Data were collected in three waves. Sample 1 compared positive awe to negative awe, while Samples 2 and 3 compared positive awe, negative awe, fear, and joy. Participants were randomly assigned to an emotion condition and were then presented with a definition of the emotion and asked to write a narrative about a time they experienced it. Following this they responded to the intensity and valence, emotions, appraisals, and elicitor (only for positive awe and negative awe conditions) measures, demographics, and attention check items.

Describing an Emotional Experience. Participants in the positive and negative awe conditions were presented with a definition of awe adapted from the Dictionary.com definition, “an overwhelming feeling of reverence… produced by that which is grand, sublime, extremely powerful, or the like…” Participants in both awe condition received the following prompt:

“Awe is an overwhelming feeling of reverence produced by the grand, the

> sublime, or the powerful—whether that's from people, places, events, or ideas. Awe is a ***complex*** emotion: We can experience something as ***amazing and wondrous***, or as ***amazing and frightening***."

The positive awe condition continued with, "Take a couple of minutes to remember an experience in which you felt the kind of awe that is ***amazing and wondrous***." The negative awe condition ended the previous statement with "***amazing and frightening***."

Participants in the joy condition received a definition adapted from Merriam-Webster dictionary as follows, "Joy is an emotion characterized by ***great pleasure and happiness***, evoked by wellbeing, success, or good fortune, or by the prospect of possessing what one desires."

Participants in the fear condition received a definition adapted from Merriam-Webster dictionary and Collins Dictionary to match the structure of the other emotion definitions, "Fear is an emotion characterized by ***distress, apprehension, or alarm***, caused by the belief that someone or something is dangerous, likely to cause pain, or a threat."

All prompts ended with, "Describe the experience in detail, as if you were telling someone who has never experienced [emotion label] before. We will be coding your narrative for how well it describes the experience or event and evokes the emotion of [emotion label]."

Intensity and Valence Ratings. Participants responded to three items: "How intensely did you feel this emotion?", and "How [positive/negative] was the experience?" (with the order of the final two questions randomized). Participants made their responses on a 5-point scale (0 = *Not at all*, 1 = *Slightly*, 2 = *Moderately*, 3 = *Very*, 4 = *Extremely*).

Elicitor Categorization. Participants assigned to an awe condition (positive or negative) responded to the item, "Which of the following elicited the feeling of awe? (Check all that apply.)" The response options were nature; human innovation (e.g., architecture, engineering, technology); a work of art or a creative act; talent, skill, or accomplishment; extreme moral qualities (virtue or vice); a spiritual or religious experience; other (specify).

Emotion Ratings. Participants responded to the question, "To what extent did you feel each of these other emotions?" The emotions were chosen to reflect positive awe (*amazement*, *inspiration*), negative awe (*anxiety*, *dread*), non-awe positive affect (*contentment*, *happiness*), and non-awe negative affect (*anger*, *sadness*). Ratings were made along on a 5-point scale (0 = *Not at all*, 1 = *Slightly*, 2 = *Moderately*, 3 = *Very*, 4 = *Extremely*).

Appraisals Ratings. Participants completed 48 appraisal ratings (two items per appraisal); item order was randomized. The instructions were, "Thinking back to the experience that you wrote about, to what extent do each of the following statements describe your perceptions and feelings during the experience?" Participants made their responses along 5-point scales (0 = *does not describe the experience at all,* 1 = *describes the experience slightly*, 2 = *describes the experience reasonably well*, 3 = *Describes the experience very well*, to 4 = *describes the experience extremely well*.) Participants responded to several types of appraisal items.

Awe-Specific Appraisals. Participants responded to items measuring vastness, need for accommodation, self-diminishment, connection, and isolation. Items for vastness and need for accommodation were adapted from definitions provided by Keltner and

Haidt (2003) and Shiota et al. (2007); wording was designed to hold to the definitions and be conceptually distinct from self-diminishment. Self-diminishment items were adapted from the subscale used in Piff et al. (2015). Connection items were adapted from items used in Shiota et al. (2007) and Krenzer et al. (2020). Isolation items were developed for this study but were adapted from Krenzer et al. (2020).

Vastness. I perceived the situation as physically/psychologically vast. I perceived the situation as physically/psychologically significant.

Need for Accommodation. I found it difficult to fully understand the situation. I felt my view of the world challenged.

Self-Diminishment. I felt small. I felt insignificant.

Connection. I felt connected. I felt like I was a part of something.

Isolation. I felt isolated. I felt alone.

General Appraisals: Replication. These items were adapted from Gordon et al. (2017) and Smith and Ellsworth (1985).

Certainty. I felt certain of what was happening. I felt I could predict what was going to happen.

Personal Responsibility/Control. I felt that I had the ability to control the situation. I felt responsible for having brought about the situation.

Other Responsibility/Control. I felt that someone or something else was controlling the situation. I felt that someone or something other than myself was responsible for having brought about the situation.

Situational Responsibility/Control. I felt that the situation was directed by circumstances beyond anyone's control. I felt that the situation was brought on by

chance.

General Appraisals: Additional Appraisals. These items were adapted from Smith and Ellsworth (1985) and Lazarus (1991).

Attentional Activity. I tried to devote my attention to the situation. I tried to direct my attention away from the situation.

Novelty/Unexpectedness. The situation was unexpected. This was a new experience for me.

Anticipated Effort. I felt that the situation required mental/physical effort from me. I felt that I needed to exert myself to deal with this situation.

Goal-Path Obstacles. There were obstacles standing in the way of getting what I wanted. There were problems that had to be solved before I could get what I wanted.

Goal Congruence. The situation was consistent with what I desired. The situation contributed to achieving my personal goals in life.

Additional Themes. These items were developed by using definitions provided in relevant literature and online dictionaries.

Approach. I wanted to immerse myself in the situation. I wanted to stay in the situation.

Avoidance. I wanted to detach myself from the situation. I wanted to leave the situation.

Challenge. I felt the situation presented me with opportunities that I wanted to take advantage of. I felt the situation would result in positive outcomes.

Threat. I felt the situation presented me with threats that I wanted to avoid or escape. I felt the situation would result in negative outcomes.

Safety. I felt safe in the situation. I felt protected in the situation.

Danger. I felt vulnerable in the situation. I felt threatened in the situation.

First-Person/Immersed Perspective. I experienced the situation through my own eyes. I experienced the situation from a first-person perspective.

Third-Person/Distanced Perspective. I experienced the situation as if I was an outside observer. I felt like I was watching myself experience the situation.

Self-Awareness. I was keenly aware of myself. I was conscious of my thoughts and feelings.

Situational Awareness. I was keenly aware of everything in the situation. I was conscious of what was going on around me.

Attention Check. Participants responded to a question asking if they (1) followed the instruction (e.g., writing in detail about their memories, (2) made an effort to be careful and honest in their responding, and (3) were not distracted. Participants were excluded from analysis if they failed this attention check.

Results

The three samples were combined in the following analyses, although comparative analyses between samples can be found in Appendix B. Six-hundred sixty-six participants were in the combined analyses (positive awe: 191; negative awe: 176; fear: 145; joy: 154). A series of linear mixed effects models were fitted using the *lme4* package in R (Bates et al., 2015) with emotion condition (positive awe, negative awe, fear, joy) fitted as a fixed effect, sample (1, 2, 3) as a random intercept, and the following dependent measures as the outcome variables. Bonferroni-corrected post hoc tests were used to analyze emotion comparisons if significant differences were present. This method

was selected to control for differences across the two undergrad and one MTurk samples.

The current presentation will include only the results for the awe-specific appraisals believed to be relevant in distinguishing positive and negative awe and the appraisals previously studied by Gordon et al. (2017). Results for additional appraisals and other related constructs are included in Appendix B. The tables will show all the significant emotion comparisons, but I will focus on three main comparisons: negative awe versus positive awe; negative awe versus fear; and positive awe versus joy, since these are the comparisons that allow us to examine which differences are due to emotion valence or awe variant.

Manipulation Check: Awe Narratives

Since the focus of the study was on positive and negative awe, those narratives were coded by three coders for whether the narrative described an awe experience by indicating yes or no to the question, "Was [the experience] an awe experience?" I used Fleiss's Kappa (Fleiss, 1971; Fleiss et al., 2003) to calculate agreement between the three coders. Any disagreements between coders were settled by a group meeting to discuss why each coder coded their response. After three rounds of coding and meeting to discuss discrepancies, the narratives ended with a Kappa of 0.99. The "Is it awe?" question led to the exclusion of 44 narratives (as already described in the Participants section).

Manipulation Check: Intensity and Positive/Negative Valence

Descriptive results and post hoc analyses are shown in Table 2.

For intensity, the analysis did not yield a significant effect for emotion condition, $F(3, 661) = 0.77$, $p = .51$, $R^2 = .003$. Intensity ratings were not significantly different between negative awe and positive awe condition, $t(661) = 0.72$, $p = 1$; nor were they

significantly different between the negative awe and fear condition, $t(302) = -1.38$, $p = 1$; nor between the positive awe and joy condition, $t(291) = -0.41$, $p = 1$.

For positive valence, the analysis yielded a significant effect for emotion condition, $F(3, 591) = 448$, $p < .001$, $R^2 = .67$. Positivity ratings were significantly lower in negative awe than positive awe conditions, $t(658) = 7.47$, $p < .001$; but were significantly greater in negative awe than fear conditions, $t(560) = 23.73$, $p < .001$. Positivity ratings did not significantly differ between positive awe and joy, $t(552) = -1.12$, $p = 1$.

Table 2.

Intensity, Valence, and Emotions Ratings (Experiment 1)

	Emotion conditions					
	Negative awe	Positive awe	Fear	Joy	Overall *F*	Marginal R^2
Intensity	3.32 (0.72)	3.38 (0.72)	3.44 (0.69)	3.41 (0.69)	0.77	.003
Positive valence	2.96 (1.21)^{bcd}	3.63 (0.66)^{ac}	0.45 (0.95)^{abd}	3.72 (0.53)^{bc}	448***	.67
Negative valence	0.87 (1.15)^{bcd}	0.18 (0.64)^{ac}	3.29 (1.02)^{abd}	0.10 (0.35)^{ac}	457***	.68
Positive awe affect	2.88 (0.93)^{bc}	3.26 (0.77)^{acd}	0.65 (1.02)^{abd}	2.73 (0.91)^{bc}	259***	.53
Negative awe affect	1.42 (1.04)^{bcd}	0.53 (0.83)^{ac}	3.25 (0.84)^{abd}	0.56 (0.82)^{ac}	311***	.58
Contentment	2.23 (1.37)^{bcd}	3.00 (1.11)^{ac}	0.42 (0.92)^{abd}	3.12 (1.04)^{ac}	181***	.45
Happiness	2.79 (1.29)^{bcd}	3.44 (0.76)^{ac}	0.46 (1.03)^{abd}	3.60 (0.61)^{ac}	338***	.61
Anger	0.34 (0.82)^{c}	0.14 (0.57)^{c}	1.52 (1.28)^{abd}	0.21 (0.66)^{c}	88.6***	.29
Sadness	0.65 (1.08)^{c}	0.41 (0.86)^{c}	1.92 (1.48)^{abd}	0.38 (0.83)^{c}	68.5***	.24

Note. Standard deviations are in parentheses. Scales are from 0 (*Not at all)* to 4 (*Extremely*). N = 666. *** $p < .001$. [a] Mean is different from negative awe. [b] Mean is different from positive awe. [c] Mean is different from fear. [d] Mean is different from joy at $p < .001$.

For negative valence, the analysis yielded a significant effect for emotion condition, $F(3, 466) = 457$, $p < .001$, $R^2 = .68$. Negativity ratings were significantly greater in negative awe than positive awe conditions, $t(658) = -7.77$, $p < .001$; but were

significantly lower in negative awe than fear conditions, $t(456) = -23.69$, $p < .001$. Negativity ratings did not significantly differ between positive awe and joy, $t(435) = 1.14$, $p = 1$.

Together, these results confirm the validity of the emotion manipulation.

Manipulation Check: Emotions

Descriptive results and post hoc analyses are shown in Table 2.

I created a composite for positive awe (amazement, inspiration; $M = 2.47$; $SD = 1.33$; $\alpha = 0.82$; $r = 0.69$). Positive awe ratings were significantly lower in negative awe than positive awe conditions, $t(659) = 3.98$, $p < .001$; greater in negative awe than fear conditions, $t(301) = 21.05$, $p < .001$; and also greater in positive awe than joy conditions, $t(294) = 5.13$, $p < .001$.

I also created a composite for negative awe (anxiety, dread; $M = 1.36$; $SD = 1.38$; $\alpha = 0.86$; $r = 0.76$). Negative awe ratings were significantly greater in negative awe than positive awe conditions, $t(657) = -9.44$, $p < .001$; and lower in negative awe than fear conditions, $t(355) = -17.32$, $p < .001$; but negative awe ratings did not significantly differ between positive awe and joy conditions, $t(353) = -0.17$, $p = 1$.

The remaining emotion items (*contentment*, *happiness*, *anger*, *sadness*) were included primarily as filler items. As Table 2 indicates, the results were generally as would be expected, with contentment and happiness yielding higher ratings for the positive emotion conditions and anger and sadness yielding higher ratings for the negative emotion conditions.

Together, these results confirm the validity of the emotion manipulation.

Appraisals

Awe-Specific Appraisals. Descriptive results and post hoc analyses are shown in Table 3.

Table 3.

Awe-Specific Appraisals and General Appraisals (Experiment 1)

		Emotion conditions					
		Negative awe	Positive awe	Fear	Joy	Overall *F*	Marginal R^2
Awe-specific appraisals	Vastness	2.52 (1.19)^{c}	2.53 (1.18)^{cd}	2.22 (1.13)^{ab}	2.23 (1.08)^{b}	4.60**	.02
	Accommodation	1.52 (1.15)^{d}	1.24 (1.00)^{cd}	1.60 (1.19)^{bd}	0.85 (0.97)^{abc}	15.40***	.07
	Self-Diminishment	1.74 (1.38)^{bcd}	1.30 (1.29)^{acd}	2.30 (1.3)^{abd}	0.34 (0.68)^{abc}	73.10***	.24
	Connection	2.55 (1.23)^{bcd}	3.1 (0.98)^{ac}	0.89 (1.05)^{abd}	3.26 (0.94)^{ac}	159***	.42
	Isolation	0.74 (1.11)^{cd}	0.46 (0.89)^{c}	2.11 (1.47)^{abd}	0.18 (0.57)^{ac}	100***	.31
General appraisals	Certainty	1.70 (0.96)^{bd}	1.98 (1.01)^{ac}	1.49 (1.18)^{bd}	2.24 (1.02)^{ac}	15.20***	.06
	Personal control	1.16 (1.07)^{d}	1.31 (1.13)^{cd}	0.91 (0.93)^{bd}	2.05 (1.18)^{abc}	31.10***	.12
	Situational control	1.46 (1.28)^{d}	1.41 (1.24)^{d}	1.70 (1.21)^{d}	1.01 (1.08)^{abc}	8.58***	.04
	Other control	1.61 (1.34)^{c}	1.40 (1.25)^{c}	2.16 (1.34)^{abd}	1.32 (1.1)^{c}	13.40***	.06

Note. Standard deviations are in parentheses. Scales are from 0 (*Not at all)* to 4 (*Extremely*). N = 666. * $p < .05$; ** $p < .01$; *** $p < .001$. [a] Mean is different from negative awe. [b] Mean is different from positive awe. [c] Mean is different from fear. [d] Mean is different from joy.

Vastness ratings were not significantly different between negative awe and positive awe conditions, $t(660) = -0.01$, $p = 1$; vastness ratings were significantly greater in negative awe than fear conditions, $t(641) = 2.75$, $p = .036$; and significantly greater in positive awe than joy conditions, $t(638) = 2.65$, $p = .05$.

Need for accommodation ratings were not significantly different in negative awe versus positive awe conditions, $t(662) = -2.45$, $p = .087$; they did not significantly differ between negative awe and fear conditions, $t(303) = -0.64$, $p = 1$; but they were significantly greater in positive awe than joy conditions, $t(292) = 3.28$, $p = .007$.

Self-diminishment ratings were significantly greater in negative awe than positive awe conditions, $t(660) = -3.66$, $p = .002$; they were significantly lower in negative awe

than fear conditions, $t(594) = -3.46$, $p = .003$; and they were significantly greater in positive awe than joy conditions, $t(660) = -3.66$, $p = .002$.

Connection ratings were significantly lower in negative awe than positive awe conditions, $t(662) = 4.96$, $p < .001$; they were significantly greater in negative awe than fear conditions, $t(303) = 13.53$, $p < .001$; and there was no significant difference between positive awe and joy conditions, $t(292) = -1.35$, $p = 1$.

Isolation ratings were not significantly different in negative awe versus positive awe conditions, $t(662) = -2.61$, $p = .055$; they were significantly lower in negative awe than fear conditions, $t(303) = -11.20$, $p < .001$; and there was no significant difference between positive awe and joy conditions, $t(292) = 2.41$, $p = .101$.

General Appraisals. Descriptive results and post hoc analyses are shown in Table 3.

For certainty, the analysis yielded a significant effect for emotion condition, $F(3, 662) = 15.20$, $p < .001$, $R^2 = .06$. Certainty ratings were significantly lower in negative awe than positive awe conditions, $t(662) = 2.64$, $p = .05$; there was no significant difference between negative awe and fear conditions, $t(303) = 1.70$, $p = .54$; and there was no significant difference between positive awe and joy conditions, $t(292) = -2.64$, $p = .19$.

Personal control ratings did not significantly differ between negative awe and positive awe conditions, $t(662) = 1.34$, $p = 1$; there was no significant difference between negative awe and fear conditions, $t(303) = 1.99$, $p = .29$; but ratings of personal control were significantly lower in positive awe than joy conditions, $t(292) = -6.04$, $p < .001$.

Situational control ratings did not significantly differ between negative awe and

positive awe conditions, $t(662) = -0.37$, $p = 1$; there was no significant difference between negative awe and fear conditions, $t(303) = -1.73$, $p = .51$; but ratings of situational control were significantly greater in positive awe than joy conditions, $t(292) = 2.99$, $p = .018$.

Ratings of other control did not significantly differ between negative awe and positive awe conditions, $t(661) = -1.61$, $p = .65$; they were significantly lower in negative awe than fear conditions, $t(439) = -3.63$, $p = .002$; and there was no significant difference between positive awe and joy conditions, $t(425) = 0.55$, $p = 1$.

Elicitors

Three hundred sixty-seven participants were in the combined three samples for positive awe and negative awe conditions (positive awe: 191; negative awe: 176). Proportions were created for each elicitor category by dividing the number of participants that selected each elicitor by the total number of awe participants (n = 367). Results for proportions are shown in Table 4.

Mixed effects logistic regression models for each elicitor were fitted with valence as a fixed effect and sample cohort as a random intercept. Full results of each model can be found in Appendix B. Positive awe (68.1%) was more likely than negative awe (55.1%) to be elicited by nature, $\chi^2 = 6.17$, $p = .013$, $R^2 = .01$. None of the other elicitors differed significantly between positive and negative awe.

Table 4.

Proportions of Awe Elicitors (Experiment 1)

Elicitor	Proportion	n
Nature	61.90%	227
Talent, skill, accomplishment	30.00%	110
Work of art or creative act	28.30%	104
Human innovation (e.g., architecture, engineering, technology)	26.70%	98
Spiritual or religious experience	19.90%	73
Other	12.50%	46
Extreme moral qualities (virtue or vice)	10.90%	40

Note. Number of participants that selected each awe elicitor category. The proportions add up to greater than 100% since participants could select multiple categories. Total n = 367.

Exploratory Narrative Analysis

Text Analysis. The narratives were coded using the statistical language R for counts of how often participants included self-related words. Self-words included the words, "I," "me," "my," "myself," "I'm," and "mine." Counts for self-words for each participant were summed and divided by the total number of words in each narrative and then multiplied by 100, so each participant had a self-word ratio.

A mixed effects regression model was conducted with emotion condition (positive awe, negative awe, joy, fear) as a fixed factor, self-word ratio as the dependent variable, and sample cohort as a random intercept. Results of the model are in Table 5. Analyses yielded a significant effect for emotion condition, $F(3, 565) = 14.0$, $p < .001$. Self-word ratios did not significantly differ between negative awe and positive awe, $t(660) = -0.49$, $p = 1$; self-word ratios were significantly lower in negative awe than fear conditions, $t(509) = -4.33$, $p < .001$; and they were significantly lower in positive awe than joy

conditions, $t(497) = -4.82$, $p < .001$.

Table 5.

Self-word ratios (Experiment 1)

	Emotion conditions					
	Negative awe	Positive awe	Fear	Joy	Overall F	Marginal R^2
Self-word ratio	.025 (0.022)[cd]	.024 (0.024)[dc]	.038 (0.028)[ab]	.038 (0.027)[ab]	14.0***	.07

Note. Standard deviations are in parentheses. N = 666. *** $p < .001$. [a] Mean is different from negative awe. [b] Mean is different from positive awe. [c] Mean is different from fear. [d] Mean is different from joy at $p < .001$.

Correlational analyses were also conducted on self-word ratios for awe-specific appraisals. For both negative and positive awe conditions, self-word ratio correlated negatively with self-diminishment ratings (negative awe: $r = -.229$, $p = .002$; positive awe: $r = -.199$, $p = .006$); that is, participants who referred to themselves more frequently in their awe narratives reported less self-diminishment. For fear and joy conditions, self-word ratio and self-diminishment ratings did not have a significant association (fear: $r = .152$, $p = .068$; joy: $r = -.012$, $p = .89$).

In the positive awe condition, self-word ratio correlated negatively with vastness ($r = -.213$, $p = .003$); that is, participants who referred to themselves more frequently in their positive awe narratives reported lower perceived vastness in the experience.

In the negative awe and fear conditions, self-word ratio correlated negatively with connection (negative awe: $r = -.179$, $p = .018$; fear: $r = -.219$, $p = .008$), that is, participants who referred to themselves more frequently in their negative awe or fear narratives reported less connection during the experience. This correlation was non-

significant among positive awe (r = .005, p = .94) and joy (r = .127, p = .117) conditions.

Discussion

Participants were randomly assigned to an emotion condition, provided with a definition of the emotion, and then wrote about a time they experienced the emotion (Sample 1 compared positive and negative awe; Samples 2 and 3 compared positive awe, negative awe, fear, and joy). They then responded to a battery of appraisals and measures asking about the experience.

Awe-Specific Appraisals

Vastness did not significantly differ between positive and negative awe, inconsistent with my hypothesis that positive awe would be associated with greater vastness; however, vastness differentiated positive and negative awe from valence-consistent emotions (positive and negative awe were associated with greater vastness ratings than joy and fear, respectively). These findings are congruent with Chaudhury et al. (2021) such that vastness ratings are greater among awe variants compared to other emotions. However, my analysis yielded no significant differences in vastness ratings between positive and negative awe, inconsistent with Chaudhury et al. (2021) and Gordon et al. (2017), who both found positive awe to be associated with higher vastness ratings than negative awe.

Need for accommodation ratings were not significantly different between negative awe and positive awe, inconsistent with my hypothesis that positive awe would be associated with greater need for accommodation ratings; negative awe and fear conditions did not significantly differ; and positive awe was associated with greater need for accommodation ratings than joy. Thus, the results do not support that need for

accommodation is a quantitative differentiator between awe variants. These findings were consistent with Chaudhury et al. (2021) and Gordon et al. (2017), who both found that positive and negative awe were associated with similar levels of need for accommodation.

Self-diminishment ratings were greater for negative awe than positive awe, inconsistent with my hypothesis that positive awe would be associated with greater self-diminishment ratings; and ratings for both awe variants were lower than ratings for fear and greater than ratings for joy. These results support self-diminishment as a quantitative differentiator between positive and negative awe. These findings, however, are incongruent with Chaudhury et al. (2021), who found positive and negative awe to be associated with similar levels of self-diminishment, and with Gordon et al. (2017), who found positive awe to be associated with greater self-diminishment ratings than negative awe.

Connection ratings were significantly lower in negative awe than positive awe; ratings were greater in negative awe than fear; and ratings did not significantly differ between positive awe and joy. Isolation ratings did not significantly differ between positive and negative awe; ratings were lower in negative awe than fear; and ratings did not significantly differ between positive awe and joy. Results for both connection and isolation follow a similar pattern: Negative awe was associated with greater connection and lesser isolation than fear; and positive awe and joy were associated with similar levels of connectedness and isolation, consistent with my hypotheses. These findings support that connectedness and isolation may act as qualitative differentiators such that positive and negative awe have different relationships with their valence-consistent

emotion comparison.

General Appraisals

Certainty ratings were lower in negative awe than positive awe conditions, consistent with my hypothesis; and ratings did not significantly differ between negative awe versus fear and positive awe versus joy. These findings support certainty acting as a quantitative differentiator. The results are consistent with Chaudhury et al. (2021) and Gordon et al. (2017) who both found that negative awe was consistently associated with lesser certainty than positive awe.

Personal control ratings did not significantly differ between negative and positive awe, inconsistent with my hypothesis that negative awe would be associated with lower personal control ratings, nor between negative awe and fear conditions; ratings were lower in positive awe than joy conditions. These findings are incongruent with Chaudhury et al. (2021) and Gordon et al. (2017) who found that negative awe was associated with lower appraisals of personal control compared to positive awe.

Situational control ratings did not significantly differ between positive and negative awe, nor between negative awe and fear conditions, inconsistent with my hypothesis that negative awe would be associated with greater situational control ratings; ratings were greater in positive awe than joy conditions. These findings are incongruent with Chaudhury et al. (2021) and Gordon et al. (2017) who both found that negative awe was associated with greater appraisals of situational control compared to positive awe.

Other control ratings did not significantly differ between positive and negative awe, consistent with my hypothesis; ratings were lower in negative awe than fear conditions; and ratings did not significantly differ between positive awe and joy

conditions. These findings are consistent with Gordon et al. (2017) and two out of three studies from Chaudhury et al. (2021) which found that positive and negative awe were associated with similar levels of other control.

Summary of Awe-Specific and General Appraisals

Recent research suggests positive and negative variants of awe differ in their underlying appraisals (Chaudhury et al., 2021; Gordon et al. 2017). I sought to replicate findings from Chaudhury et al. (2021) and Gordon et al. (2017) and to investigate additional appraisals not included in previous investigations. Results of Experiment 1 showed that among the awe-specific appraisals, negative awe was associated with a higher need for accommodation, greater self-diminishment, lower feelings of connection, and greater feelings of isolation compared to positive awe. Regarding the key appraisals that Gordon et al. (2017) and Chaudhury et al. (2021) examined, the only finding that replicated was that negative awe was associated with lower certainty than positive awe. I found no significant differences for personal control and situational control between positive and negative awe.

Out of the awe-specific appraisals believed to be relevant in distinguishing positive and negative awe and the appraisals previously studied by Gordon et al. (2017), ratings of self-diminishment (R^2 = .24) and connection/isolation (R^2 = .42, .31) were associated with the largest effect sizes between tested emotion conditions. This could potentially be because feelings of self-diminishment and connection/isolation are better determinants of type of emotion experienced. In later sections, I will describe how these factors may interact to create differently valenced awe experiences.

Exploratory Narrative Analysis

The text analysis of self-word ratios revealed that both positive and negative awe were associated with lower self-word ratios than both joy and fear. In other words, participants writing about awe experiences referenced themselves less than participants writing about joy and fear experiences. This is consistent with awe's association with a reduced focus on the self (Keltner & Haidt, 2003; Piff et al., 2015; Shiota et al., 2007).

Both positive and negative awe were associated with lower self-word ratios and lower self-diminishment ratings compared to fear conditions. This is surprising because the expected pattern would be for greater self-diminishment to correspond with lower self-word ratios (e.g., an individual experiencing high self-diminishment during a fear experience *should* be reflected in a lower frequency of self-words). Despite fear eliciting higher self-diminishment, participants in the fear condition focused on themselves more in their written narratives. In contrast, for both positive and negative awe conditions, there was a negative association between self-word ratio and self-diminishment: The more frequently participants referenced themselves in awe narratives, the less self-diminishment they reported. This suggests that self-diminishment may be understood differently under different emotional contexts. Under fearful contexts, feeling small and insignificant can be understood negatively such that there is an inward focus (represented by greater self-word ratios) making individuals feel threatened and powerless. Under other contexts, feeling small and insignificant may be understood more with an outward focus (represented by reduced self-word ratios) in ways traditionally defined in the awe literature (e.g., feeling in the presence of something greater than the self and an attentional shift toward a "bigger picture;" Piff et al., 2015; Shiota et al., 2007).

I suspect that connectedness may contribute to how an individual understands their self-diminishment to be pleasant or unpleasant in awe contexts. Indeed, in both the negative awe and fear conditions, self-word ratio correlated negatively with connectedness: The more frequently participants referenced themselves, the less connectedness they reported. To reiterate previously mentioned patterns, the more frequently participants referenced themselves: the less self-diminishment they reported in positive and negative awe conditions; the greater self-diminishment they reported in fear conditions; and the less connectedness they reported in negative awe and fear conditions. This suggests an interesting potential relationship between self-diminishment and connectedness such that self-diminishment can sometimes be appraised positively but other times negatively. Within fearful experiences, self-diminishment seems to always be appraised negatively, whereas within awe experiences (positive and negative), self-diminishment's valence may be partially determined by the connectedness one feels (i.e., higher connectedness to be associated with appraising self-diminishment positively). These analyses were exploratory so conclusions should be interpreted cautiously, but they provide tentative support for self-diminishment and connectedness interacting to change the valence of an awe experience.

Implications for Proposed Model

The results of Experiment 1 provided tentative evidence that self-diminishment/self-words and connectedness have the capacity to differentiate awe variants. Connectedness acted as a qualitative differentiator such that positive and negative awe have different relationships with their valence-consistent emotion; that is, negative awe was associated with greater connectedness than fear, but positive awe and

joy shared similar ratings of connectedness. Out of the awe-specific appraisals believed to be relevant in distinguishing positive and negative awe and the general appraisals previously studied by Chaudhury et al. (2021) and Gordon et al. (2017), ratings of self-diminishment (R^2 = .24) and connection/isolation (R^2 = .42, .31) were associated with the largest effect sizes between tested emotion conditions. This also points to the possibility that feelings of self-diminishment and connection/isolation are better determinants of type of emotion experienced. The exploratory narrative analysis provided cautious support for self-diminishment being appraised differently depending on factors such as emotional context and feelings of connectedness. Taken together, these findings are consistent with my proposed model that the different ways in which an individual feels small and connected versus small and isolated may key in determining whether an individual experiences awe as safe or threatening. Feeling small is positive when you are a small part of something; feeling small is negative when you are a small part of nothing.

Pilot Study

A pilot study[6] was conducted to establish evidence for the effectiveness of separate manipulations of self-significance and connectedness. Participants watched a video segment of an interview with Neil DeGrasse Tyson, followed by self-significance (low, high) and connectedness (low, high) manipulations in which they wrote narratives aligned with their assigned conditions. Then, participants went through an awe induction, which was a video starting out from a street view, zooming out to show the country, zooming out further to show the Earth, and progressively zooming further out to highlight

[6] In reality, five pilot studies were conducted; I report the most promising here in the main text. Pilot Studies 1–4 are described in detail in Appendix C.

the relatively tiny size of Earth compared to the Universe. Finally, participants reported self-diminishment, connection, and valence ratings.

Method

Participants and Design

Participants were recruited via Amazon's Mechanical Turk (MTurk) and provided with $2 upon completion, based on an hourly rate of $8/hour. The study used a 2 (Self-Significance[7]: low, high) × 2 (Connectedness: low, high) between-participants design. Based on the earlier pilot studies, a sample size of 150 was selected to be the target sample size.

One hundred and fifty participants took part in the study (64 women, 85 men, 1 did not identify). The sample ranged from 22 to 68 years old (M = 37.2, SD = 10.0; 69.3% not Hispanic in origin; 30.7% Hispanic in origin; 77.3% White, 7.3% South Asian/Southeast Asian, 5.3% Black/African, 4.0% East Asian, 4.0% Mixed, 1.3% LatinX/Latiné, 1.0% Middle Eastern/North African). One participant was excluded for failing the attention check, leaving a final sample of 149 participants (high self-significance/high connection: 43; low self-significance/high connection: 37; high self-significance/low connection: 33; low self-significance/low connection: 36).

Procedure and Materials

Participants completed all study materials online via Qualtrics and were told that researchers were interested in the types of arguments people use in persuasive speech.

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[7] Note that whereas I previously wrote about self-diminishment, I am now referring to self-significance. These two constructs are essentially the two poles of the same continuum. I switch the framing to better represent the nature of the experimental manipulations.

Participants read the following:

> In this study, we are investigating people's ability to take on the perspectives of others.
>
> The following audio clip is taken from an interview with Neil DeGrasse Tyson, physicist and host of the popular *Cosmos* documentary series. As you listen to it, we want you to put yourself into his shoes and imagine his thoughts and feelings as he reflects on Earth's origins. Imagine yourself giving Dr. DeGrasse Tyson's answer to the question, 'What is the most astounding fact?'

Then, participants watched a 78-second video with scrolling text, narrated by Neil DeGrasse Tyson (https://youtu.be/HbSL5RhEBP0). The text and narration were as follows:

> The most astounding fact is the knowledge that the atoms that comprise life on Earth—the atoms that make up the human body—are traceable to the crucibles that cooked light elements into heavy elements in their core under extreme temperatures and pressures. These stars, the high mass ones among them, went unstable in their later years; they collapsed and then exploded scattering their enriched guts across the galaxy—guts made of carbon, nitrogen, oxygen and all the fundamental ingredients of life itself. These ingredients become part of gas clouds that condense, collapse, form the next generation of solar systems—stars with orbiting planets, and those planets now have the ingredients for life itself.

On the next page, participants read the following instructions:

Dr. Neil DeGrasse Tyson was talking about the Universe, but what he said later in the interview was targeted toward the human experience.

You will now be presented with two additional sentences from Dr. DeGrasse Tyson's interview, one at a time. In each case, think about how it applies to your own personal experiences.

Next, participants completed two writing tasks designed to manipulate connectedness and self-significance, with the order randomized. The connectedness manipulation was as follows:

'When I look up at the night sky and I know that yes, **[each of us is connected to / I am alone in]** this universe, **[each of us is a part of / I am isolated in]** this universe, but perhaps more important than both of those facts is that the Universe **[is in each of us / continues with or without me]**.'

Now, **explain how or why** this statement describes the human experience—how **everyone can be [connected/separated]**—using your personal experiences as an example. How would you **persuade** someone who doesn't believe this to change their mind?

The self-significance manipulation was as follows:

'When I reflect on the Universe, I look up. I feel **[big/small]** because I know that my actions play **[a significant / an insignificant]** role in the grand scheme of things, and that my day-to-day concerns **[do deserve / don't deserve]** the weight I give them.'

Now, **explain how or why** this statement describes the human

> experience—**how [everyone / no one] has a significant role** in the grand scheme of things——using your personal experiences as an example. How would you **persuade** someone who doesn't believe this to change their mind?

Both manipulations ended with the instruction, "Aim to write at least 8 sentences to make a coherent argument. The strength of your argument will be coded by experimenters." Participants then completed the following measures.

Self-Diminishment. Self-diminishment was measured with four items on a 5-point scale (0 = *Not at all*, 1 = *Slightly*, 2 = *Moderately*, 3 = *Very*, 4 = *Extremely*). Participants rated the extent to which they felt each of the following during the video: "I felt like my own issues and concerns did not matter that much," "I felt small," "I felt like my current concerns were important" (R), and "I felt like what I accomplish in the world was impactful in the broader scheme of things" (R). Item order was randomized with connection ratings.

Connection. Connection was measured with four items on a 5-point scale (0 = *Not at all*, 1 = *Slightly*, 2 = *Moderately*, 3 = *Very*, 4 = *Extremely*). Participants rated the extent to which they felt each of the following during the video: "I felt connected," "I felt like I was a part of something," "I felt isolated" (R), and "I felt alone" (R). Item order was randomized with self-diminishment ratings.

Valence. Participants responded to two questions: "How [positive/negative] was the experience?" (with the order of the questions randomized). Participants made their responses on a 5-point scale (0 = *Not at all*, 1 = *Slightly*, 2 = *Moderately*, 3 = *Very*, 4 = *Extremely*).

Attention Check. Participants responded to a question asking whether they (1) followed the instruction (e.g., writing in detail about their memories, (2) made an effort to be careful and honest in their responding, and (3) were not distracted. Participants were excluded from analysis if they failed this attention check.

Results and Discussion

Exploratory factor analyses (EFA) were conducted to determine the structure of the measures. I then calculated whatever scores were suggested by those analyses (averaging across the relevant items). Then each factor and valence ratings were analyzed separately with ANOVAs with self-significance and connectedness conditions as fixed factors. Descriptive results can be found in Table 6.

Self-Diminishment

An exploratory factor analysis with oblimin rotation on the four items was performed, Bartlett's test of sphericity (Bartlett, 1950) was significant, χ^2 (6) = 155, $p <$ .001, and Kaiser-Meyer-Olkin (KMO; Kaiser & USCG, 1974) measure of sampling adequacy was 0.55. Factor loadings shown in Table 7. A two-factor structure appeared with two items loading onto an "Insignificance" factor and the other two items loading onto a "Significance" factor. Each factor's items were averaged together to form composite scores before being analyzed with ANOVAs.

For the insignificance factor, the ANOVA did not yield significant effects of self-significance, $F(1, 145) = 1.53$, $p = .22$, $\eta_p^2 = 0.01$; nor of connectedness, $F(1, 145) = 1.21$, $p = .27$, $\eta_p^2 = 0.01$; nor their interaction, $F(1, 145) = 2.95$, $p = .09$, $\eta_p^2 = 0.02$.

Table 6.

R*esults for Self-Significance Factors, Conectedness Factors, and Valence Ratings (Pilot Study)*

	High Self-Significance		Low Self-Significance			
	High Connection	Low Connection	High Connection	Low Connection	Overall F	*p*
Significance Factor	2.90 (0.92)	2.73 (0.99)	2.68 (0.92)	2.36 (1.26)	1.81	.15
Insignificance Factor	2.24 (1.27)	2.12 (1.33)	2.15 (1.19)	2.71 (1.02)	1.84	.14
Connection Factor	3.00 (0.70)	2.98 (0.86)	2.96 (0.77)	2.64 (1.07)	1.43	.24
Isolation Factor	1.91 (1.40)	1.80 (1.42)	1.66 (1.41)	2.11 (1.29)	0.68	.57
Positive Valence	2.95 (0.87)	2.73 (1.15)	3.05 (0.71)	2.39 (1.34)	3.01	.03*
Negative Valence	1.47 (1.35)	1.58 (1.48)	1.19 (1.17)	1.83 (1.38)	1.43	.24

Note. Standard deviations are in parentheses. Scales are from 0 (*Not at all)* to 4 (*Extremely*). N = 149. * $p < .05$.

Table 7.

Factor Loadings of Self-Diminishment Items (Pilot Study)

	Factor		
	1	2	Uniqueness
1. I felt like my own issues and concerns did not matter that much.	0.76		0.39
2. I felt small.	0.86		0.28
3. I felt like my current concerns were important.		0.63	0.58
4. I felt like what I accomplish in the world was impactful in the broader scheme of things.		0.92	0.16

Note. 'Minimum residual' extraction method was used in combination with a "oblimin" rotation.

For the significance factor, the ANOVA showed directional differences I predicted, such that participants in the high (versus low) self-significance condition reported greater levels of significance; however these differences were non-significant, $F(1, 145) = 3.01$, $p = .09$, $\eta_p^2 = 0.02$. The effect of connectedness was non-significant, $F(1, 145) = 2.04$, $p = .16$, $\eta_p^2 = 0.01$; as was the interaction , $F(1, 145) = 0.19$, $p = .67$, $\eta_p^2 = 0.001$. Manipulation order effects were non-significant in all cases.

Connection

An exploratory factor analysis with oblimin rotation on the four items was performed, Bartlett's test of sphericity (Bartlett, 1950) was significant, χ^2 (6) = 221, $p <$ .001, and Kaiser-Meyer-Olkin (KMO; Kaiser & USCG, 1974) measure of sampling adequacy was 0.51. Factor loadings shown in Table 8. A two-factor structure appeared with two items loading onto the "Isolation" factor and the other two items loading onto

the “Connection” factor. Each factor’s items were averaged together to form composite scores before being analyzed with ANOVAs.

Table 8.

Factor Loadings of Connection Items (Pilot Study)

	Factor		
	1	2	Uniqueness
1. I felt isolated.	0.90		0.20
2. I felt alone.	0.91		0.15
3. I felt connected.		0.71	0.50
4. I felt like I was a part of something.		0.81	0.34

Note. 'Minimum residual' extraction method was used in combination with a "oblimin" rotation.

For the isolation factor, the ANOVA did not yield significant effects of self-significance, $F(1, 145) = 0.02$, $p = .89$, $\eta_p^2 < 0.001$; connectedness, $F(1, 145) = 0.57$, $p = .45$, $\eta_p^2 = 0.004$; or their interaction, $F(1, 145) = 1.48$, $p = .23$, $\eta_p^2 = 0.01$.

For the connection factor, the ANOVA did not yield significant effects of self-significance, $F(1, 142) = 1.83$, $p = .18$, $\eta_p^2 = 0.013$; connectedness, $F(1, 142) = 1.37$, $p = .24$, $\eta_p^2 = 0.01$; or their interaction, $F(1, 142) = 1.12$, $p = .29$, $\eta_p^2 = 0.01$.

Valence

Positive Valence. The ANOVA did not yield a significant effect of self-significance, $F(1, 145) = 0.49$, $p = .486$, $\eta_p^2 = 0.003$; however, it did yield a significant effect of connectedness, $F(1, 145) = 6.86$, $p = .01$, $\eta_p^2 = 0.045$, such that participants in the high connectedness condition had higher ratings of positive valence compared to participants in the low connectedness condition. The interaction effect was not

significant, $F(1, 145) = 1.66$, $p = .199$, $\eta_p^2 = 0.011$.

Negative Valence. The ANOVA did not yield significant effects of self-significance, $F(1, 145) = 0.001$, $p = .967$, $\eta_p^2 = 0.000$; connectedness, $F(1, 145) = 2.89$, $p = .091$, $\eta_p^2 = 0.020$; or the interaction effect, $F(1, 145) = 1.45$, $p = .231$, $\eta_p^2 = 0.010$.

Summary

Although not statistically reliable, the self-significance effect on self-diminishment ratings and connectedness effect on connection ratings were in the predicted directions. Given time constraints, I decided to use the manipulations from the current pilot study as the manipulations for Experiment 2.

Experiment 2

The goal of Experiment 2 was to test my theoretical model, which hypothesized that self-significance and connectedness interact to determine whether awe is experienced as positive or negative. As stated previously, feeling small and insignificant can be a positive experience if it is associated with a reduction in perceived boundaries and feeling connected to one's environment and others around them; however, it can also be a negative experience if the self-diminishment is associated with feeling isolated and helpless without the proper resources to approach a situation.

Experiment 2 also included an exploration of visual attention during awe experiences, to determine whether cognitive mechanisms can also differentiate positive and negative awe. This was accomplished via eye-tracking, looking at patterns of eye movement that have been shown elsewhere to reflect processes of attentional engagement (indexed by a higher number of gaze fixations and longer average fixation durations; Miller & Unsworth, 2020; Negi & Mitra, 2020) and cognitive load (indexed by a higher

blink rate [number of blinks/time]; Chen & Epps, 2014; Siegle et al., 2008). Based on the broaden-and-build theory premise that positive emotions broaden one's scope of attention and thought–action repertoires (Fredrickson, 1998, 2001) and evidence that people want to prolong their positive awe experiences (Shiota et al., 2007), it seemed possible that positive awe would be associated with attentional engagement. Based on findings from Chaudhury et al. (2021) and Taylor and Uchida (2019) that participants in a negative (compared to positive) awe condition reported greater feelings that the situation required mental/physical exertion to deal with (e.g., appraisals of anticipated effort), it seemed possible that negative awe would be associated with cognitive load.

Overview, Hypotheses, and Exploratory Questions

In Experiment 2, two separate samples participated in the procedure: an online sample and an in-lab eye-tracking sample. The procedures were the same except that the in-person eye-tracking sample watched the awe-inducing video on a monitor equipped with eye-tracking equipment; the online sample watched the video on their own computers from a location of their choice. Participants were induced to experience high or low self-significance and high or low connectedness before watching a video designed to induce awe; in the eye-tracking sample, their eye movements were tracked during the video. After the video, participants rated their experience on a series of appraisals and other constructs. My predictions and study design for both samples were preregistered on the Open Science Framework (https://osf.io/bqs76; https://osf.io/apfq7).

Hypotheses

Manipulation Check Hypotheses.

Hypothesis 0a. High self-significance, compared to low self-significance, will be

associated with lower ratings on self-diminishment.

Hypothesis 0b. High connectedness, compared to low connectedness, will be associated with higher ratings on connection.

Hypothesis 0c. Awe ratings will be higher than non-awe positive emotion ratings.

Main Hypotheses.[8] I proposed two main effects (H1 and H2). I also proposed a Self-Significance × Connectedness interaction, but the specific pattern was unclear. I thus considered two possible patterns (H3a versus H3b) that would provide support for my model.[9] See Table 9 for a subsection of my predictions.

Hypothesis 1: Self-Significance. Low self-significance[10], compared to high self-significance, will be associated with lower ratings on the positive valence, awe-specific appraisal[11], and positive appraisal[12] indices, and higher ratings on the negative valence, negative appraisal[13], and threat emotion[14] indices.

Hypothesis 2: Connectedness. High connectedness, compared to low

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[8] In my preregistration, I also included hypotheses for negative non-awe-related emotions. However, I deviate here from the preregistration because I came to question my reasoning. In line with the preregistration, I conducted the originally planned analyses, but because I am no longer clear on how results for negative non-awe-related emotions relate to my theoretical model, I present these analyses in Appendix E rather than in the main body of the dissertation.

[9] I did not have predictions for the appraisal of other control/responsibility because of the results from Experiment 1 and unclear patterns in the literature. I included them in the appraisals section, however, because they are often measured alongside personal and situational control/responsibility appraisals.

[10] In Experiment 1, I predicted positive (versus negative) awe to be associated with lower self-significance (i.e., higher self-diminishment); however, after the results demonstrated negative awe was associated with lower self-significance, I revised my predictions for Experiment 2.

[11] Awe-specific appraisals = vastness, need for accommodation

[12] Positive appraisals = certainty, personal control/responsibility

[13] Negative appraisals = situational control, self-awareness, situational awareness

[14] Threat emotions = anxiety, fear

connectedness, will be associated with higher ratings on the positive valence, awe-specific appraisal, and positive appraisal indices, and lower ratings on negative valence, negative appraisal, and threat emotion indices.

Hypothesis 3: Self-Significance × Connectedness. Self-significance and connectedness will interact to influence whether awe is experienced as positive or negative, with connectedness buffering against the negative influence of low self-significance.

Specifically, under conditions of low connectedness, low (versus high) self-significance will be associated with lower ratings on the positive valence, awe-specific appraisal, and positive appraisal indices, and higher ratings on the negative valence, negative appraisal, and threat emotion indices.

Under conditions of high connectedness, however, these differences in ratings between low (versus high) self-significance will be smaller (Hypothesis 3a), perhaps even disappearing completely (Hypothesis 3b).

Table 9

Predicted Patterns for Positive and Negative Appraisals

	Positive Appraisals: Vastness, NFA, Certainty, Personal Control	**Negative Appraisals:** Threat Emotions, Situational Control, Self-Awareness, Situational Awareness
Low Connection: More Significance	More X	Less X
High Connection: More Significance	Slightly/no more X	Slightly/no less X

Note. "Low connection: more significance" represents the effect of increasing significance ratings for participants low in connection. NFA = Need for accommodation.

Secondary Hypotheses. Attentional engagement and cognitive load, as assessed via eye-tracking, were used to further characterize positive versus negative awe, to generalize from the self-report and physiological measures used previously to include cognitive measures.

Hypothesis S1. I predicted that more positively valenced awe would be associated with greater levels of attentional engagement than negatively valenced awe.

Hypothesis S1a. I predicted that high (versus low) connectedness would be associated with a higher number of gaze fixations and longer average fixation durations.

Hypothesis S1b. I predicted that high (versus low) self-significance would be associated with a higher number of gaze fixations and longer average fixation durations.

Hypothesis S1c. I predicted that connectedness and self-significance would interact, such that the advantage of high (versus low) self-significance would be smaller under conditions of high (versus low) connectedness.

Hypothesis S1d. I predicted that positive valence ratings would correlate positively with number of gaze fixations and longer average fixation durations.

Hypothesis S2. I predicted that more negatively valenced awe would be associated with greater levels of cognitive load than positive valenced awe.

Hypothesis S2a. I predicted that low (versus high) connectedness would be associated with higher blink rate.

Hypothesis S2b. I predicted that low (versus high) self-significance would be associated with higher blink rate.

Hypothesis S2c. I predicted that connectedness and self-significance would interact, such that the negative effect of low (versus high) self-significance would be

smaller under conditions of high (versus low) connectedness.

Hypothesis S1d. I predicted that negative valence ratings would correlate positively with blink rate.

Exploratory Questions

The eye-tracking analysis included an exploratory examination of defined areas of interest (AOI) within the *Cosmos* video. At the bottom of the video, for example, there is continuously updating text and a visual describing the distance from the starting point (starting at 10 centimeters and ending at 10 billion light-years). This was the defined AOI. Attention to this AOI was examined on the intuition that the more time participants spent attending to the distance may influence how small they felt. On the one hand, it seemed reasonable to expect that more time looking at the distance ticker would be associated with greater self-diminishment, as the size of the universe would be highlighted. However, it was also possible that the more time participants spent attending to the distance ticker would be associated with less self-diminishment, due to not fully engaging with the main content of the video and perhaps undermining awe.

Method

Participants and Design

Both samples used a 2 (Self-Significance: low, high) × 2 (Connectedness: low, high) between-participants design.

Online Sample. Participants in the online sample were recruited via (www.prolific.co) [November 17, 2022] and provided with $2.67 upon completion, based on an hourly rate of $8.24/hour.

Three hundred and nine participants took part in the online study (158 women,

140 men, 7 non-binary, 2 preferred to not self-identify, 1 preferred a different description, and 1 did not respond). The sample ranged from 19 to 77 years old (M = 38.3, SD = 13.7; 86.1% not Hispanic in origin; 13.3% Hispanic in origin; 0.6% did not respond; 62.5% White, 12.9% Black/African; 8.7% Mixed; 7.4% East Asian; 4.9% LatinX/Latiné; 3.6% South Asian/Southeast Asian; 0.3% Native Hawaiian/Pacific Islander; 0.3% Alaskan Native/American Indian/Indigenous; 0.6% preferred not to report; 0.6% describe themselves a different way; 0.3% did not respond).

Data collection occurred in two waves. The first wave collected 241 participants. I aimed to have at least 240 participants in my final analysis, after exclusions. First, I excluded three participants for failing the attention check question. Then a research assistant and I independently coded the participant-written narratives to make sure the content fit the instructions (e.g., writing about a time when they felt particularly significant, for participants in the high self-significance condition). We indicated our responses with a yes or no. The percent agreement between raters was 90.1%. The coding team met to resolve any discrepancies in our coding. Participants were excluded if they were deemed to not have followed instructions. This led to the exclusion of 47 participants. I also checked to make sure participants wrote at least 40 words. If they wrote less than 40 words, they were excluded from the analysis. This led to the exclusion of three participants. This left a sample of 188 participants—an exclusion rate of ~22%.

Accounting for this exclusion rate, I recruited 68 more participants to obtain at least 240 participants in the final analysis, after exclusions. After the second wave of recruitment, the new narratives went through the same coding process to determine whether participants followed directions. The new percent agreement between raters for

the entire sample (n = 309) was 89.7%. From the entire sample (n = 309), three participants were excluded for failing the attention check question; 59 participants were excluded for not following directions on the writing prompts; and five participants were excluded for writing less than 40 words; leaving a sample of 241 participants (high self-significance/high connection: 74; low self-significance/high connection: 54; high self-significance/low connection: 53; low self-significance/low connection: 60).

Eye-Tracking Sample. The in-person eye-tracking sample was a part of an exploratory question and thus I did not have a specific target sample size; rather, the planned sample size was as many possible participants that could be collected within the Autumn Quarter and the early weeks of the Winter Quarter of the academic year.

Sixty-two participants took part in the study (39 women, 18 men, 3 non-binary, 1 preferred a different description, 1 did not self-identify). The sample ranged from 18 to 35 years old (M = 19.9, SD = 3.4; 63% not Hispanic in origin; 37% Hispanic in origin; 45.2% White, 22.6% LatinX/Latiné, 12.9% Mixed, 4.8% Black/African, 3.2% East Asian, 3.2% South Asian/Southeast Asian, 1.6% Middle Eastern/North African, 4.8% described themselves in another way, 1.6% preferred not to report). Seven participants were excluded due to technical or experimenter errors and five participants were excluded for not following instructions on the writing task, leaving a final sample of 50 (high self-significance/high connection: 13; low self-significance/high connection: 12; high self-significance/low connection: 14; low self-significance/low connection: 11).

Procedure and Materials

Participants completed all study materials either in a lab (eye-tracking sample) or online in a location of their choosing (online sample). See Appendix F for full materials.

Participants learned that the research study was designed to learn about how certain features of videos influence emotions and gaze behaviors. All participants were randomly assigned to view one of the four Self-Significance × Connectedness manipulations before watching the awe-inducing *Cosmos* video and completing the dependent measures; randomization was executed by the computer program that ran the experiment.

Participants in the online sample completed the entire experiment via a Qualtrics survey. Participants in the eye-tracking sample completed the self-significance and connectedness manipulation tasks on a desktop computer outfitted with a Tobii x3-120 eye-tracker, run by Tobii Studio software, and then watched the *Cosmos* video and completed the dependent measures via a Qualtrics survey.

Self-Significance and Connectedness Manipulations. The self-significance and connectedness manipulations were the same as used in the pilot study.

Stimulus Video. The stimulus video was the *Cosmos* video used in the pilot study.

Dependent Measures. All measures were administered via a Qualtrics survey.

Self-Diminishment and Connection Ratings. Participants responded to the same items measuring self-diminishment and connection as in the pilot study. Self-diminishment and connection items were randomized together in a block.

Appraisals Ratings. Participants responded to appraisal items taken from the previous experiments. They responded to the awe-specific appraisals of vastness and need for accommodation used in Experiment 1. They also responded to a subset of general appraisal items: certainty, personal responsibility/control, other

responsibility/control, situational responsibility/control, self-awareness, and situational awareness [15]. All appraisal rating items were randomized together in a block.

Valence Ratings. Participants responded to the same valence items from the pilot study.

Emotions Ratings. Participants responded to the question, "To what extent did you feel each of these emotions?" The emotions were chosen to reflect awe (*awe*, *wonder*), threat (*anxiety*, *fear*), positive non-awe emotion (*amusement*, *gratitude*, *pride*, *hope*), and negative non-awe emotion (*sadness*, *boredom*). Ratings were made along on a 5-point scale (0 = *Not at all*, 1 = *Slightly*, 2 = *Moderately*, 3 = *Very*, 4 = *Extremely*); item order was randomized. Due to experimenter error, the survey for the eye-tracking sample did not include the emotions ratings until after 17 participants had already completed the study. The item *wonder* was not added until after 27 participants had already completed the study.

Attention Check. Participants responded to a question asking whether they (1) followed the instructions (e.g., writing a full persuasive narrative), (2) made an effort to be careful and honest in their responding, and (3) were not distracted.

Results

Results are reported separately for the online and eye-tracking samples[16].

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[15] The certainty and control items were included because of their focal use in past research (Chaudhury et al., 2021; Gordon et al., 2017). I decided to use the self-awareness and situational awareness items again since the literature suggests there should be differences between awe variants, and it is possible that the nature of the awe induction used in Experiment 1 (e.g., memory recall) could have influenced people's perceptions of how they were thinking at the time.

[16] I also conducted an analysis with a combined sample, comprised of both the online and the eye-tracking samples, to capitalize on greater statistical power with the larger sample

Analyses were the same for both samples, except that the eye-tracking sample also included secondary and exploratory analyses.

Online Sample

Each record was checked to identify participant noncompliance. No participants from either sample were excluded as a result of this check. Only the records of participants who completed the entire experiment were included in analysis. See Appendix E for online sample tables. See Appendix G for eye-tracking sample tables.

For the online sample, a sensitivity analysis using G*Power (Faul et al., 2007) (specifying N = 241, a power level of .90, a between-subjects design with 4 groups, and numerator *df* = 1) suggested power to observe a partial eta-squared effect size of 0.04. I used this benchmark to calibrate my inferences from the statistical results.

Self-Significance × Connectedness Manipulation Checks. Confirmatory factor analyses were conducted separately on the self-diminishment and connection items. Based on the results of the previous studies, I specified a two-factor solution in both cases. For the four self-diminishment items, two of them were written in a way that assesses feelings of significance, and two of them were written in a way that assesses feelings of insignificance. For the four connection items, two of them were written in a way that assesses feelings of connection, and two were written in a way that assesses feelings of isolation. To accept the solution as having good fit, at least three of the following criteria need to be met: RMSEA < .08, SRMR < .08, CFI > .90, TLI > .95,

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size. Although there were a few minor differences, they were not theoretically relevant. Given the significant methodological difference between the two samples, I decided that the minor differences in results were not significant enough to justify the change in analysis.

non-significant chi-square.

Self-Diminishment. The self-diminishment ratings were subjected to CFA using the Lavaan software package within R, using maximum likelihood estimation. The two-factor model is specified so that the latent variables correlated with one another.

The confirmatory factor analysis yielded the two-factor solution I predicted, with the two items assessing feelings of significance loaded onto the one factor and the two items assessing feelings of insignificance loaded onto another factor (see Table E1). Indicators of good fit met thresholds (RMSEA = 0.00, 90%CI [0.00, 0.14]; SRMR = 0.005; CFI = 1.00; TLI = 1.02; $\chi^2 = 0.27$, $p = .61$). This led to the averaging of each factors' items together. See Table 10 for descriptive results.

For the significance factor, the ANOVA yielded a significant main effect for self-significance ($p < .001$), such that participants in the high self-significance condition reported greater levels of significance compared to participants in the low self-significance condition. The effects for the condition of connectedness ($p = .35$) and the interaction effect ($p = .38$) were both non-significant (see Table E3 for full ANOVA table).

For the insignificance factor, the ANOVA yielded a significant main effect self-significance ($p = .003$), such that participants in the low self-significance condition reported greater levels of insignificance compared to participants in the high self-significance condition. The ANOVA also yielded a significant interaction effect ($p = .025$), such that participants in the high connectedness – low self-significance condition reported greater levels of insignificance compared to participants in the high connectedness – high self-significance condition; all other comparisons were non-

significant. The main effect for the condition of connectedness was non-significant (p = .83).

Table 10.

Results for Online Sample for Self-Significance Factors, Connectedness factors, Valence, Emotions

	High Self-Significance		Low Self-Significance		Overall F	p
	High Connection	Low Connection	High Connection	Low Connection		
Significance Factor	2.03 (1.07)	1.79 (1.09)	1.16 (0.99)	1.15 (0.78)	12.73	<.001
Insignificance Factor	2.01 (1.21)	2.32 (1.20)	2.81 (1.07)	2.44 (1.13)	1.27	.29
Connection Factor	2.55 (1.14)	2.25 (1.07)	2.17 (1.22)	1.78 (1.10)	5.14	.002
Isolation Factor	1.02 (1.08)	1.53 (1.21)	1.58 (1.27)	1.67 (1.11)	4.25	.006
Positive Valence	2.35 (1.23)	2.23 (1.23)	2.28 (1.07)	1.85 (1.22)	2.18	.09
Negative Valence	0.67 (0.94)	0.71 (0.87)	0.63 (0.81)	0.78 (1.02)	0.28	.84
Awe Index	2.91 (1.10)	3.05 (0.86)	3.01 (1.07)	2.73 (1.08)	1.11	.35
Positive Emotion Index	1.83 (0.98)	1.81 (1.06)	1.52 (0.91)	1.37 (0.85)	3.47	.017
Threat Index	0.90 (1.02)	1.12 (1.10)	0.99 (1.04)	0.99 (0.99)	0.49	.69
Sadness	0.92 (1.12)	0.91 (1.04)	0.93 (1.10)	0.93 (1.10)	0.01	.99
Boredom	0.43 (0.86)	0.43 (0.95)	0.33 (0.78)	0.41 (0.83)	0.17	.92

Note. Standard deviations are in parentheses. Scales are from 0 (*Not at all)* to 4 (*Extremely*). N = 241.

Connection. The connection ratings were subjected to CFA using the Lavaan software package within R, using maximum likelihood estimation. The two-factor model is specified so that the latent variables correlated with one another.

The confirmatory factor analysis yielded the two-factor solution I predicted, with the two items assessing feelings of connection loaded onto one factor; and the two items assessing feelings of isolation loaded onto another factor (see Table E2). Indicators of good fit met thresholds (RMSEA = 0.00, 90%CI [0.00, 0.06]; SRMR = 0.00; CFI = 1.00; TLI = 1.01; $\chi^2 = 0.01$, p = .93). This led to the averaging of each factors' items together.

For the connection factor, the ANOVA yielded a significant main effect for connectedness (p = .02), such that participants in the high connectedness condition reported greater levels of connection compared to participants in the low connectedness condition (see Table E3 for full ANOVA table). However, the ANOVA also yielded a significant main effect for self-significance (p = .004), such that participants in the high self-significance condition reported greater levels of connection than participants in the low self-significance condition. The interaction was non-significant (p = .80).

For the isolation factor, the ANOVA also yielded a significant main effect self-significance (p = .02), such that participants in the low self-significance condition reported greater levels of isolation compared to participants in the high self-significance condition. The ANOVA did not yield significant effects for the condition of connectedness (p = .05), nor the interaction (p = .16).

Summary of Manipulation Effectiveness. In general, these results suggest the manipulations of self-significance and connectedness worked as I intended, with the self-significance manipulation affecting self-reported diminishment and the connectedness manipulation affecting self-reported connection.

It should also be noted, however, that self-reported insignificance was only affected by the self-significance manipulation in the high-connectedness condition and that self-reported connection was influenced by both manipulated connectedness and manipulated self-significance, suggesting that the manipulations were not entirely orthogonal. As a result, I conducted additional analyses to supplement the originally planned ANOVAs for all dependent measures. In these analyses, instead of the manipulated Self-Significance × Connectedness conditions, I used self-reported

significance and connection and their interaction term as predictor variables in a series of linear regressions. Due to the correlational and post hoc nature of these analyses, conclusions should be drawn cautiously. Results tables for regression analyses can be found in Appendix E.

Awe Video Manipulation Check. For the positive awe emotion items (*awe, wonder*), McDonald's Omega was calculated and used to ensure reliability. For the positive non-awe emotions (*amusement, gratitude, hope, pride*), an EFA using principal axis factoring and oblimin rotation was conducted to probe structure. The reliability analysis for the awe index yielded a McDonald's Omega of 0.86, so the awe and wonder items were averaged together. The EFA for the positive emotions yielded a single factor solution (see Table E4), so the four items were averaged together.

I ran a linear mixed effects model with connectedness, self-significance, and emotion type (awe index, positive emotion index) as fixed effects; rating (of the awe index and positive non-awe emotion index) as the dependent variable; and participant ID as a random intercept (see Table E5 for full results). This allowed me to test whether participants reported greater levels of the awe index compared to the positive emotion index across all conditions.

The analysis yielded a significant main effect for emotion type ($p < .001$), such that ratings on the awe index were greater than ratings on the positive emotion index across all conditions.

Summary of Awe Induction Effectiveness. Not only did the *Cosmos* video succeed in generating awe ($M_{awe} = 2.91$ on a 0 to 4 scale), but it did so selectively.

Valence.

Positive Valence. For ratings on positive valence, the ANOVA showed directional differences I predicted, such that participants in the high (versus low) connectedness condition reported greater levels of positive valence; however, these differences were non-significant ($p = .08$). The main effect for the condition of self-significance ($p = .15$) and the interaction were both non-significant ($p = .33$) (see Table 11 for ANOVA results).

The regression model with self-reported significance and connection and their interaction term as fixed effects yielded a significant effect for connection ($p < .001$), such that connection ratings were positively associated with ratings of positive valence. No other effects were significant.

Negative Valence. For ratings on negative valence, the ANOVA did not yield any significant effects for the conditions of self-significance ($p = .91$), connectedness ($p = .43$), nor the interaction ($p = .65$) (see Table 11 for ANOVA results).

The regression model yielded a significant effect for connection ($p = .04$), such that connection ratings were negatively associated with ratings of negative valence. No other effects were significant.

Appraisals. Appraisal items were averaged into a single score if their correlations were greater than 0.35 (a medium-sized correlation). Otherwise, items were analyzed separately. Reliability checks can be found in Table E8. See Table 12 for descriptive results. A series of ANOVAs were conducted with self-significance (low, high) and connectedness (low, high) as fixed factors and appraisal rating as the dependent variable. See Table 13 for full ANOVA results. Additionally, I conducted a series of linear

regressions with self-reported significance and connection and their interaction term as predictor variables (see Figure 1 for regression graphs). See Appendix E for full regression results.

Table 11.

ANOVA Table for Positive and Negative Valence Items

Variable	Effect	df	*F*	*p*	η_p^2
Positive Valence	Main effect: Self-Significance	$F(1, 237)$	2.10	.15	0.01
	Main effect: Connectedness	$F(1, 237)$	3.16	.08	0.01
	Interaction	$F(1, 237)$	0.95	.33	0.004
Negative Valence	Main effect: Self-Significance	$F(1, 234)$	0.01	.91	0.00
	Main effect: Connectedness	$F(1, 234)$	0.63	.43	0.003
	Interaction	$F(1, 234)$	0.21	.65	0.001

Note. N = 241. A sensitivity analysis (specifying N = 241, a power level of .90, a between-subjects design with 4 groups, and numerator df = 1) suggested power to observe a partial eta-squared effect size of 0.04

Vastness. The vastness items were averaged. The ANOVAs did not yield any significant effects. The regression model, however, yielded a significant main effect for significance ($p = .005$), such that significance was negatively associated with vastness ratings. There was also a significant interaction effect ($p = .006$), such that participants high in connection ($M + 1SD$) reported high vastness independent of significance ratings, whereas for those low in connection ($M – 1SD$) there was a negative association between significance and vastness.

Need for Accommodation. The two need for accommodation items were analyzed separately due to a low correlation ($r = 0.15$). For the item, "I found it difficult to fully understand the situation," the ANOVA did not yield any significant effects. For the item,

"I felt my view of the world challenged," the ANOVA yielded a significant main effect of connectedness (p = .02), such that participants in the high connectedness condition reported greater levels or a challenged worldview compared to participants in the low connectedness condition.

In terms of the regressions analyses, the model for the item "I found it difficult to fully understand the situation" did not yield any significant effects. For the item, "I felt my view of the world challenged," the model yielded a significant main effect for connection (p = .007), such that there was a positive association between connection ratings and ratings for having one's world view challenged.

Certainty. The certainty items were averaged. The ANOVA did not yield any significant effects. The regression model yielded a significant main effect for significance (p = .01), such that there was a negative association between significance ratings and certainty ratings. It also yielded a significant interaction effect (p = .01). Participants high in connection exhibited a positive association between significance and certainty ratings, whereas participants low in connection exhibited a negative association between significant and certainty ratings.

Personal Control/Responsibility. The personal control/responsibility items were averaged. The ANOVA did not yield any significant effects. The regression model yielded a significant interaction effect (p < .001). Participants high in connection exhibited a positive association between significance and personal control/responsibility ratings, whereas participants low in connection exhibited a negative association between significance and personal control/responsibility ratings.

Table 12.

Results for Appraisals

	High Self-Significance		Low Self-Significance		Overall F	*p*
	High Connection	Low Connection	High Connection	Low Connection		
Vastness	2.71 (1.12)	2.88 (0.75)	3.01 (1.07)	2.75 (0.98)	1.13	.34
Need for Accommodation: I found it difficult to fully understand the situation.	1.22 (1.30)	1.09 (1.23)	0.89 (1.19)	0.97 (1.07)	0.91	.44
Need for Accommodation: I felt my view of the world challenged.	1.50 (1.21)	1.38 (1.23)	2.08 (1.40)	1.43 (1.20)	3.59	.01
Certainty	1.74 (1.09)	1.72 (0.90)	1.97 (1.21)	1.81 (0.88)	0.70	.55
Personal Control/Responsibility	1.06 (0.94)	0.93 (0.94)	0.96 (1.10)	0.71 (0.77)	1.56	.20
Situational Control/Responsibility: I felt that the situation was directed by circumstances beyond anyone's control.	2.04 (1.28)	1.92 (1.25)	1.87 (1.35)	2.12 (1.26)	0.43	.73
Situational Control/Responsibility: I felt that the situation was brought on by chance.	1.23 (1.12)	1.26 (1.16)	1.43 (1.33)	1.32 (1.31)	0.29	.83
Other Control/Responsibility	1.64 (1.08)	1.94 (1.15)	1.72 (1.27)	1.55 (1.20)	1.15	.33
Self-Awareness	2.55 (1.01)	2.46 (0.92)	2.69 (0.98)	2.51 (1.02)	0.56	.64
Situational Awareness	2.23 (1.05)	2.34 (0.86)	2.42 (1.06)	2.32 (1.02)	0.37	.78

Note. Standard deviations are in parentheses. Scales are from 0 (*Not at all)* to 4 (*Extremely*). N = 241.

Table 13.

ANOVA Table for Appraisals and Threat Index

Appraisal	Effect	df	*F*	*p*	η_p^2
Vastness	Self-Significance	$F(1, 235)$	0.42	.52	0.002
	Connectedness	$F(1, 235)$	0.09	.76	0.00
	Interaction	$F(1, 235)$	2.81	.095	0.01
Need for Accommodation: I found it difficult to fully understand the situation.	Self-Significance	$F(1, 237)$	2.11	.15	0.01
	Connectedness	$F(1, 237)$	0.02	.89	0.00
	Interaction	$F(1, 237)$	0.41	.53	0.002
Need for Accommodation: I felt my view of the world challenged.	Self-Significance	$F(1, 236)$	3.73	.055	0.02
	Connectedness	$F(1, 236)$	5.47	.02	0.02
	Interaction	$F(1, 236)$	2.53	.11	0.01
Certainty	Self-Significance	$F(1, 236)$	1.49	.22	0.01
	Connectedness	$F(1, 236)$	0.47	.50	0.002
	Interaction	$F(1, 236)$	0.29	.59	0.001
Personal Control/Responsibility	Self-Significance	$F(1, 237)$	1.71	.19	0.01
	Connectedness	$F(1, 237)$	2.36	.13	0.01
	Interaction	$F(1, 237)$	0.25	.62	0.001
Situational Control/Responsibility: I felt that the situation was directed by circumstances beyond anyone's control.	Self-Significance	$F(1, 237)$	0.004	.95	0.00
	Connectedness	$F(1, 237)$	0.15	.70	0.001
	Interaction	$F(1, 237)$	1.18	.28	0.01
Situational Control/Responsibility: I felt that the situation was brought on by chance.	Self-Significance	$F(1, 237)$	0.61	.44	0.003
	Connectedness	$F(1, 237)$	0.05	.81	0.00
	Interaction	$F(1, 237)$	0.20	.65	0.001
Other Control/Responsibility	Self-Significance	$F(1, 236)$	1.09	.30	0.01
	Connectedness	$F(1, 236)$	0.19	.66	0.001
	Interaction	$F(1, 236)$	2.35	.13	0.01
Self-Awareness	Self-Significance	$F(1, 237)$	0.57	.45	0.002
	Connectedness	$F(1, 237)$	1.12	.29	0.01
	Interaction	$F(1, 237)$	0.16	.69	0.001
Situational Awareness	Self-Significance	$F(1, 237)$	0.39	.53	0.002
	Connectedness	$F(1, 237)$	0.001	.97	0.00
	Interaction	$F(1, 237)$	0.64	.42	0.003
Threat Index	Self-Significance	$F(1, 236)$	0.02	.89	0.00
	Connectedness	$F(1, 236)$	0.71	.40	0.003
	Interaction	$F(1, 236)$	0.70	.41	0.003

Note. N = 241. A sensitivity analysis (specifying N = 241, a power level of .90, a between-subjects design with 4 groups, and numerator df = 1) suggested power to observe a partial eta-squared effect size of 0.04

Situational Control/Responsibility. The two situational control/responsibility items were analyzed separately due to a low correlation ($r = 0.17$). For both items, the ANOVAs did not yield any significant effects. For both items, the regression models also did not yield any significant effects.

Other Control/Responsibility.[17] The other control/responsibility items were averaged. The ANOVA did not yield any significant effects, suggesting participants did not feel more or less other control/responsibility based on which topics they were assigned to write about. The regression model did not yield any significant effects.

Self-Awareness. The self-awareness items were averaged. The ANOVA did not yield any significant effects.

The regression model yielded a significant interaction effect ($p = .026$). Overall, there was a positive association between significance and self-awareness, and those high in connection exhibited a stronger positive association than those low in connection.

Situational Awareness. The two situational awareness items were averaged. The ANOVA did not yield any significant effects.

The regression model yielded a significant main effect for significance ($p = .036$) and a significant interaction effect ($p = .002$). Participants high in connection exhibited a positive association between significance and situational awareness ratings, whereas participants low in connection exhibited a negative association between significance and situational awareness ratings.

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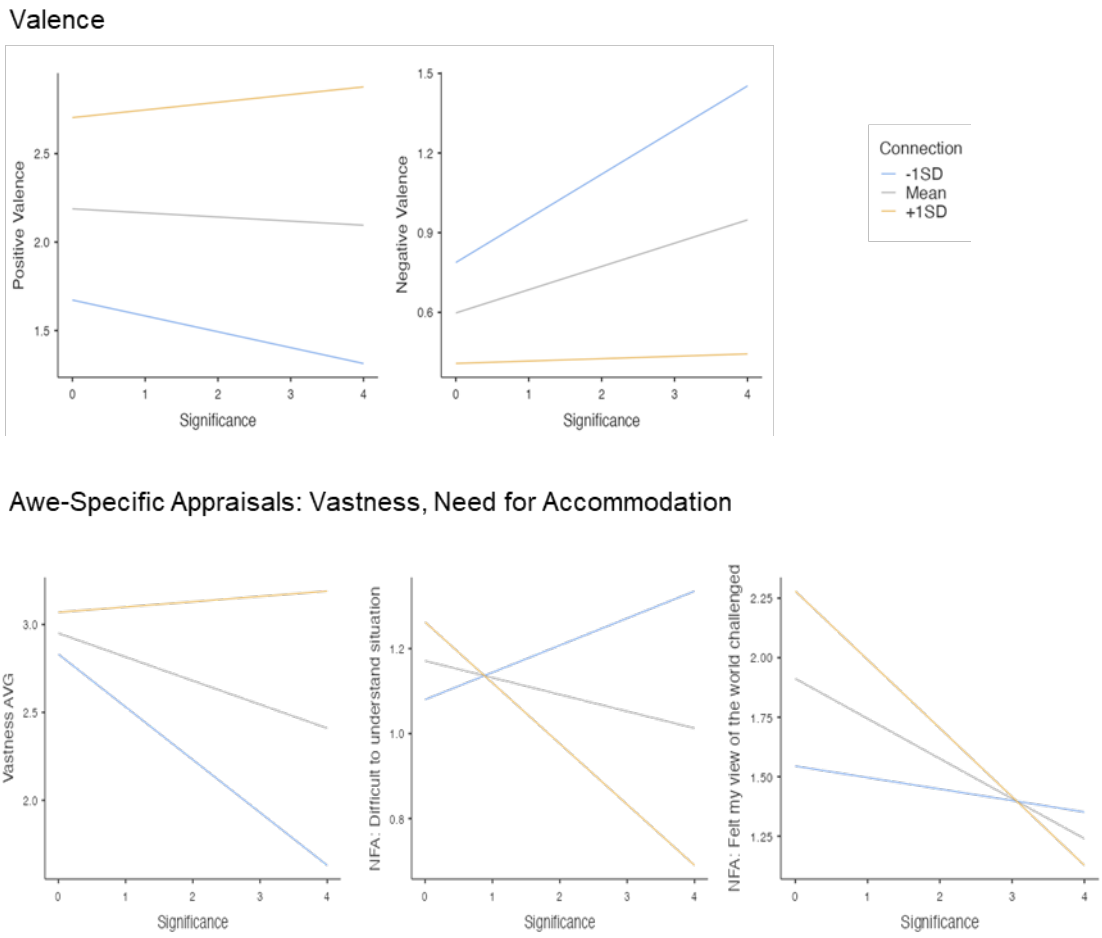
[17] I did not have a prediction for other control/responsibility because of Experiment 1 results and unclear patterns in the literature; however, I included it here for comparison to other appraisals.

Figure 1a

Regression Models, Valence and Awe-Specific Appraisals, Experiment 2



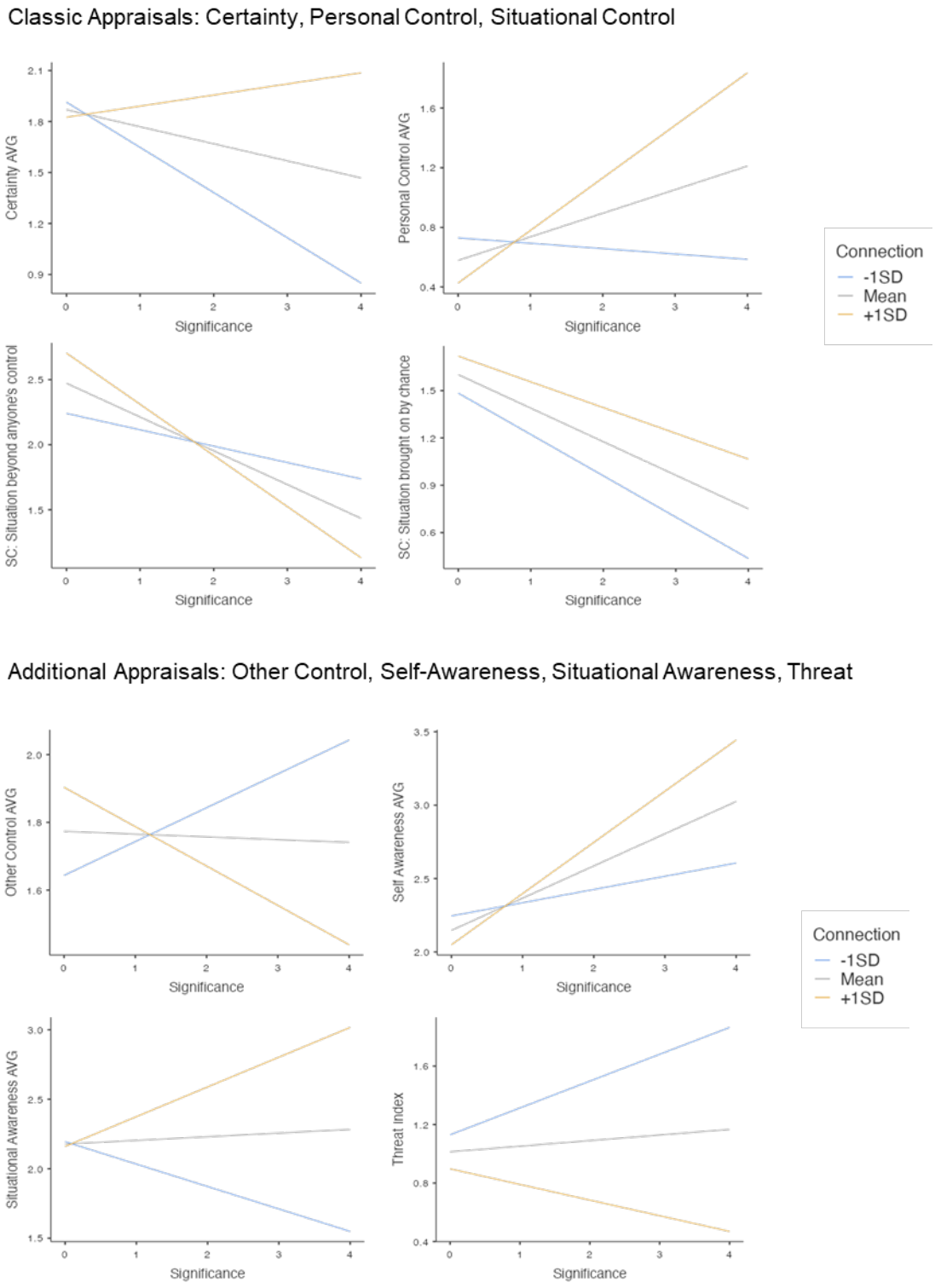
Eye-Tracking Sample

For the eye-tracking sample, a sensitivity analysis with the same parameters as the online sample (except N = 50) suggested power to observe a partial eta-squared effect size of 0.18.

Self-Significance × Connectedness Manipulation Checks. Analyses were the same as in the online sample.

Figure 1b

Regression Models, Classic and Other Appraisals, Experiment 2



Self-Diminishment. The confirmatory factor analysis yielded the two-factor solution I predicted, with the two items assessing feelings of significance loaded onto one factor and the two items assessing feelings of insignificance loaded onto another factor (see Appendix G). Indicators of good fit met thresholds (RMSEA = 0.00, 90%CI [0.00, 0.27]; SRMR = 0.01; CFI = 1.00; TLI = 1.21; $\chi^2 = 0.13$, $p = .71$). This led to the averaging of each factors' items together.

For the significance factor, the ANOVA yielded a significant main effect for self-significance ($p < .001$), such that participants in the high self-significance condition reported greater levels of significance compared to participants in the low self-significance condition. The effects for the conditions of connectedness ($p = .64$) and the interaction ($p = .76$) effect were both non-significant (see Appendix G for full ANOVA table).

For the insignificance factor, the ANOVA yielded a significant main effect for self-significance ($p = .04$), such that participants in the low self-significance condition reported greater levels of insignificance compared to participants in the high self-significance condition. The effects for the conditions of connectedness ($p = .77$) and the interaction ($p = .62$) effect were both non-significant.

Connection. The confirmatory factor analysis yielded the two-factor solution I predicted, with the two items assessing feelings of connection loaded onto one factor and the two items assessing feelings of isolation loaded onto another factor (See Appendix G). Indicators of good fit met thresholds (RMSEA = 0.00, 90%CI [0.00, 0.16]; SRMR = 0.002; CFI = 1.00; TLI = 1.08; $\chi^2 = 0.01$, $p = .91$). This led to the averaging of each factors' items together.

For the connection factor, the ANOVA did not yield any significant effects for self-significance (p = .07), connectedness (p = .21), or their interaction (p = .27).

For the isolation factor, the ANOVA did not yield any significant effects for self-significance (p = .69), connectedness (p = .61), or their interaction (p = .60).

Summary of Manipulation Effectiveness. These results suggest the manipulation of self-significance worked as I intended. The connectedness manipulation was not effective, but this is not surprising given the sample size. As a result, I conducted the same additional analyses as in the online sample. Results tables for regression analyses can be found in Appendix G.

Awe Video Manipulation Check. The reliability analysis for the awe index yielded a McDonald's Omega of 0.63, so the awe and wonder items were analyzed separately. The EFA for the positive emotions yielded a single factor solution, so the four items were averaged together.

For both awe and wonder ratings versus positive emotion index ratings, the analyses yielded only a significant main effect for emotion type (p < .001), such that awe and wonder ratings were greater than positive emotion index ratings across all conditions.

Summary of Awe Induction Effectiveness. The *Cosmos* video succeeded in generating awe (M_{awe} = 3.07) and did so selectively.

Valence.

Positive Valence. For ratings on positive valence, the ANOVA yielded a significant effect for the condition of self-significance (p = .027), such that participants in the high self-significance condition reported greater positive valence than participants in the low self-significance condition. There were directional differences I predicted, such

that participants in the high (versus low) connectedness condition reported greater levels of positive valence; however, these differences were non-significant (p = .096). The interaction was non-significant (p = .34).

The regression model with self-reported significance and connection, and their interaction term as fixed effects yielded a significant effect for connection (p = .006). Connection ratings were positively associated with ratings of positive valence. No other effects were significant.

Negative Valence. For ratings on negative valence, the ANOVA yielded a significant effect of self-significance (p = .027), such that participants in the low self-significance condition reported greater levels of negative valence compared to participants in the high self-significance condition. There were directional differences I predicted, such that participants in the low (versus high) connectedness condition reported greater levels of negative valence; however, these differences were non-significant, p = .059. The interaction was non-significant (p = .34).

The regression model yielded a significant effect for connection (p = .017). Connection ratings were negatively associated with ratings of negative valence. No other effects were significant.

Appraisals. Appraisals were analyzed with the same methods as in the online sample. Reliability checks, full ANOVA results, and full regression results can be found in Appendix G.

Vastness. The vastness items were analyzed separately. The ANOVAs did not yield any significant effects for both vastness items. The regression models did not yield any significant effects.

Need for Accommodation. The need for accommodation items were analyzed separately. For both items, the ANOVAs did not yield any significant effects.

For the item, "I found it difficult to fully understand the situation," the regression model yielded a significant effect for connection (p = .029). Connection ratings were negatively associated with ratings on this item. For the item, "I felt my view of the world challenged," the model did not yield any significant effects.

Certainty. The certainty items were averaged together. The ANOVA did not yield any significant effects. The regression model also did not yield any significant effects.

Personal Control/Responsibility. The personal control/responsibility items were averaged together. The ANOVA did not yield any significant effects. The regression model also did not yield any significant effects.

Situational Control/Responsibility. The situational control/responsibility items were analyzed separately. For the item, "I felt that the situation was directed by circumstances beyond anyone's control," the ANOVA yielded a significant main effect of self-significance (p = .035), such that participants in the low self-significance condition reported greater levels than participants in the high self-significance condition. There were directional differences I predicted, such that participants in the low connectedness condition reported greater levels of situational control/responsibility than participants in the high connectedness condition; however, these differences were non-significant (p = .09). The interaction was non-significant (p = .70). For the item, "I felt that the situation was brought on by chance," the ANOVA did not yield any significant effects. The regression model did not yield any significant effects for both items.

Other Control/Responsibility. The other control/responsibility items were

averaged together. The ANOVA did not yield any significant effects. The regression model also did not yield any significant effects.

Self-Awareness. The self-awareness items were averaged together. The ANOVA did not yield any significant effects. The regression model also did not yield any significant effects.

Situational Awareness. The situational awareness items were averaged together. The ANOVA did not yield any significant effects. The regression model also did not yield any significant effects.

Secondary Analyses. Data was filtered such that only data recorded during the awe video was analyzed.

Attentional Engagement. Attentional engagement was measured by the number of gaze fixations and the average fixation duration of participants during the awe video. Each was analyzed in an ANOVA with self-significance and connectedness as fixed factors. Neither analysis yielded significant effects. The regression model similarly did not yield any significant effects for either measure of attentional engagement (number of gaze fixations and average fixation duration). The correlational analyses with positive and negative valence also did not yield any significant effects for both number of gaze fixations (positive: $r = .25$, $p = .09$; negative: $r = .14$, $p = .34$) and average fixation duration (positive: $r = .12$, $p = .40$; negative: $r = .01$, $p = .93$).

Cognitive Load. Cognitive load was measured by the blink rate of participants during the awe video. Blinks were extrapolated from the eye-tracking data by searching for consecutive data loss from both eyes for 100–400ms which is the broad duration of a human eye blink (Hollander & Huette, 2022). Blinks during the awe video were summed

and then divided by 2 to yield a # of blinks/minute rate (the awe video was two minutes). Blink rate was analyzed in an ANOVA with self-significance and connectedness as fixed factors. The analysis did not yield any significant effects. The regression model also did not yield any significant effects. The correlational analyses with positive (r = .22, p = .13) and negative (r = .17, p = .25) valence also did not yield any significant effects for blink rate.

Exploratory Analyses.

Total Time Spent Attending to the Distance AOI. The total time participants visually attended to the distance AOI (the area at the bottom of the awe video that displayed text describing the increasing distance scale) was calculated and then examined in correlational analyses for each dependent measure. The only significant correlation with total time spent attending to the distance AOI was with the awe index (r = -.37, p = .046). In other words, spending more time looking at the distance AOI was associated with feeling less awe. See Appendix G for full correlation data.

Discussion

The goal of the experiment was to test my theoretical model that self-significance (commonly referred to as self-diminishment in awe literature) and connectedness interact to determine whether awe is experienced as more positive or more negative. Feeling "small" is a hallmark trait of awe experiences, which have been conceptualized as both positive and negative experiences. My model posited that if the smallness is paired with feelings of connection, then the overall experience would be positive; however, if the smallness is paired with feelings of isolation, then the experience would be negative. I was also interested in learning how appraisals such as vastness, need for accommodation,

certainty, personal control, situational control, self-awareness, and situational awareness were influenced by whether a person feels connected or insignificant.

Although the manipulation checks provided reasonable evidence that participants experienced the connection and self-significance manipulations as intended, there was also some evidence that the two constructs were not manipulated orthogonally, limiting my ability to interpret any effects observed in the main analyses. As a result, supplemental regression analyses using self-reported connection and significance as predictors were conducted. Indeed, the planned ANOVAs as a function of the self-significance and connectedness manipulations yielded few reliable effects, and so I focus my discussion on the regression analyses, with the acknowledgement that causal inferences cannot be drawn from these correlational data. I also focus primarily on the results from the online sample, given that is much larger sample size provides greater statistical power and thus supports more reliable inferences than the eye-tracking sample.

To reiterate, my sensitivity analysis suggested power to detect effect sizes of at least $R^2 = 0.04$, and the regression models that yielded significant results yielded R^2 values ranging from 0.04 to 0.25 providing greater confidence these results are reliable. See Table 14 for a summary of regression results.

Valence

My main dependent measures targeted valence, as the goal of the experiment was to test a theoretical model in which self-significance and connection interact to determine whether awe is experienced as positive or negative. I predicted that higher self-significance and higher connection would be associated with *higher* positive valence scores and *lower* negative valence scores. I also predicted a Self-Significance ×

Table 14.

Regression Results Compared to Predicted Patterns (Online Sample)

	Predictions for Positive Appraisals: Vastness, NFA, Certainty, Personal Control	**Results for Positive Appraisals:**	**Predicted Negative Appraisals:** Threat Emotions, Situational Control, Self-Awareness, Situational Awareness	**Results for Negative Appraisals:**
Low Connection: More Significance	More X	Vastness: Less (opposite direction) Certainty: Less (opposite direction) Personal Control: Less (opp direction)	Less X	Threat Emotions: More (opposite direction) Self-Awareness: More (opposite direction) Situational Awareness: Less (predicted direction)
High Connection: More Significance	Slightly/no more X	Vastness: No assoc. (3b predicted direction) Certainty: More (3a predicted direction) Personal Control: More (3a predicted direction)	Slightly/no less X	Threat Emotions: Less (3a predicted direction) Self-Awareness: More (opposite direction) Situational Awareness: More (opposite direction)

Note. "Low connection: more significance" represents the effect of increasing significance ratings for participants low in connection. NFA = Need for accommodation. If appraisal is missing from Results columns, there were no significant effects.

Connection interaction whereby higher connection would weaken the negative impact of low self-significance (shrinking the low/high self-significance difference, manifesting is a lower slope in the high- versus low-connection condition).

The regression analyses in both cases yielded only effects of connection. Higher connection was associated with higher positive valence and lower negative valence ratings. Feelings of significance did not have any effects on positive or negative valence. Feelings of self-significance may not be important in valence determination because it merely changes the importance of the event to the individual, acting as a magnifier rather than a differentiator.

Positive Appraisals

I assumed that several of the appraisal measures (awe-specific appraisals of vastness, need for accommodation; general appraisals of certainty, personal control) reflected positive interpretations of events and therefore made the same predictions as I did for positive valence ratings.

The resulting interactions between connection and significance for positive appraisals had mixed results. I predicted that increases in significance would always lead to increases in positive appraisals, albeit less so for those high in connection. To my surprise, the effect that significance had on positive appraisals changed depending on one's connection levels[18]. When connection levels were low, increases in significance were associated with lower ratings of vastness, certainty, and personal control;

[18] Due to the correlational nature of these analyses, the direction of the relationship cannot be determined. I discussed the interactions in terms of my theoretical model, but more research is warranted to support these conclusions.

conversely, when connection levels were high, increases in significance were associated with higher ratings of certainty and personal control.

I originally reasoned that self-significance (versus self-diminishment) would always lead to more positive and less negative appraisals, but my results suggest it is possible that self-significance can be either positive or negative depending on how connected one feels. If an individual feels connected, then feeling significant becomes a more positive experience; however, if an individual feels isolated, then feeling significant becomes a more negative experience. Perhaps feelings of connection determine the valence of an awe experience and significance changes the stakes of the event. In other words, feelings of connection are what "flavors" awe experiences to be positive or negative, whereas feelings of significance magnify the importance of the event. These results suggest that significance can act as a magnifier or diminisher of appraisals, but this relationship depends on whether one feels connection or isolated.

Negative Appraisals

I assumed that several of the appraisal measures (threat emotions; general appraisals of situational control; other appraisals of self-awareness, situational awareness) reflected negative interpretations of events and therefore made the same predictions as I did for negative valence ratings.

I predicted that increases in significance would always lead to either decreases (for those low in connection) or only slight decreases or no changes (for those high in connection) in negative appraisals. Surprisingly, the analyses often yielded opposite patterns. When connection levels were low, increases in significance were associated with increases in threat emotions, self-awareness and decreases in situational awareness.

When connection levels were high, increases in significant were associated with decreases in threat emotions and increases in self-awareness and situational awareness.

The pattern for threat emotions is consistent with the pattern discussed for positive appraisals such that feelings of connection paint the experience to be positive or negative and then feelings of significance magnify the positivity or negativity. The patterns were self-awareness and situational awareness were less clear. It is possible the original categorizations of self-awareness and situational awareness as negative appraisals were misinformed. For example, I assumed that self-awareness in the context of awe would be negative: Self-awareness would make one's sense of smallness more salient, and self-diminishment tends to be experienced as negative. However, this analysis might have been too simplistic, and self-awareness in the context of feeling connected might actually be a positive appraisal. Due to the correlational and post hoc nature of these analyses, conclusions are to be drawn with caution.

Eye-Tracking Sample

The eye-tracking sample was added as an exploratory portion of the study to examine whether visual attention differentiates different types of awe. The sensitivity analysis suggested power to observe a partial eta-squared effect size of 0.18, a quite large effect. Given the observed effect sizes ranged from 0.00 to 0.09, these results cannot be taken with confidence. However, in several cases, the patterns in the eye-tracking sample matched the patterns in the larger online sample. Consistent across samples, connection appraisals were positively associated with positive valence and negatively associated with negative valence. This reinforces the idea that connection acts as a key determinant of the valence of awe experiences.

Eye-Tracking Analyses

Attentional engagement was operationalized by measuring the number of fixations and average fixation duration during the awe video, and cognitive load was measured by blink rate. The results did not yield significant differences in attentional engagement or cognitive load. This is not surprising given the small sample size.

General Discussion

Two experiments successfully induced awe using two different methods. Experiment 1 provided participants with definitions of either positive or negative awe and asked them to write about times they experienced that emotion. Experiment 2 exposed participants to an expanding cosmos video. Both methods were effective at inducing awe and did so selectively.

My theoretical model was based on the results from Experiment that suggested self-diminishment and connection have the capacity to differentiate positive and negative awe. My model posited that that self-diminishment and connection interact to determine the valence of an awe experience such that connectedness buffers against the negative influence of low self-significance. Specifically, when people feel isolated, feeling insignificant leads to more negative experiences; however, when people feel more connected, feeling insignificant does not make as much of a difference in the positivity/negativity of their experience.

Experiment 2 tested my theoretical model by manipulating self-significance and connectedness preceding an awe induction. The regression results showed that feelings of connection were a significant predictor of positive and negative valence: Feeling connected was a positive experience, feeling isolated was a negative experience. My full

model was not supported, however, as no significant interaction effect was observed. I acknowledge these results come from a post hoc internal analysis and thus need to be replicated to establish robustness and cannot be used for causal inference. However, they do suggest several key takeaways about the roles of connection and significance in awe experiences.

Connection as the Key Determinant of Awe's Valence

Connection appraisals may act as a key determinant of awe's valence. The importance of connection corresponds with our fundamental need to belong and maintain frequent interactions with people we like (Baumeister & Leary, 1995; Maslow, 1943). Baumeister and Leary (1995) refer to the need to belong as a fundamental human motivation, suggesting that connection might be an "automatic" appraisal to the extent that our gauge of how connected we feel is constantly running and can paint how we appraise our experiences. In contrast, assessments of self-diminishment/self-significance might require more informational or cognitive input and thus more time. The relevance of this distinction to awe experiences is that valence is considered to be one of the most basic appraisal dimensions (Ellsworth & Scherer, 2003), raising the possibility that appraisals of connection but not self-diminishment/self-significance are made quickly enough to shape appraisals of valence.

A Limited Role for Self-Diminishment/Self-Significance

I found little evidence that self-diminishment determined appraisals of awe experiences. This was surprising given the pivotal role accorded to the small self in the awe literature and may speak to a broader definitional issue. Specifically, it is unclear in the literature what "small self" means (e.g., whether it is a physical or psychological

phenomenon) or how awe experiences evoke this small self. Some language implies a comparison process whereby the self seems small relative to the awe-eliciting event (e.g., Piff et al., 2015), whereas in other cases it is described as an attentional process whereby the individual's focus shifts away from the self and toward the eliciting event (Shiota et al., 2007);. The literature also neglects the question of whether or when self-diminishment might be experienced as positive or negative, and across the literature, measures of self-diminishment reflect both possibilities (e.g., "Everything I do is meaningless" versus "My day-to-day concerns are relatively trivial"). Without clearer definitions in the literature, it is difficult to know

Revised Proposal

I did not find support for my theoretical model; however, the results in Experiment 2 provide an interesting alternative model. Rather than connection and significance interacting to determine awe's valence, the results of Experiment 2 suggest that connection alone determines the valence of an awe experience, with feelings of significance raising the stakes of the event such that it makes a negative event worse and makes a positive event better. In cases of low connection, feelings of significance diminish positive appraisals and magnify negative appraisals; whereas in cases of high connection, feelings of significance amplify positive appraisals and diminish negative appraisals. In other words, significance can be either positive or negative depending on one's feelings of connection. If one feels connected, significance is a good thing; if one feels isolated, significance is a bad thing. The positive appraisals of vastness, certainty, and personal control, and the negative threat emotions fit the proposed interaction. Further research is needed to support this proposed interaction.

Other Appraisals of Interest

A secondary goal of the present research was to test the replicability of previous appraisal approaches.

Awe-Specific Appraisals

In general, the results reported in this dissertation replicated past research, albeit imperfectly. Experiment 2 (but not Experiment 1) provided support for the findings of Chaudhury et al. (2021) and Gordon et al. (2017) that vastness appraisals were higher for positive than negative awe. Similarly, Experiment 1 (but not Experiment 2) replicated the findings of Chaudhury et al. (2021) and Gordon et al. (2017) of no significant differences in need for accommodation between positive and negative awe[19].

Classic Appraisal Theory Dimensions

For positive appraisals, the results again provided some confirmation of past research. Across both experiments here, and consistent with Chaudhury et al. (2021), and Gordon et al. (2017), negative awe was associated with a lower sense of certainty than positive awe. Similarly, in Experiment 2 (although not in Experiment 1), and consistent with Chaudhury et al. (2021), and Gordon et al. (2017), negative awe was associated with lower appraisals of personal control.

Replication was poorer for negative appraisals. Both Chaudhury et al. (2021) and Gordon et al. (2017) found that appraisals of situational control were greater for negative than positive awe, but the results of Experiments 1 and 2 here showed no significant differences. These discrepancies could be due to the type of awe elicitors used in each

[19] Null findings should be interpreted with caution.

study. Nature-based awe elicitors such as tornadoes and supercells, which are often used in research on negative awe, may naturally elicit greater situational control due to their destructive force compared to cosmos-based awe elicitors or memory recall awe inductions.

Conclusion

The emotion of awe is a powerful and transformative experience that has the potential to profoundly impact our lives. By exposing us to the vastness and complexity of the world around us, awe can alter our sense of self and our perspective on the world, leader to a deeper understanding of our places in it. Furthermore, awe can bring us closer to others and our environment, creating a shared sense of wonder and forging more meaningful connections. While positive awe can inspire and uplift us, negative awe can be threatening and lead to feelings of fear and powerlessness. As such, understanding the mechanisms that lead to awe's multiple "flavors" is an important part of fostering a healthy relationship with the emotion. The current study provided another step in differentiating positive and negative awe, using an appraisal approach.

Acknowledging the post hoc nature of my final analysis, my concluding proposal—that connection determines awe's valence and self-significance amplifies awe's effects--provides a promising new avenue for research. It suggests that if we want to foster more positive awe experiences, we need to focus on fostering a sense of connection with others and our environment. It also suggests that fostering feelings of significance might not always be positive. Feeling connected can help cultivate more positive feelings of significance and change how individuals view their impact in the world; feeling isolated can make individuals feel threatened and powerless, which can

then heighten anxieties surrounding their daily concerns and stressors. Acknowledging the significance of fostering connection and mitigating feelings of isolation can help us gain a deeper appreciation of our place in the world and our impact on it, unlocking the potential for transformative experiences of awe.

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Appendix A: Materials, Experiment 1

Rating Scale

0 = *not at all*
1 = *slightly*
2 = *moderately*
3 = *very*
4 = *extremely/completely*

Describing Awe (developed for this study; between-subjects design)

Positive Awe

Awe is an overwhelming feeling of reverence produced by the grand, the sublime, or the powerful—whether that's from people, places, events, or ideas. Awe is a ***complex*** emotion: We can experience something as ***amazing and wondrous***, or as ***amazing and frightening***.
Take a couple of minutes to remember an experience in which you felt the kind of awe that is ***amazing and wondrous***.
Describe the experience in detail, as if you were telling someone who has never experienced awe before.
We will be coding your narrative for how well it describes the experience or event and evokes the emotion of awe.

Negative Awe

Awe is an overwhelming feeling of reverence produced by the grand, the sublime, or the powerful—whether that's from people, places, events, or ideas. Awe is a ***complex*** emotion: We can experience something as ***amazing and wondrous***, or as ***amazing and frightening***.
Take a couple of minutes to remember an experience in which you felt the kind of awe that is ***amazing and frightening***.
Describe the experience in detail, as if you were telling someone who has never experienced awe before.
We will be coding your narrative for how well it describes the experience or event and evokes the emotion of awe.

Joy

Joy is an emotion characterized by ***great pleasure and happiness***, evoked by well-being, success, or good fortune, or by the prospect of possessing what one desires.
Take a couple of minutes to remember an experience in which you felt joy.
Describe the experience in detail, as if you were telling someone who has never experienced joy before.
We will be coding your narrative for how well it describes the experience or event and evokes the emotion of joy.

Fear

Fear is an emotion characterized by ***distress, apprehension, or alarm***, caused by the belief that someone or something is dangerous, likely to cause pain, or a threat.
Take a couple of minutes to remember an experience in which you felt fear. Describe the experience in detail, as if you were telling someone who has never experienced fear before.
We will be coding your narrative for how well it describes the experience or event and evokes the emotion of fear.

Emotion Intensity (developed for this study)

How intensely did you feel this emotion?

Emotion Valence (developed for this study)

How positive was the experience?
How negative was the experience?

Related Emotions (developed for this study)

To what extent did you feel each of these other emotions?

Amazement
Inspiration
Anxiety
Dread
Contentment
Happiness
Anger
Sadness

Categorizing the Awe Experience (adapted from Stellar et al., 2017) (awe participants only)

Thinking back to the experience that you wrote about, which of the following elicited the feeling of awe? (Check all that apply.)

Nature
Human innovation (e.g., architecture, engineering, technology)
A work of art, a creative act, or any form of extreme beauty
Talent, skill, or accomplishment
Extremely moral qualities (virtue or vice)
A spiritual or religious experience
Other (Specify:)

Appraisals (various sources)

Thinking back to the experience that you wrote about, to what extent do each of the following statements describe your perceptions and feelings **during the experience**?

0 = *does not describe the experience at all*
1 = *describes the experience a little*

2 = *describes the experience reasonably well*
3 = *describes the experience very well*
4 = *describes the experience extremely well*

Awe-Specific Appraisals (various sources)

Vastness

I perceived the situation as physically/psychologically vast.
I perceived the situation as physically/psychologically significant.

Need for accommodation

I found it difficult to fully understand the situation.
I felt my view of the world challenged.

Self-diminishment

I felt small.
I felt insignificant.

Connection

I felt connected.
I felt like I was a part of something.

Isolation

I felt isolated.
I felt alone.

General Appraisals

Certainty

I felt certain of what was happening.
I felt I could predict what was going to happen.

Personal agency/responsibility/control/coping potential

I felt that I had the ability to control the situation.
I felt responsible for having brought about the situation.

Other agency/responsibility/control/coping potential

I felt that someone or something else was controlling the situation.
I felt that someone or something other than myself was responsible for having brought about the situation.

Situational agency/responsibility/control/coping potential

I felt that the situation was directed by circumstances beyond anyone's control.
I felt that the situation was brought on by chance.

Additional General Appraisals

Attentional activity

I tried to devote my attention to the situation.
I tried to direct my attention away from the situation.

Novelty/unexpectedness

The situation was unexpected.
This was a new experience for me.

Anticipated effort

I felt that the situation required mental/physical effort from me.
I felt that I needed to exert myself to deal with this situation.

Goal–path obstacles

There were obstacles standing in the way of getting what I wanted.
There were problems that had to be solved before I could get what I wanted.

Goal congruence

The situation was consistent with what I desired.
The situation contributed to achieving my personal goals in life.

Other Related Constructs

Approach/Appetitive Motivation

I wanted to immerse myself in the situation.
I wanted to stay in the situation.

Avoidance/Aversive Motivation

I wanted to detach myself from the situation.
I wanted to leave the situation.

Challenge

I felt the situation presented me with opportunities that I wanted to take advantage of.
I felt the situation would result in positive outcomes.

Threat

I felt the situation presented me with threats that I wanted to avoid or escape.
I felt the situation would result in negative outcomes.

Safety

I felt safe in the situation.
I felt protected in the situation.

Danger

I felt vulnerable in the situation.
I felt threatened in the situation.

First-person/immersed perspective

I experienced the situation through my own eyes.
I experienced the situation from a first-person perspective.

Third-person/distanced perspective

I experienced the situation as if I was an outside observer.
I felt like I was watching myself experience the situation.

Self-awareness

I was keenly aware of myself.
I was conscious of my thoughts and feelings.

Situational awareness

I was keenly aware of everything in the situation.
I was conscious of what was going on around me.

Demographic Information

Age (in years): [open-ended response]

First/main language: [open-ended response]

Which of the following best describes how you identify yourself?

Female
Cis female
Trans female
Male
Cis male
Trans male
Non-binary
I prefer a different description (specify): [open-ended response]
I prefer not to self-identify

To what extent is this identity important or central to your daily life?

Not at all
Somewhat
Moderately
Very
Extremely

Are you of Hispanic origin?

Yes
No

Which of the following describe you? Select all that apply.
Alaskan Native/American Indian/Indigenous
Black/African
East Asian
LatinX/Latiné
Middle Eastern/North African
Native Hawaiian/Pacific Islander
South Asian/Southeast Asian
White
I describe myself in another way (specify): [open-ended response]
I prefer not to report this information

To what extent is this identity important or central to your daily life?
Not at all
Somewhat
Moderately
Very
Extremely

What is your religious affiliation?
Buddhist
Christian (incl. Catholic, Protestant, etc.)
Hindu
Jewish
Muslim
Sikh
Agnostic
Atheist
I have another affiliation (specify): [open-ended response]
I prefer not to report this information

To what extent is this identity important or central to your daily life?
Not at all
Somewhat
Moderately
Very
Extremely

Appendix B: Additional Results, Experiment 1

Elicitors

Table B1. Results from linear mixed models for awe elicitors. Estimates are unstandardized β coefficients (95% confidence intervals); *SE* = standard error.

	Nature				**Talent, skill, accomplishment**				**Work of art or creative act**				**Human innovation (e.g., architecture, engineering, technology)**				**Spiritual or religious experience**				**Other**				**Extreme moral qualities (virtue or vice)**			
Coefficient	*Estimates*	*SE*	*t*	*p*	*Estimates*	*SE*	*t*	*p*	*Estimates*	*SE*	*t*	*p*	*Estimates*	*SE*	*t*	*p*	*Estimates*	*SE*	*t*	*p*	*Estimates*	*SE*	*t*	*p*	*Estimates*	*SE*	*t*	*p*
Intercept	0.68 (0.50 – 0.85)	0.06	12.17	**0.001**	0.30 (0.01 – 0.59)	0.08	3.90	**0.045**	0.31 (-0.04 – 0.66)	0.09	3.41	0.064	0.26 (0.08 – 0.44)	0.05	4.66	**0.021**	0.21 (0.14 – 0.28)	0.03	7.20	**<0.001**	0.10 (0.04 – 0.16)	0.02	4.13	**0.004**	0.11 (0.02 – 0.20)	0.03	3.60	**0.028**
Negative Awe - Positive Awe	-0.12 (-0.22 – -0.03)	0.05	-2.50	**0.013**	0.00 (-0.09 – 0.10)	0.05	0.10	0.921	-0.04 (-0.13 – 0.05)	0.05	-0.94	0.350	0.03 (-0.06 – 0.12)	0.05	0.61	0.543	-0.02 (-0.10 – 0.06)	0.04	-0.52	0.601	0.05 (-0.01 – 0.12)	0.03	1.56	0.121	-0.00 (-0.07 – 0.06)	0.03	-0.13	0.900
ICC	0.02				0.07				0.10				0.03												0.01			
N	3 Cohort				3 Cohort				3 Cohort				3 Cohort				3 Cohort				3 Cohort				3 Cohort			
Observations	367				367				367				367				367				367				367			
Marginal R^2 / Conditional R^2	0.016 / 0.040				0.000 / 0.069				0.002 / 0.105				0.001 / 0.031				0.001 / NA				0.007 / NA				0.000 / 0.014			

Differences across Samples

Intensity, Valence, and Emotions (positive awe versus negative awe)

Table B2 shows which awe variant (positive awe, negative awe) was significantly greater in the intensity, valence, and emotions ratings for each sample in Experiment 1.

Table B2

Differences Across Samples: Intensity, Valence, and Emotions (Experiment 1)

Measure	Sample 1	Sample 2	Sample 3
Intensity	=	=	Pos
Positive	Pos	Pos	Pos
Negative	Neg	Neg	Neg
Amazement	=	=	Pos
Inspiration	=	Pos	=
Anxiety	Neg	Neg	Neg
Dread	Neg	Neg	=
Contentment	Pos	Pos	Pos
Happiness	Pos	Pos	Pos
Anger	=	=	=
Sadness	=	=	=

Note. "[Pos/Neg]" indicates which awe variant was associated with significantly higher ratings of that measure compared to its counterpart. "=" indicates there was no significant difference shown between the awe variants.

Awe-Specific, General, Additional General Appraisals, and Other Related Constructs (positive awe versus negative awe)

Table B3 shows which awe variant (positive awe, negative awe) was significantly greater in the awe-specific appraisals, general appraisals, additional general appraisals, and other related constructs for each sample in Experiment 1.

Table B3

Differences Across Samples: Awe-Specific, General, Additional General Appraisals, and Other Related Constructs (Experiment 1)

Measure	Sample 1	Sample 2	Sample 3
Vastness	=	=	=
Accommodation	=	=	=
Self-Diminishment	=	Neg	=
Connection	Pos	Pos	Pos
Isolation	=	Neg	=
Certainty	=	=	=
Personal Control	=	=	=
Situational Control	=	=	=
Other Control	=	Neg	=
Attention	=	=	=
Novelty	=	=	=
Effort	Neg	Neg	Neg
Goal-Path Obstacles	=	Neg	=
Goal Congruence	=	Pos	=
Challenge	Pos	Pos	Pos
Threat	Neg	Neg	Neg
Safety	Pos	Pos	Pos
Danger	Neg	Neg	Neg
First-Person	=	=	=
Third-Person	=	=	=
Self-Aware	=	=	=
Situational Aware	=	=	=
Approach	Pos	Pos	Pos
Avoidance	Neg	Neg	Neg

Note. "[Pos/Neg]" indicates which awe variant was associated with significantly higher ratings of that measure compared to its counterpart. "=" indicates there was no significant difference shown between the awe variants.

Additional Appraisals from Experiment 1

Table B4 includes descriptive results and post hoc analyses for ratings on awe-specific appraisals, general appraisals, additional general appraisals, and other related constructs.

Table B4.

Awe-Specific Appraisals, General Appraisals, Additional General Appraisals, and Other Related Constructs (Experiment 1)

		Emotion conditions					
		Negative awe	Positive awe	Fear	Joy	Overall *F*	Marginal R^2
Awe-specific appraisals	Vastness	2.52 (1.19)[c]	2.53 (1.18)[cd]	2.22 (1.13)[ab]	2.23 (1.08)[b]	4.60**	.02
	Accommodation	1.52 (1.15)[d]	1.24 (1.00)[cd]	1.60 (1.19)[bd]	0.85 (0.97)[abc]	15.40***	.07
	Self-Diminishment	1.74 (1.38)[bcd]	1.30 (1.29)[acd]	2.30 (1.3)[abd]	0.34 (0.68)[abc]	73.10***	.24
	Connection	2.55 (1.23)[bcd]	3.1 (0.98)[ac]	0.89 (1.05)[abd]	3.26 (0.94)[ac]	159***	.42
	Isolation	0.74 (1.11)[cd]	0.46 (0.89)[c]	2.11 (1.47)[abd]	0.18 (0.57)[ac]	100***	.31
General appraisals	Certainty	1.70 (0.96)[bd]	1.98 (1.01)[ac]	1.49 (1.18)[bd]	2.24 (1.02)[ac]	15.20***	.06
	Personal control	1.16 (1.07)[d]	1.31 (1.13)[cd]	0.91 (0.93)[bd]	2.05 (1.18)[abc]	31.10***	.12
	Situational control	1.46 (1.28)[d]	1.41 (1.24)[d]	1.70 (1.21)[d]	1.01 (1.08)[abc]	8.58***	.04
	Other control	1.61 (1.34)[c]	1.40 (1.25)[c]	2.16 (1.34)[abd]	1.32 (1.1)[c]	13.40***	.06
Additional general appraisals	Attentional activity	1.80 (0.77)	1.73 (0.66)	1.94 (0.82)[d]	1.70 (0.62)[c]	3.34*	.02
	Novelty	2.56 (1.01)[d]	2.53 (1.11)[cd]	2.87 (1.11)[bd]	2.13 (1.2)[abc]	11.30***	.05
	Anticipated effort	1.45 (1.25)[bc]	0.95 (1.06)[acd]	2.45 (1.12)[abd]	1.38 (1.27)[bc]	44.40***	.17
	Goal-path obstacles	0.92 (1.15)[bc]	0.55 (0.97)[acd]	1.75 (1.3)[abd]	0.97 (1.11)[bc]	31.70***	.13
	Goal congruence	1.88 (1.26)[bcd]	2.24 (1.12)[acd]	0.49 (0.89)[abd]	2.92 (1.04)[abc]	130***	.37
	Challenge	2.14 (1.3)[bcd]	2.68 (1.05)[acd]	0.55 (0.87)[abd]	3.07 (0.88)[abc]	167***	.43
	Threat	1.07 (1.27)[bcd]	0.23 (0.59)[ac]	3.09 (1.01)[abd]	0.29 (0.63)[ac]	320***	.59
Other related constructs	Approach	2.48 (1.35)[bcd]	3.38 (0.85)[ac]	0.41 (0.79)[abd]	3.23 (0.94)[ac]	278***	.56
	Avoidance	0.84 (1.28)[bcd]	0.17 (0.56)[ac]	2.92 (1.16)[abd]	0.22 (0.73)[ac]	270***	.55
	Safety	1.82 (1.32)[bcd]	2.74 (1.11)[ac]	0.40 (0.71)[abd]	3.00 (0.97)[ac]	186***	.46
	Danger	1.64 (1.22)[bcd]	0.68 (0.79)[ac]	3.08 (1.12)[abd]	0.67 (0.85)[ac]	195***	.47
	First-person	3.30 (0.96)	3.51 (0.77)[c]	3.16 (1.07)[bd]	3.45 (0.72)[c]	5.60***	.03
	Third-person	1.41 (1.24)	1.26 (1.07)	1.13 (1.02)	1.22 (1.11)	0.68	.003
	Self-awareness	2.86 (1.03)[c]	2.83 (0.99)[c]	2.47 (1.07)[abd]	3.01 (0.82)[c]	8.85***	.04
	Situational awareness	2.87 (0.98)[c]	3.05 (0.97)[c]	2.50 (1.1)[abd]	2.92 (0.89)[c]	10.10***	.05

Note. Standard deviations are in parentheses. Scales are from 0 (*Not at all)* to 4 (*Extremely*). N = 666. * $p < .05$; ** $p < .01$; *** $p < .001$. [a] Mean is different from negative awe. [b] Mean is different from positive awe. [c] Mean is different from fear. [d] Mean is different from joy.

Appendix C: Pilot Studies 1–4

Pilot Study 1

To provide a test of my hypothesized theoretical model, I needed manipulations of self-diminishment and connection, and stimuli to induce awe. In Pilot Study 1, two videos were tested to identify which would be more useful as an awe induction.

Method

Participants and Design

The study used a single-factor (Video: control, biology, cosmos) within-participants design. I used G*Power (Faul et al., 2007) to conduct a power analysis to obtain a target sample size. Hornsey et al. (2018) conducted a similar single factor study with two awe conditions and a control condition and yielded an effect size of $f = 0.47$ for their manipulation of awe. Using an alpha level of .05, power level of .80, and Hornsey et al.'s (2018) effect size of $f = 0.47$, I obtained a target sample size of at least 48 participants.

One hundred participants watched the three videos and completed the measures (67 women, 25 men, 4 non-binary, 1 preferred a different description, 1 preferred not to self-identify). The sample ranged from 18 to 27 years old (M = 19.59, SD = 1.76; 60% not Hispanic in origin; 38% Hispanic in origin; 2% did not report; 36% White; 23% LatinX/Latiné; 15% Mixed Race; 8% South Asian/Southeast Asian; 6% Black/African; 3% East Asian; 3% described themselves in another way; 2% Middle Eastern/North African; 4% did not report). Two participants were excluded for failing the attention check, leaving a total sample of 98.

Procedure and Materials

Participants completed all study materials online via Qualtrics and were told that the research study was interested in learning more about how certain features of videos influence emotions. Participants watched three videos; after each, they rated the valence of the video and several emotion items. The first and third videos were the target (biology/cosmos) videos, randomly assigned (via Qualtrics) to be either the cosmos or biology video, and the middle video was always the control video; finally, the third and final video was whichever video was not randomly assigned during the first viewing. After the videos, they responded to demographics items and an attention check item.

Video Stimuli. Three two-minute videos were presented in the current study. Two of the videos (cosmos, biology) were meant to induce awe and the other video was a baseline control video. The cosmos video featured footage starting out from a street view, zooming out to show the country, zooming out further to show the Earth, and progressively zooming further and further out to show the relatively tiny size of Earth compared to the Universe. The biology video featured footage starting out looking at a tree zooming into a leaf, zooming in to show the cellular structure of the leaf, zooming in further to show the inner cellular makeup to show the relatively small but vast world existing inside organisms. Thus, both videos shift dramatically in scope (from close up to far away, or vice versa) to convey vastness (one of the known elicitors of awe; Keltner & Haidt, 2003). Both videos will be set to the song, "Mountains" by Hans Zimmer, as featured on the Interstellar soundtrack (https://www.youtube.com/watch?v=arNkB9vxS3Q), a song with "scope" shifts (e.g., in loudness and intensity, presence of crescendos, sudden changes in dynamics) that should also be conducive to eliciting awe. The control video features a compilation of footage of

farms, fields, and flowers set to the song, “Peter the Pumpkin of Peace” by Joshua Salvation, a pleasant and happy song without any significant crescendos (https://www.youtube.com/watch?v=1-5C4A6Yejg).

Valence Ratings. Participants responded to two questions: “How [positive/negative] was the experience?” (with the order of the questions randomized). Participants made their responses on a 5-point scale (0 = *Not at all*, 1 = *Slightly*, 2 = *Moderately*, 3 = *Very*, 4 = *Extremely*).

Emotions Ratings. Participants responded to the question, “To what extent did you feel each of these emotions?” The emotions were awe, amusement, gratitude, pride, hope, anxiety, sadness, boredom, and fear. Ratings were made along on a 5-point scale (0 = *Not at all*, 1 = *Slightly*, 2 = *Moderately*, 3 = *Very*, 4 = *Extremely*). Item order was randomized.

Attention Check. Participants responded to the question asking if they (1) followed the instruction (e.g., writing in detail about their memories, (2) made an effort to be careful and honest in their responding, and (3) were not distracted. Participants were excluded from analysis if they failed this attention check.

Results and Discussion

Valence and emotions rating were analyzed using linear mixed models with participant as a random intercept and video as a fixed factor. Results can be found in Table 6.

Table 6.

Valence and Emotions Ratings (Pilot Study 1)

	Video Conditions				
	Cosmos	**Biology**	**Control**	**Overall F**	**Marginal R^2**
Awe	2.72 (1.22)[bc]	2.27 (1.21)[ac]	1.27 (1.30)[ab]	54.1***	0.19
Amusement	1.96 (1.38)[c]	1.81 (1.23)[c]	1.33 (1.18)[ab]	11.6***	0.04
Gratitude	1.63 (1.31)	1.51 (1.33)	1.54 (1.24)	0.37	0.001
Pride	0.59 (0.92)	0.85 (1.20)	0.70 (1.01)	2.27	0.01
Hope	1.12 (1.19)	1.29 (1.32)	1.42 (1.28)	1.92	0.01
Anxiety	1.79 (1.36)[bc]	0.89 (1.11)[ac]	0.44 (0.91)[ab]	55.7***	0.20
Sadness	1.08 (1.16)[bc]	0.30 (0.63)[a]	0.28 (0.63)[a]	36.3***	0.17
Boredom	0.47 (0.84)[bc]	0.87 (0.90)[ac]	1.53 (1.30)[ab]	31.8***	0.15
Fear	1.54 (1.34)[bc]	0.4 (0.85)[a]	0.27 (0.73)[a]	68.6***	0.25
Positive	2.98 (1.12)[bc]	2.06 (1.10)[a]	2.24 (1.27)[a]	20.0***	0.10
Negative	0.99 (1.14)[bc]	0.41 (0.77)[a]	0.47 (0.82)[a]	13.7***	0.07

Note. Standard deviations are in parentheses. Scales are from 0 (Not at all) to 4 (Extremely). N = 98. * $p < .05$; ** $p < .01$; *** $p < .001$. [a] Mean is different from Cosmos. [b] Mean is different from Biology. [c] Mean is different from Control.

Valence Ratings

Positive. For positive valence, the analysis yielded a significant effect for video condition. Positive valence was significantly higher in the cosmos condition compared to both the biology condition, $t(194) = 5.98$, $p < .001$, and the control condition, $t(194) = 4.78$, $p < .001$. The biology and control conditions did not significantly differ, $t(194) = -1.20$, $p = .70$.

Negative. For negative valence, the analysis yielded a significant effect for video condition. Negative valence was significantly higher in the cosmos condition compared to both the biology condition, $t(194) = 4.76$, $p < .001$, and the control condition, $t(194) = 4.26$, $p < .001$. The biology and control conditions did not significantly differ, $t(194) =$

−0.50, $p = 1.00$.

The cosmos video elicited higher ratings of both positive and negative valence, compared to the biology and control videos. This finding suggests the cosmos video is the most amenable to influence by the self-diminishment and connection manipulations that were tested in Pilot Studies 2–5.

Emotions Ratings

The cosmos video also elicited greater ratings of awe, anxiety, and fear, compared to the biology and control videos. Higher ratings of fear and anxiety are markers of negative threat-based awe (Gordon et al., 2017), which further suggests the cosmos video is more amenable to influence since it elicits threat whereas the fear and anxiety ratings for the biology and control videos were close to the floor of the scale.

To provide further evidence that awe was the greatest emotion felt during the cosmos video, I analyzed each video's dataset separately using linear mixed effects models. First, I filtered for only cosmos data and ran the mixed model with emotion (awe, amusement, gratitude, pride, hope, anxiety, sadness, boredom, fear) as a fixed effect, participant as a random intercept, and rating as the outcome variable. This allows us to determine whether awe was the dominant emotion experienced during the videos. Bonferroni-corrected post hoc tests were used to analyze emotion comparisons if significant differences were present. The overall model was significant, $F(8, 775) = 38.9$, $p < .001$, and the post hoc tests showed that awe was rated significantly higher than all other emotions for participants watching the cosmos video, ts$(775) > 4.79$, ps $< .001$. This suggests that awe was the primary emotion elicited when participants watched the cosmos video.

I ran the same analyses while filtering for data from the biology video and then data from the control video. For the biology data, the overall model was significant, $F(8, 775) = 39.8$, $p < .001$, and the post hoc tests showed that awe was rated significantly higher than all emotions, ts(775) > 5.20, ps < .001, except for amusement , $t(775) = 3.13$, $p = .066$. For the control data, the overall model was significant, $F(8, 774) = 28.4$, $p < .001$, and the post hoc tests showed that awe was rated significantly higher than anxiety, fear, pride, and sadness, ts(774) > 3.91, ps < .005, but showed no significant differences with amusement, boredom, gratitude, and hope, ts(774) < 1.91, ps > .99.

Taken together, these results further demonstrate that cosmos was the best video to elicit our target emotion of awe.

Pilot Study 2

Pilot Studies 2–3 were designed to validate and choose between two possible methods for manipulating self-significance and connectedness. Pilot Study 2 was video-based. Participants watched an awe-inducing nature video preceded by voiceover narrations designed to manipulate low versus high self-significance and feelings of connection versus isolation from the world.

Method

Participants and Design

Participants were recruited as in Pilot Study 1. The study used a 2 (self-significance: low, high) × 2 (connectedness: low, high) between-participants design. I used G*Power (Faul et al., 2007) to conduct a power analysis to obtain a target sample size. I used a medium generic effect size since these are new manipulations and I have no a priori knowledge of the strength of the manipulation. Using an alpha level of .05, power

level of .80, and the effect size of $f = 0.25$, I obtained a target sample size of at least 128 participants.

One hundred ninety-three participants took part in the study (125 women, 50 men, 5 non-binary, 2 preferred not to self-identify, 11 did not respond). The sample ranged from 18 to 34 years old (M = 20.1, SD = 2.15; 62.7% not Hispanic in origin; 31.1% Hispanic in origin; 6.2% did not report; 43.5% White; 19.2% LatinX/Latiné; 9.3% Mixed Race; 6.2% Black/African; 6.2% South Asian/Southeast Asian; 4.1% East Asian; 2.6% Middle Eastern/North African; 0.5% Native Hawaiian/Pacific Islander; 0.5% Alaskan Native/American Indian/Indigenous; 1.6% preferred not to report; 0.5% preferred to describe themselves in another way; 5.7% did not respond). Three participants were excluded for failing the attention check, and 11 participants were excluded due to technical failures (i.e., survey never started), leaving a total sample of 179 (high significance/high connectedness: 43; low significance/high connectedness: 44; high significance/low connectedness: 47; low significance/low connectedness: 45).

Procedure and Materials

Participants completed all study materials online via Qualtrics in the same manner as Pilot Study 1. Participants were given the same cover story used in Pilot Study 1. They watched the cosmos video from Pilot Study 1, preceded by scrolling text and a voiceover to deliver the experimental manipulations. Participants completed measures assessing self-diminishment, connection, and valence, reported their demographics, and responded to an attention check.

Video Preview Text. The cosmos video from Pilot Study 1 was edited to include an initial black screen with scrolling text accompanied by a voiceover narrating the text.

The text was adapted from a video of Dr. Neil DeGrasse Tyson (https://www.youtube.com/watch?v=kl0J6Le5MpM). Parts of the text were altered to reflect the 2 (self-significance: low, high) × 2 (connectedness: low, high) design. The preview text was as follows:

> "The most astounding fact is the knowledge that the atoms that comprise life on Earth—the atoms that make up the human body—are traceable to the crucibles that cooked light elements into heavy elements in their core under extreme temperatures and pressures. These stars, the high mass ones among them, went unstable in their later years; they collapsed and then exploded scattering their enriched guts across the galaxy guts made of carbon, nitrogen, oxygen and all the fundamental ingredients of life itself. These ingredients become part of gas clouds that condense, collapse, form the next generation of solar systems stars with orbiting planets, and those planets now have the ingredients for life itself."

To manipulate connectedness, the prompt continued with the following:

> "So that when I look up at the night sky and I know that yes, each of us is **[connected to/isolated in]** this universe, each of us is **[a part of/unusual in]** this universe, but perhaps more important than both of those facts is that the Universe **[is in each of us/happens with or without each of us]**."

To manipulate self-significance, the text ended with the following:

> "When I reflect on that fact, I look up –I feel **[big/small]** because I know that my actions may play a **[significant/minor]** role in the grand scheme of things, and that my day to day concerns **[do deserve/don't deserve]** the weight I give them."

Self-Diminishment Ratings. Self-diminishment was measured with four items on a 5-point scale (0 = *Not at all*, 1 = *Slightly*, 2 = *Moderately*, 3 = *Very*, 4 = *Extremely*). Participants rated the extent to which they felt each of the following during the video: "I felt like my own issues and concerns did not matter that much," "I felt small," "I felt like my current concerns were important" (R), and "I felt like what I accomplish in the world was impactful in the broader scheme of things" (R). Item order was randomized with connection ratings.

Connection Ratings. Connection was measured with four items on a 5-point scale (0 = *Not at all*, 1 = *Slightly*, 2 = *Moderately*, 3 = *Very*, 4 = *Extremely*). Participants rated the extent to which they felt each of the following during the video: "I felt connected," "I felt like I was a part of something," "I felt isolated" (R), and "I felt alone" (R). Item order was randomized with self-diminishment ratings.

Valence Ratings. Participants completed the same measure as in Pilot Study 1.

Emotions Ratings. Participants completed the same measure as in Pilot Study 1.

Attention Check. Participants responded to the same attention check from Pilot Study 1.

Results and Discussion

Confirmatory factor analyses (CFA) were conducted separately on the self-

diminishment and connection items using maximum likelihood estimation. I expect a single factor solution for both measures. To accept the solution as having good fit, at least three of the following criteria need to be met: RMSEA < .08, SRMR < .08, CFI > .90, TLI > .95, non-significant chi-square. In cases where the solution did not have good fit, exploratory factor analyses (EFA) were conducted to determine the structure of the measures. I then calculated whatever scores were suggested by those analyses (averaging across the relevant items). Then each factor, valence, and emotions ratings, were analyzed separately with ANOVAs with self-significance and connectedness conditions as fixed factors. Results can be found in Table 7.

The manipulations can be considered successful if the analyses yield significant main effects of self-significance and connectedness on the self-diminishment and connection ratings, respectively. Specifically, participants in the high connectedness condition should have higher connection ratings than participants in the low connectedness condition; and participants in the low self-significance condition should have higher ratings for self-diminishment than participants in the high self-significance condition. Emotion ratings should be highest for awe, compared to the other emotions, serving as another manipulation check. Valence was included as an exploratory measure, to examine self-significance's and connectedness's influence on pleasantness.

Table 7.

Results for self-significance factors, connectedness factors, valence, and emotions ratings (Pilot Study 2)

	High Self-Significance		Low Self-Significance			
	High Connection	Low Connection	High Connection	Low Connection	Overall F	*p*
Significance Factor	1.62 (1.00)	1.81 (1.10)	1.41 (0.94)	1.46 (0.86)	1.55	.20
Insignificance Factor	2.60 (0.85)	2.34 (1.15)	2.27 (1.10)	2.43 (1.00)	0.85	.47
Connection Factor	2.13 (0.97)	2.26 (1.24)	1.99 (1.05)	2.08 (1.02)	0.49	.69
Isolation Factor	1.01 (0.92)	1.09 (1.14)	1.09 (1.13)	1.31 (1.14)	0.63	.60
Positive Valence	2.33 (1.08)	2.36 (1.09)	2.07 (1.09)	2.07 (0.96)	1.03	.38
Negative Valence	0.72 (0.85)	0.96 (1.00)	0.80 (1.00)	1.02 (0.99)	0.93	.43
Awe	2.84 (1.15)	2.60 (1.17)	2.61 (1.26)	2.69 (1.08)	0.39	.76
Amusement	1.84 (1.45)	2.09 (1.32)	2.00 (1.26)	2.02 (1.10)	0.30	.83
Gratitude	2.00 (1.33)	1.98 (1.38)	2.02 (1.32)	1.93 (1.37)	0.04	.99
Pride	1.02 (1.22)	0.98 (1.28)	1.21 (1.39)	0.89 (1.15)	0.50	.68
Hope	1.56 (1.22)	1.45 (1.36)	1.50 (1.27)	1.36 (1.21)	0.20	.89
Anxiety	1.88 (1.24)	1.62 (1.41)	1.18 (1.32)	1.49 (1.25)	2.17	.09
Sadness	0.86 (1.08)	1.11 (1.32)	0.77 (1.01)	1.11 (1.01)	1.07	.36
Boredom	0.93 (0.99)	0.87 (1.15)	0.93 (1.07)	0.82 (0.91)	0.11	.95
Fear	1.53 (1.14)	1.45 (1.33)	1.07 (1.15)	1.64 (1.32)	1.80	.15

Note. Standard deviations are in parentheses. Scales are from 0 (*Not at all)* to 4 (*Extremely*). N = 179.

Self-Diminishment Ratings

A confirmatory factor analysis with a single factor solution was specified for the four self-diminishment items. Indicators of good fit did not meet thresholds (RMSEA = 0.25, 90%CI [0.17, 0.35]; SRMR = 0.08; CFI = 0.71; TLI = 0.14; $\chi^2 = 25.0$, $p < .001$). This led to conducting an exploratory factor analysis on the items.

An exploratory factor analysis using principal axis factoring and oblimin rotation on the four items was performed, Bartlett's test of sphericity (Bartlett, 1950) was

significant, χ^2 (6) = 87.9, $p < .001$, and Kaiser-Meyer-Olkin (KMO; Kaiser & USCG, 1974) measure of sampling adequacy was 0.55. Factor loadings shown in Table 8. A two-factor structure appeared with two items loading onto an "Insignificance" factor, and the other two loading onto a "Significance" factor.[20] Each factor's items were averaged together to form composite scores before being analyzed with ANOVAs.

Table 8.

Factor Loadings of Self-Diminishment Items (Pilot Study 2)

	Factor		
	1	2	Uniqueness
1. I felt like my own issues and concerns did not matter that much.	–0.31	0.37	0.74
2. I felt small.		1.00	0.00
3. I felt like my current concerns were important.	1.00		0.00
4. I felt like what I accomplish in the world was impactful in the broader scheme of things.	0.41		0.82

Note. 'Minimum residual' extraction method was used in combination with a "oblimin" rotation.

For the insignificance factor, the ANOVA did not yield significant effects for either condition of self-significance, $F(1, 173) = 0.58$, $p = .45$, $\eta_p^2 = 0.003$; nor the condition of connectedness, $F(1, 173) = 0.12$, $p = .73$, $\eta_p^2 = 0.001$; nor their interaction, $F(1, 173) = 1.88$, $p = .17$, $\eta_p^2 = 0.01$.

For the significance factor, the ANOVA did not yield significant effects of self-

[20] One item loaded onto both factors, but loaded higher on the Insignificance factor and was also a better conceptual fit for that factor.

significance, $F(1, 174) = 3.64$, $p = .058$, , $\eta_p^2 = 0.02$; nor the condition of connectedness, $F(1, 174) = 0.67$, $p = .42$, $\eta_p^2 = 0.004$; nor their interaction, $F(1, 174) = 0.24$, $p = .63$, $\eta_p^2 = 0.001$.

These results suggest that the self-significance and connectedness manipulations of altered preview text preceding awe videos were ineffective in influencing people's feelings of significance/insignificance.

Connection Ratings

A confirmatory factor analysis with a single factor solution was specified for the four connection items. Indicators of good fit did not meet thresholds (RMSEA = 0.44, 90%CI [0.36, 0.53]; SRMR = 0.15; CFI = 0.64; TLI = -0.09; $\chi^2 = 72.5$, $p < .001$). This led to conducting an exploratory factor analysis on the items.

The exploratory factor analysis with oblimin rotation on the four items was performed, Bartlett's test of sphericity (Bartlett, 1950) was significant, χ^2 (6) = 196.0, $p < .001$, and Kaiser-Meyer-Olkin (KMO; Kaiser & USCG, 1974) measure of sampling adequacy was 0.52. Factor loadings shown in Table 9. A two-factor structure appeared, with two items loading onto an "Isolation" factor and two items loading onto a "Connection" factor. Each factor's items were averaged together to form composite scores before being analyzed with ANOVAs.

Table 9.

Factor Loadings of Self-Diminishment Items (Pilot Study 2)

	Factor		
	1	2	Uniqueness
1. I felt isolated.	0.79		0.37
2. I felt alone.	0.89		0.21
3. I felt connected.		1.00	0.01
4. I felt like I was a part of something.		0.58	

Note. 'Minimum residual' extraction method was used in combination with a "oblimin" rotation.

For the isolation factor, the ANOVA did not yield significant effects for either condition of self-significance, $F(1, 175) = 0.88$, $p = .35$, $\eta_p^2 = 0.005$; nor the condition of connectedness, $F(1, 175) = 0.81$, $p = .37$, $\eta_p^2 = 0.005$; nor their interaction, $F(1, 175) = 0.20$, $p = .65$, $\eta_p^2 = 0.001$.

For the connection factor, the ANOVA did not yield significant effects for either the condition of self-significance, $F(1, 175) = 0.97$, $p = .33$, $\eta_p^2 = 0.006$; nor the condition of connectedness, $F(1, 175) = 0.45$, $p = .50$, $\eta_p^2 = 0.003$; nor their interaction, $F(1, 175) = 0.01$, $p = .91$, $\eta_p^2 = 0.00$.

These results suggest that the self-significance and connectedness manipulations of altered preview text preceding awe videos were ineffective in changing people's feelings of connection/isolation.

Valence Ratings

Positive. The ANOVA did not yield significant effects for either condition of self-significance, $F(1,175) = 3.41$, $p = .08$, $\eta_p^2 = 0.02$; nor the condition of connectedness, $F(1, 175) = 0.01$, $p = .913$, $\eta_p^2 = 0.00$; nor their interaction, $F(1, 175) = 0.01$, $p = 0.905$, $\eta_p^2 = 0.00$.

Negative. The ANOVA did not yield significant effects for either condition of self-significance, $F(1,175) = 0.23$, $p = .63$, $\eta_p^2 = 0.001$; nor the condition of connectedness, $F(1, 175) = 2.40$, $p = .11$, $\eta_p^2 = 0.015$; nor their interaction, $F(1, 175) = 0.00$, $p = 0.973$, $\eta_p^2 = 0.00$.

In other words, varying the preview narration text before an awe video did not have significant effects on how positive or negative participants felt.

Emotions Ratings

An exploratory factor analysis was conducted on all emotion items except for the target emotion of awe in order to determine the structure of the emotions experienced during the awe video. The factor analysis with oblimin rotation on the eight items was performed, Bartlett's test of sphericity (Bartlett, 1950) was significant, χ^2 (28) = 374, $p <$ .001, and Kaiser-Meyer-Olkin (KMO; Kaiser & USCG, 1974) measure of sampling adequacy was 0.66. Factor loadings are shown in Table 10. A three-factor structure appeared with amusement (amusement loaded onto two factors but had a higher loading on this factor), gratitude, pride, and hope loading onto a factor to form a positive emotion composite; anxiety, sadness, and fear loaded onto another factor to form a negative emotion composite; and boredom loaded onto its own factor. Each factor's items were averaged together to form composite scores before being analyzed with ANOVAs.

Table 10.

Factor Loadings of Emotions Items (Pilot Study 2)

	Factor			
	1	2	3	Uniqueness
1. Amusement	0.38		–0.30	0.73
2. Gratitude	0.70			0.40
3. Pride	0.72			0.49
4. Hope	0.77			0.42
5. Anxiety		0.78		0.35
6. Sadness		0.54		0.68
7. Fear		0.92		0.14
8. Boredom			0.6	0.63

Note. 'Minimum residual' extraction method was used in combination with a "oblimin" rotation.

For the positive emotions composite, the ANOVA did not yield significant effects for either condition of self-significance, $F(1, 173) = 0.00$, $p = .95$, $\eta_p^2 = 0.00$; nor the condition of connectedness, $F(1, 173) = 0.14$, $p = .71$, $\eta_p^2 = 0.00$; nor the interaction, $F(1, 173)$, $p = .62$, $\eta_p^2 = 0.00$.

For the negative emotions composite, the ANOVA did not yield significant effects for either condition of self-significance, $F(1, 175) = 1.67$, $p = .20$, $\eta_p^2 = 0.01$; nor the condition of connectedness, $F(1, 175) = 1.48$, $p = .23$, $\eta_p^2 = 0.01$; nor the interaction, $F(1, 175) = 2.11$, $p = .15$, $\eta_p^2 = 0.01$.

For the item of boredom, the ANOVA did not yield significant effects for either condition of self-significance, $F(1, 175) = 0.02$, $p = .88$, $\eta_p^2 = 0.00$; nor the condition of connectedness, $F(1, 175) = 0.29$, $p = .59$, $\eta_p^2 = 0.00$; nor the interaction, $F(1, 175) = 0.03$, $p = .87$, $\eta_p^2 = 0.00$.

For the item of awe, the ANOVA did not yield significant effects for either

condition of self-significance, $F(1, 175) = 0.14$, $p = .71$, $\eta_p^2 = 0.00$; nor the condition of connectedness, $F(1, 175) = 0.23$, $p = .64$, $\eta_p^2 = 0.00$; nor the interaction, $F(1, 175) = 0.82$, $p = .37$, $\eta_p^2 = 0.01$.

These results suggest that the self-significance and connectedness manipulations of altered preview text preceding awe videos did not significantly influence any emotion over another. Based on the results of Pilot Study 2, I decided to not pursue using a video narration preceding an awe video as a manipulation of either self-significance or connectedness. Other manipulations are explored in Pilot Studies 3–5.

Pilot Study 3

Pilot Study 3 used a writing task designed to manipulate self-significance and feelings of connectedness. Participants wrote a persuasive argument in favor of an assigned statement. The rationale for this type of manipulation is that writing from certain perspectives can prime subsequent attitudes and feelings; it has been used successfully in research before (e.g., Bruneau & Saxe, 2012; Shnabel et al., 2013). Writing tasks for manipulations of self-significance and connectedness have not been tested yet so this pilot study was designed to validate their effectiveness.

Method

Participants and Design

Participants were recruited as in Pilot Studies 1 and 2. The study used a 2 (self-significance: low, high) × 2 (connectedness: low, high) between-participants design. I used G*Power (Faul et al., 2007) to conduct a power analysis to obtain a target sample size, with the same parameters as in Pilot Study 2, yielding a target sample size of at least 128 participants.

Two hundred and eighty-one participants took part in the study (171 women, 70 men, 9 non-binary, 2 preferred different descriptions, 2 preferred not to self-identify, 27 did not respond). The sample ranged from 18 to 39 years old (M = 19.9, SD = 2.40; 60.1% not Hispanic in origin; 30.6% Hispanic in origin; 9.3% did not report; 37.0% White; 19.9% LatinX/Latiné; 11.0% Mixed Race; 6.0% South Asian/Southeast Asian; 5.3% Black/African; 4.3% East Asian; 3.2% Middle Eastern/North African; 1% Alaskan Native/American Indian/Indigenous; 1% Native Hawaiian/Pacific Islander; 1% preferred not to report this information; 1% preferred to describe themselves in another way; 9.6% did not respond). Thirteen participants were excluded for failing the attention check, and 28 were excluded for not filling in any responses, leaving a final sample of 240 participants (high self-significance/high connection: 59; low self-significance/high connection: 60; high self-significance/low connection: 58; low self-significance/low connection: 63).

Procedure and Materials

Participants completed all study materials online via Qualtrics and were told that researchers were interested in the types of arguments people use in persuasive speech. Participants received a speech prompt and wrote a persuasive argument in favor of the assigned statement. They were asked to take a moment to reflect on what they just wrote about. Then they completed the same self-diminishment, connection, and valence measures as in Pilot Study 2.

Speech Prompt. Participants read a statement about how the universe is either related to or separate from everything else (manipulating connectedness) and how that means that we all have a relatively significant or minor role to play in the grand scheme

of things (manipulating self-significance). Each participant's prompt reflected one condition in the 2 (self-significance: low, high) × 2 (connectedness: low, high) design. The exact prompt was as follows:

> "Everyone and everything in the Universe is somehow **[related to/separate from]** everything else. This means that we all have a relatively **[significant/minor]** role to play in the grand scheme of things.
>
> Explain how or why this might be true. How would you persuade someone who doesn't believe this to change their mind?
>
> Aim to write at least 8 sentences to make a coherent argument. The strength of your argument will be coded by experimenters."

Results and Discussion

Analyses followed the same procedure as in Pilot Study 2. Descriptive results can be found in Table 11.

Self-Diminishment Ratings

Based on Pilot Study 2's CFA, EFA's were conducted for the proceeding self-diminishment and connection measures. The exploratory factor analysis with oblimin rotation on the four items was performed, Bartlett's test of sphericity (Bartlett, 1950) was significant, χ^2 (6) = 85.9, $p < .001$, and Kaiser-Meyer-Olkin (KMO; Kaiser & USCG, 1974) measure of sampling adequacy was 0.60. Factor loadings shown in Table 12. A single-factor structure appeared with all four items loading onto a single factor.

Appropriate items were reverse-coded and then the four self-diminishment items were averaged together into a single measure.

Table 11.

Results for self-diminishment, connectedness factors, valence, and emotions ratings (Pilot Study 3)

	High Self-Significance		Low Self-Significance			
	High Connection	Low Connection	High Connection	Low Connection	Overall F	*p*
Self-Diminishment Factor	1.71 (0.63)	1.56 (0.77)	1.76 (0.83)	1.67 (0.72)	0.79	.50
Connection Factor	2.47 (0.95)	2.51 (0.92)	2.14 (1.07)	2.18 (0.90)	2.30	.08
Isolation Factor	1.18 (1.10)	0.95 (1.00)	1.18 (1.17)	1.31 (1.14)	1.09	.36
Positive Valence	2.31 (1.07)	2.22 (1.09)	2.07 (0.97)	2.08 (1.15)	0.69	.56
Negative Valence	0.76 (0.84)	0.59 (0.84)	0.88 (1.01)	0.60 (0.91)	0.06	.81

Note. Standard deviations are in parentheses. Scales are from 0 (*Not at all)* to 4 (*Extremely*). N = 240.

Table 12.

Factor Loadings of Self-Diminishment Items (Pilot Study 3)

	Factor	
	1	Uniqueness
1. I felt like my own issues and concerns did not matter that much.	0.58	0.67
2. I felt small.	0.44	0.81
3. I felt like my current concerns were important.	–0.52	0.73
4. I felt like what I accomplish in the world was impactful in the broader scheme of things.	–0.46	0.79

Note . 'Minimum residual' extraction method was used in combination with a "oblimin" rotation.

For the self-diminishment factor, the ANOVA did not yield any significant effects for either condition of self-significance, $F(1, 235) = 0.68$, $p = .41$, $\eta_p^2 = 0.003$; nor the condition of connectedness, $F(1, 235) = 1.66$, $p = .20$, $\eta_p^2 = 0.01$; nor their interaction, $F(1, 235) = 0.08$, $p = .77$, $\eta_p^2 = 0.00$. These results suggest that my self-significance manipulation was not effective at manipulating participants' feelings of self-diminishment.

Connection Ratings

The exploratory factor analysis with oblimin rotation on the four items was performed, Bartlett's test of sphericity (Bartlett, 1950) was significant, χ^2 (6) = 644, $p <$ .001, and Kaiser-Meyer-Olkin (KMO; Kaiser & USCG, 1974) measure of sampling adequacy was 0.60. Factor loadings shown in Table 13. The same two-factor structure as in Pilot Study 2 appeared with two items loading onto the "Isolation" factor and the other two items loading onto the "Connection" factor. Each factor's items were averaged together to form composite scores before being analyzed with ANOVAs.

Table 13.

Factor Loadings of Connection Items (Pilot Study 3)

	Factor		
	1	2	Uniqueness
1. I felt isolated.	0.96		0.07
2. I felt alone.	0.97		0.07
3. I felt connected.		0.81	0.34
4. I felt like I was a part of something.		0.81	0.35

Note. 'Minimum residual' extraction method was used in combination with a "oblimin" rotation.

For the isolation factor, the ANOVA did not yield significant effects for either condition of self-significance, $F(1, 235) = 1.97$, $p = .21$, $\eta_p^2 = 0.01$; nor connectedness, $F(1, 235) = 0.14$, $p = .71$, $\eta_p^2 = 0.001$; nor their interaction, $F(1, 235) = 1.52$, $p = .22$, $\eta_p^2 = 0.01$.

For the connection factor, the ANOVA yielded a significant effect of self-significance, $F(1, 234) = 6.82$, $p = .01$, $\eta_p^2 = 0.03$, such that participants in the high self-significance condition reported greater levels of connection than participants in the low self-significance condition; the ANOVA did not yield significant effects of connectedness, $F(1, 234) = 0.11$, $p = .74$, $\eta_p^2 = 0.00$; nor their interaction, $F(1, 235) < .001$, $p = .99$, $\eta_p^2 = 0.00$.

These results suggest that my self-significance manipulation unintentionally had a significant effect on participants' feelings of connection—making people feel significant also made them feel connected. They also suggest my connectedness manipulation was ineffective at influencing feelings of connection.

Valence Ratings

Positive. The ANOVA did not yield significant effects for either condition of self-significance, $F(1, 236) = 1.90$, $p = .169$, $\eta_p^2 = 0.008$; nor the condition of connectedness, $F(1, 236) = 0.06$, $p = .806$, $\eta_p^2 = 0.00$; nor their interaction, $F(1, 236) = 0.11$, $p = 0.736$, $\eta_p^2 = 0.00$.

Negative. The ANOVA did not yield significant effects for either condition of self-significance, $F(1, 236) = 0.35$, $p = .55$, $\eta_p^2 = 0.001$; nor the condition of connectedness, $F(1, 236) = 3.84$, $p = .051$, $\eta_p^2 = 0.016$; nor their interaction, $F(1, 236) = 0.20$, $p = 0.657$, $\eta_p^2 = 0.001$.

Taken together, these findings suggest that my self-significance and connectedness manipulations are not significantly different in feelings of positivity and negativity.

Exploratory Narrative Analysis

Two undergrad research assistants coded the narratives that people wrote during the self-significance and connectedness manipulations. They coded: (1) whether the participant wrote four or more sentences (Yes/No); (2) whether they wrote about connectedness (Yes/No); and (3) whether they wrote about self-significance (Yes/No). The research assistants were blind to the participants' conditions. Discrepancies were discussed and resolved by the principal investigator.

Twenty-two participants wrote fewer than four sentences; 60 participants did not write about connectedness; and 34 participants did not write about self-significance. This led to an exclusion of 101 participants, since 15 participants did not write about *both* connectedness and self-significance. The new analyses with this sample of 139 participants did not significantly change the results, except for the self-significance condition's effect on ratings of the connection factor, which became non-significant, $F(1, 133) = 2.80$, $p = .096$, $\eta_p^2 = 0.02$. Because the change was small—a difference of $\eta_p^2 = 0.007$—it suggests that excluding participants based on narrative content did not significantly impact the overall results of the study.

Based on the results of Pilot Study 3, I decided to iterate on the writing manipulations and turn them into two separate writing tasks in efforts to strengthen the effect of each manipulation. This manipulation was tested in Pilot Study 4.

Pilot Study 4

Pilot Study 4 was conducted as a reaction to the results from Pilot Studies 2 and 3. Pilot Study 3's results could have been because both manipulations were grouped together in a single writing task (i.e., participants wrote a single speech for two manipulated variables). In Pilot Study 4, the writing prompts were separated, and participants wrote two speeches—one for each manipulated variable.

Method

Participants and Design

Participants were recruited via Amazon's Mechanical Turk (MTurk) and provided with $2 compensation upon completion, based on an hourly rate of $8/hour. The study used a 2 (self-significance: low, high) × 2 (connectedness: low, high) between-participants design. Based on the previous pilot studies, a sample size of 150 was selected to be the target sample size.

One hundred and fifty participants took part in the study (67 women, 82 men, 1 non-binary). The sample ranged from 25 to 69 years old (M = 39.2, SD = 10.1; 96.7% not Hispanic in origin; 3.3% Hispanic in origin; 50% White, 32.7% South Asian/Southeast Asian, 4.7% East Asian, 4% Alaskan Native/American Indian/Indigenous, 3.3% Mixed, 2% Black/African, 3.3% did not identify). One participant was excluded for failing the attention check, leaving a final sample of 149 participants (High self-significance/high connection: 39; low self-significance/high connection: 33; high self-significance/low connection: 37; low self-significance/low connection: 40).

Procedure and Materials

The procedure was the same as in Pilot Study 3, except that the self-significance

and connectedness manipulations were split into two separate writing tasks. They were first presented with general instructions as follows: “You will be presented with statements that you will ***write persuasive speeches in favor for, even if you don't believe it yourself***. Then you will answer some questions regarding your current mindset.” Then they received two writing tasks, completed in succession. For the connectedness manipulation they read, “*Everyone and everything in the Universe is somehow* ***[related to/separate from]*** *everything else.*" For the self-significance manipulation they read, “*You have* ***[a very large/very little]*** *impact in the grand scheme of things.*” The order of these were counterbalanced. Both prompts ended with the following:

> “Explain how or why this might be true, regardless of how much you agree. How would you persuade someone who doesn’t believe this to change their mind? (Aim to write at least 8 sentences to make a coherent argument. The strength of your argument will be coded by experimenters.)”

Participants then completed the same self-diminishment, connection, and valence measures as in Pilot Study 3.

Results and Discussion

Analyses followed the same procedure as in Pilot Study 3. Descriptive results can be found in Table 14.

Table 14.

Results for self-significance factors, connectedness factors, valence, and emotions ratings (Pilot Study 4)

	High Self-Significance		Low Self-Significance			
	High Connection	Low connection	High Connection	Low connection	Overall F	*p*
Significance Factor	2.71 (0.89)	2.50 (0.93)	2.08 (1.19)	2.27 (1.26)	2.33	.08
Insignificance Factor	1.87 (1.30)	1.84 (1.24)	2.32 (1.27)	2.30 (1.23)	1.61	.19
Connection Factor	2.76 (0.84)	2.28 (1.16)	2.48 (1.11)	2.45 (1.15)	1.29	.28
Isolation Factor	1.71 (1.63)	1.81 (1.54)	1.77 (1.46)	1.99 (1.42)	0.25	.86
Positive Valence	2.87 (1.06)	2.46 (1.32)	2.39 (1.09)	2.17 (1.32)	2.28	.08
Negative Valence	1.26 (1.39)	1.14 (1.42)	1.15 (1.30)	1.90 (1.50)	2.58	.056

Note. Standard deviations are in parentheses. Scales are from 0 (*Not at all)* to 4 (*Extremely*). N = 149.

Self-Diminishment Ratings

The exploratory factor analysis with oblimin rotation on the four items was performed, Bartlett's test of sphericity (Bartlett, 1950) was significant, χ^2 (6) = 151, $p <$ .001, and Kaiser-Meyer-Olkin (KMO; Kaiser & USCG, 1974) measure of sampling adequacy was 0.52. Factor loadings shown in Table 15. The same two-factor structure as in Pilot Study 2 appeared in the current study, with two items loading onto the "Insignificance" factor and the other two items loading onto the "Significance" factor. Each factor's items were averaged together to form composite scores before being analyzed with ANOVAs.

Table 15.

Factor Loadings of Self-Diminishment Items (Pilot Study 4)

	Factor		
	1	2	Uniqueness
1. I felt like my own issues and concerns did not matter that much.	0.90		0.20
2. I felt small.	0.73		0.46
3. I felt like my current concerns were important.		0.78	0.40
4. I felt like what I accomplish in the world was impactful in the broader scheme of things.		0.72	0.41

Note. 'Minimum residual' extraction method was used in combination with a "oblimin" rotation.

For the insignificance factor, the ANOVA yielded a significant effect of self-significance, $F(1, 145) = 4.83$, $p = .03$, $\eta_p^2 = 0.03$, such that participants in the low self-significance condition reported greater levels of insignificance compared to participants in the high self-significance condition. The ANOVA did not yield significant effects of connectedness, $F(1, 145) = 0.02$, $p = .90$, $\eta_p^2 = 0.00$; nor their interaction, $F(1, 145) = 0.001$, $p = .97$, $\eta_p^2 = 0.00$.

For the significance factor, the ANOVA yielded a significant effect of self-significance, $F(1, 145) = 5.84$, $p = .017$, $\eta_p^2 = 0.04$, such that participants in the high self-significance condition reported greater feelings of significance than participants in the low self-significance condition. The ANOVA did not yield significant effects of connectedness, $F(1, 145) = 0.00$, $p = .99$, $\eta_p^2 = 0.00$; nor the interaction, $F(1, 145) = 1.31$, $p = .26$, $\eta_p^2 = 0.01$.

These results suggest that the self-significance manipulation was effective in

manipulating participants' feelings of significance/insignificance.

Connection Ratings

The exploratory factor analysis with oblimin rotation on the four items was performed, Bartlett's test of sphericity (Bartlett, 1950) was significant, χ^2 (6) = 392, p < .001, and Kaiser-Meyer-Olkin (KMO; Kaiser & USCG, 1974) measure of sampling adequacy was 0.51. Factor loadings shown in Table 16. The same two-factor structure as in Pilot Study 3 appeared with two items loading onto the "Isolation" factor and the other two items loading onto the "Connection" factor. Each factor's items were averaged together to form composite scores before being analyzed with ANOVAs.

Table 16.

Factor Loadings of Connection Items (Pilot Study 4)

	Factor		
	1	2	Uniqueness
1. I felt isolated.	0.99		0.004
2. I felt alone.	0.92		0.14
3. I felt connected.		0.99	0.004
4. I felt like I was a part of something.		0.74	0.45

Note. 'Minimum residual' extraction method was used in combination with a "oblimin" rotation.

For the isolation factor, the ANOVA did not yield significant effects for either condition of self-significance, $F(1, 145) = 0.24$, $p = .62$, $\eta_p^2 = 0.002$; nor connectedness, $F(1, 145) = 0.42$, $p = .52$, $\eta_p^2 = 0.003$; nor their interaction, $F(1, 145) = 0.05$, $p = .83$, $\eta_p^2 = 0.00$.

For the connection factor, the ANOVA did not yield significant effects for either

condition of self-significance, $F(1, 144) = 0.10$, $p = .75$, $\eta_p^2 = 0.001$; nor connectedness, $F(1, 144) = 2.11$, $p = .15$, $\eta_p^2 = 0.01$; nor their interaction, $F(1, 144) = 1.58$, $p = .21$, $\eta_p^2 = 0.01$.

These results suggest that the manipulations were ineffective in manipulating feelings of both isolation and connection.

Valence Ratings

Positive. The ANOVA did not yield significant effects for either condition of self-significance, $F(1, 145) = 3.70$, $p = .057$, $\eta_p^2 = 0.025$; nor the condition of connectedness, $F(1, 145) = 2.53$, $p = .114$, $\eta_p^2 = 0.017$; nor their interaction, $F(1, 145) = 0.24$, $p = .627$, $\eta_p^2 = 0.002$.

Negative. The ANOVA did not yield significant effects of self-significance, $F(1, 145) = 2.03$, $p = .156$, $\eta_p^2 = 0.014$; nor the condition of connectedness, $F(1, 145) = 1.84$, $p = .177$, $\eta_p^2 = 0.013$; nor their interaction, $F(1, 145) = 3.53$, $p = .062$, $\eta_p^2 = 0.024$.

The results of Pilot Study 4 demonstrated the self-significance manipulations were effective, but the connectedness manipulations were not. I decided to iterate on the writing manipulations again and add a more elaborate introduction to the writing prompts and paired it with a video of an excerpt from Dr. Neil DeGrasse Tyson, to increase the manipulation's impact. This manipulation is tested in Pilot Study 5.

Appendix D: Materials, Pilot Studies 1–4

Manipulations

Pilot Study 1: Video Comparison

Participants watched one of the awe induction videos, fill out the measures, then watch the other awe induction video, and fill out the measures again (within-participants).

Cosmos Video (Awe)

It will feature a video, set to ominous music, that starts out from the perspective of someone on Earth and will zoom out further and further showing other planets, stars, and galaxies, showing how small we are compared to the rest of the Universe.
https://youtu.be/W15zvZE9IVU

Biology Video (Awe)

It will feature a video, set to the same ominous music as the Cosmos video, and will start out from the same perspective of someone on Earth but will zoom in further and further showing the inner biology of a leaf.
https://youtu.be/DRzPAC7uQLY

Baseline Video (Control)

It will feature a video, set to happy upbeat music, that features footage of farms, fields, and close-up shots of plant life. It is meant to feature nature but not in an awe-inducing manner.
https://youtu.be/-sdTfV0Bkb4

Pilot Study 2: Preview Text for Videos

Participants watched the Cosmos video, but before the video begins they saw a black screen with scrolling text on it accompanied with a voiceover narrating the text. The text will describe our 2 (Self-diminishment: significant, insignificant) × 2 (Connection: connected, disconnected) design. (Between-participants).

Preview Text

> The most astounding fact is the knowledge that the atoms that comprise life on Earth—the atoms that make up the human body—are traceable to the crucibles that cooked light elements into heavy elements in their core under extreme temperatures and pressures. These stars, the high mass ones among them, went unstable in their later years; they collapsed and then exploded scattering their enriched guts across the galaxy—guts made of carbon, nitrogen, oxygen and all the fundamental ingredients of life itself. These ingredients become part of gas clouds that condense, collapse, form the next generation of solar systems—stars

with orbiting planets, and those planets now have the ingredients for life itself.

Connected/Disconnected
So that when I look up at the night sky and I know that yes, each of us is **[connected to/isolated in]** this universe, each of us is **[a part of/unusual in]** this universe, but perhaps more important than both of those facts is that the Universe **[is in each of us/happens with or without each of us]**.

Significant/Insignificant
When I reflect on that fact, I look up — I feel **[big/small]** because I know that my actions may play a **[significant/minor]** role in the grand scheme of things, and that my day-to-day concerns **[do deserve/don't deserve]** the weight I give them.

Conditions

Connected/Significant: https://youtu.be/G0YvrtjI3cU
So that when I look up at the night sky and I know that yes, each of us is **connected to** this universe, each of us is **a part of** this universe, but perhaps more important than both of those facts is that the Universe **is in each of us**.

When I reflect on that fact, I look up — I feel **big** because I know that my actions may play a **significant** role in the grand scheme of things, and that my day-to-day concerns **do deserve** the weight I give them."

Connected/Insignificant: https://youtu.be/k1PiPRyhpz8
So that when I look up at the night sky and I know that yes, each of us is **connected to** this universe, each of us is **a part of** this universe, but perhaps more important than both of those facts is that the Universe **is in each of us**.

When I reflect on that fact, I look up — I feel **small** because I know that my actions may play a **minor** role in the grand scheme of things, and that my day-to-day concerns **don't deserve** the weight I give them."

Disconnected/Significant: https://youtu.be/iUv5z30yAGE
So that when I look up at the night sky and I know that yes, each of us is **isolated in** this universe, each of us is **unusual in** this universe, but perhaps more important than both of those facts is that the Universe **happens with or without each of us**.

When I reflect on that fact, I look up — I feel **big** because I know that my actions may play a **significant** role in the grand scheme of things, and that my day-to-day concerns **do deserve** the weight I give them."

Disconnected/Insignificant: https://youtu.be/gBbQYdPVy7A
So that when I look up at the night sky and I know that yes, each of us is **isolated in** this universe, each of us is **unusual in** this universe, but perhaps more

important than both of those facts is that the Universe **happens with or without each of us**.

When I reflect on that fact, I look up — I feel **small** because I know that my actions may play a **minor** role in the grand scheme of things, and that my day-to-day concerns **don't deserve** the weight I give them."

Pilot Study 3: Persuasive Speech

Participants read a statement that describes the 2 (Self-diminishment: significant, insignificant) × 2 (Connection: connected, disconnected) design. (Between-participants).

Speech Prompt

Everyone and everything in the Universe is somehow **[related to/separate from]** everything else. This means that we all have a relatively **[significant/minor]** role to play in the grand scheme of things.

Explain how or why this might be true. How would you persuade someone who doesn't believe this to change their mind?

Aim to write at least 8 sentences to make a coherent argument. The strength of your argument will be coded by experimenters."

Pilot Study 4: Persuasive Speeches for Each Manipulation

Participants read a statement that described the self-diminishment (significant, insignificant) manipulation followed by a writing prompt. Afterward, they read a statement that described the connection (connected, disconnected) manipulation followed by another writing prompt. Order was randomized. (Between-participants).

Speech Prompts

For the connectedness manipulation they read, "*Everyone and everything in the Universe is somehow **[related to/separate from]** everything else.*"

For the self-significance manipulation they read, "*You have **[a very large/very little]** impact in the grand scheme of things.*"

Explain how or why this might be true, regardless of how much you agree. How would you persuade someone who doesn't believe this to change their mind? (Aim to write at least 8 sentences to make a coherent argument. The strength of your argument will be coded by experimenters.)

Measures

Pilot Study 1

Valence
Emotions
Demographics
Attention Check

Pilot Study 2

Self-diminishment
Connection
Valence
Emotions
Demographics
Attention Check

Pilot Study 3

Self-diminishment
Connection
Valence
Demographics
Attention Check

Pilot Study 4

Self-diminishment
Connection
Valence
Demographics
Attention Check

Rating Scale

0 = *not at all*
1 = *slightly*
2 = *moderately*
3 = *very*
4 = *extremely*

Self-Diminishment

I felt [feel] like my own issues and concerns do not matter that much.
I felt [feel] small.
I felt [feel] like my current concerns are important. [R]
I felt [feel] like what I accomplish in the world is impactful in the grand scheme of things. [R]

Connection

I felt [feel] isolated. [R]
I felt [feel] alone. [R]
I felt [feel] connected.

I felt [feel] like I was [am] a part of something.

Valence

How **positive** was your experience [watching the video/writing the speech]?
How **negative** was your experience [watching the video/writing the speech]?

Emotions

Awe
Amusement
Gratitude
Pride
Hope
Anxiety
Sadness
Boredom
Fear

Demographic Information

Age (in years): [open-ended response]

Which gender do you identify with the most?
Female
Male
Non-binary
I prefer a different description (specify): [open-ended response]
I prefer not to self-identify

Are you of Hispanic origin?
Yes
No

Which of the following describe you? (Select all that apply)
Alaskan Native/American Indian/Indigenous
Black/African
East Asian
LatinX/Latiné
Middle Eastern/North African
Native Hawaiian/Pacific Islander
South Asian/Southeast Asian
White
I describe myself in another way (specify): [open-ended response]
I prefer not to report this information

Attention Check

In order for our analyses to be valid, we need to know that our participants (1) followed the instructions (e.g., watching the full video), (2) made an effort to be careful and honest in their responding, and (3) were not distracted. If for any reason you believe your responses might not meet these criteria, please tell us so that we can delete your data from our records. This will not affect your subject pool credits; you will receive your credits regardless of your answer.

I followed the instructions and was careful and attentive; you may keep my data.
I did not follow the instructions / I was distracted; you should delete my data.

Appendix E: Additional Analyses and Tables, Experiment 2

Negative Emotion Ratings

For the two negative emotion indices (threat: *anxiety, fear*; negative emotion: *boredom, sadness*), McDonald's Omega's were calculated and used to ensure reliability. If the omega was below 0.80 (Kamata et al., 2003), the items were analyzed separately.

The reliability analysis for the threat index yielded a McDonald's Omega of 0.85, so the anxiety and fear items were averaged together. The reliability analysis for the negative emotion index yielded a McDonald's Omega of 0.46, so the boredom and sadness items were analyzed separately. The data reduction procedures support a single factor for a threat emotion index (*fear, anxiety*) but not for negative emotion index (*sadness, boredom*), so sadness and boredom items were analyzed separately.

I ran two linear mixed effects models (A, B) with connectedness, self-significance, and emotion type (threat index, A: sadness, B: boredom) as fixed effects; rating (of the threat index and negative emotion ratings) as the dependent variable; and participant ID as a random intercept. The first model (threat index versus sadness) yielded no significant effects, demonstrating that participants did not report threat levels significantly different from sadness levels in any of the conditions. The second model (threat index versus boredom) yielded a significant effect for only emotion type, such that participants reported greater threat levels compared to boredom levels across all conditions.

I also conducted an ANOVA with self-significance (low, high) and connectedness (low, high) as fixed factors and threat index ratings as the dependent variable. The ANOVA did not yield any significant effects.

The regression model with self-reported significance and connection, and their interaction term as fixed effects yielded a significant interaction effect (p = .019). Those high in connection exhibited a negative association between significance and threat ratings (i.e., the more significant they felt, the less threat they felt), whereas those low in connection exhibited a positive association between significant and threat ratings (i.e., the more significant they felt, the more threat they felt).

Table E1.

Results from CFA on Self-Diminishment Items (Experiment 2 - Online Sample)

	Factor Loading	
Item	1	2
Factor 1: Significance		
I felt like my current concerns are important.	0.93	
I felt like what I accomplish in the world is impactful in the grand scheme of things.	0.80	
Factor 2: Insignificance		
I felt like my own issues and concerns do not matter that much.		1.12
I felt small.		0.92

Note. N = 241.

Table E2.

Results from CFA on Connection Items (Experiment 2 - Online Sample)

	Factor Loading	
Item	1	2
Factor 1: Connection		
I felt connected.	1.07	
I felt like I was a part of something.	1.10	
Factor 2: Isolation		
I felt isolated.		1.08
I felt alone.		1.19

Note. N = 241.

Table E3.

ANOVA Table for Manipulation Checks: Self-Diminishment and Connection (Experiment 2 - Online Sample)

Variable	Effect	df	*F*	*p*	η_p^2
Self-Diminishment					
Significance Factor	Main effect: Self-Significance	*F*(1, 236)	34.24	<.001	0.13
	Main effect: Connectedness	*F*(1, 236)	0.88	.35	0.004
	Interaction	*F*(1, 236)	0.78	.38	0.003
Insignificance Factor	Main effect: Self-Significance	*F*(1, 234)	9.31	.003	0.04
	Main effect: Connectedness	*F*(1, 234)	0.05	.83	0.00
	Interaction	*F*(1, 234)	5.07	.025	0.02
Connection					
Connection Factor	Main effect: Self-Significance	*F*(1, 237)	8.30	.004	0.03
	Main effect: Connectedness	*F*(1, 237)	5.51	.02	0.02
	Interaction	*F*(1, 237)	0.06	.80	0.00
Isolation Factor	Main effect: Self-Significance	*F*(1, 233)	5.32	.02	0.02
	Main effect: Connectedness	*F*(1, 233)	3.76	.05	0.02
	Interaction	*F*(1, 233)	1.96	.16	0.01

Note. N = 241. A sensitivity analysis (specifying N = 241, a power level of .90, a between-subjects design with 4 groups, and numerator df = 1) suggested power to observe a partial eta-squared effect size of 0.04

Table E4.

Exploratory Factor Analysis of Positive Emotion Items (Experiment 2 - Online Sample)

	Factor	
	1	Uniqueness
1. Amusement	0.44	0.81
2. Gratitude	0.80	0.36
3. Pride	0.71	0.50
4. Hope	0.86	0.26

Note. 'Minimum residual' extraction method was used in combination with a "oblimin" rotation.

Table E5.

Results for the Linear Mixed Model for the Awe Index versus the Positive Emotion Index (Experiment 2 - Online Sample)

Effect	df	*F*	*p*
Self-Significance	$F(1, 241)$	4.65	.03
Connectedness	$F(1, 241)$	0.52	.47
Emotion Type	$F(1, 241)$	439.25	<.001
Connectedness*Self-Significance	$F(1, 241)$	1.30	.26
Connectedness*Emotion Type	$F(1, 241)$	0.03	.87
Self-Significance*Emotion Type	$F(1, 241)$	4.64	.03
Connectedness*Self-Significance*Emotion Type	$F(1, 241)$	1.87	.17

Note. The mixed model was conducted with self-significance, connectedness, and emotion type (awe index, positive emotion index) as fixed factors, rating as the dependent variable, and participant ID as a random intercept. Satterthwaite method for degrees of freedom.

Table E6.

Results for the Linear Mixed Model for the Threat Index versus Sadness Ratings (Experiment 2 - Online Sample)

Effect	df	*F*	*p*
Self-Significance	$F(1, 237)$	0.004	.95
Connectedness	$F(1, 237)$	0.14	.71
Emotion Type	$F(1, 237)$	2.37	.13
Connectedness*Self-Significance	$F(1, 237)$	0.12	.73
Connectedness*Emotion Type	$F(1, 237)$	.82	.37
Self-Significance*Emotion Type	$F(1, 237)$	0.20	.66
Connectedness*Self-Significance*Emotion Type	$F(1, 237)$	0.93	.34

Note. The mixed model was conducted with self-significance, connectedness, and emotion type (threat index, sadness) as fixed factors, rating as the dependent variable, and participant ID as a random intercept. Satterthwaite method for degrees of freedom.

Table E7.

Results for the Linear Mixed Model for the Threat Index versus Boredom Ratings (Experiment 2 - Online Sample)

Effect	df	*F*	*p*
Self-Significance	$F(1, 236)$	0.23	.63
Connectedness	$F(1, 236)$	0.52	.47
Emotion Type	$F(1, 236)$	61.07	<.001
Connectedness*Self-Significance	$F(1, 236)$	0.09	.76
Connectedness*Emotion Type	$F(1, 236)$	0.14	.71
Self-Significance*Emotion Type	$F(1, 236)$	0.03	.86
Connectedness*Self-Significance*Emotion Type	$F(1, 236)$	0.78	.38

Note. The mixed model was conducted with self-significance, connectedness, and emotion type (threat index, boredom) as fixed factors, rating as the dependent variable, and participant ID as a random intercept. Satterthwaite method for degrees of freedom.

Table E8.

R*eliability for appraisals (Experiment 2 - Online Sample)*

Variable	ω	*r*
Vastness	0.67	0.51
Need for Accommodation	0.26	0.15
Certainty	0.54	0.37
Personal Control/Responsibility	0.65	0.48
Situational Control/Responsibility	0.29	0.17
Other Control/Responsibility	0.63	0.46
Self-Awareness	0.74	0.58
Situational Awareness	0.57	0.39

Note. N = 241. ω = McDonald's Omega. *r* = Pearon's correlation.

Regression Analyses Tables

Table E9.

Regression Table for Valence, Appraisals, and Threat Index (Experiment 2 - Online Sample)

Variable	R^2	Effect	Estimate	Std. Error	*t*	*p*
Positive Valence	0.25	Significance	–0.15	0.17	–0.87	.39
		Connection	0.45	0.10	4.65	<.001
		Interaction	0.06	0.06	1.02	.31
Negative Valence	0.09	Significance	0.24	0.15	1.62	.11
		Connection	–0.17	0.08	–2.11	.04
		Interaction	–0.07	0.05	–1.40	.16
Vastness	0.12	Significance	–0.45	0.16	–2.84	.005
		Connection	0.10	0.09	1.17	.23
		Interaction	0.14	0.05	2.77	.006
Need for Accommodation: I found it difficult to fully understand the situation.	0.02	Significance	0.16	0.20	0.79	.43
		Connection	0.08	0.11	0.71	.48
		Interaction	–0.09	0.07	–1.37	.17
Need for Accommodation: I felt my view of the world challenged.	0.04	Significance	0.06	0.21	0.29	.77
		Connection	0.32	0.12	2.73	.007
		Interaction	–0.10	0.07	–1.52	.13
Certainty	0.05	Significance	–0.42	0.17	–2.48	.01
		Connection	–0.04	0.09	–0.41	.68
		Interaction	0.14	0.05	2.61	.01
Personal Control/Responsibility	0.16	Significance	–0.21	0.15	–1.46	.15
		Connection	–0.13	0.08	–1.62	.11
		Interaction	0.17	0.05	3.54	<.001
Situational Control/Responsibility: I felt that the situation was directed by circumstances beyond anyone's control.	0.07	Significance	–0.003	0.21	–0.02	.99
		Connection	0.20	0.11	1.75	.08
		Interaction	–0.12	0.07	–1.72	.09
Situational Control/Responsibility: I felt that the situation was brought on by chance.	0.03	Significance	–0.31	0.20	–1.53	.13
		Connection	0.10	0.11	0.91	.36
		Interaction	0.04	0.07	0.65	.52
Other Control/Responsibility	0.01	Significance	0.20	0.20	1.01	.31
		Connection	0.11	0.11	1.03	.30
		Interaction	–0.09	0.06	–1.46	.14
Self-Awareness	0.14	Significance	–0.03	0.15	–0.19	.85
		Connection	–0.08	0.08	–1.00	.32
		Interaction	0.11	0.05	2.25	.026
Situational Awareness	0.12	Significance	–0.33	0.16	–2.11	.036
		Connection	–0.01	0.09	–0.17	.87
		Interaction	0.16	0.05	3.16	.002
Threat Index	0.11	Significance	0.32	0.16	1.94	.053
		Connection	–0.10	0.09	–1.11	.27
		Interaction	–0.13	0.05	–2.37	0.02

Note. N = 241.

Appendix F: Materials, Experiment 2

Writing Task [Both versions of study]

First the participant will complete a writing task that is designed to influence participants' feelings of connection and self-significance. The task is as follows:

> *"In this study, we are investigating people's ability to take on the perspectives of others.*
>
> *The following audio clip is taken from an interview with Neil DeGrasse Tyson, physicist and host of the popular Cosmos documentary series. As you listen to it, we want you to put yourself into his shoes and imagine his thoughts and feelings as he reflects on Earth's origins. Imagine yourself giving Dr. DeGrasse Tyson's answer to the question, "What is the most astounding fact?"*

[A video of Neil DeGrasse Tyson reading the following passage is played with scrolling text of the passage on the video: https://youtu.be/HbSL5RhEBP0]

> *"The most astounding fact is the knowledge that the atoms that comprise life on Earth—the atoms that make up the human body—are traceable to the crucibles that cooked light elements into heavy elements in their core under extreme temperatures and pressures. These stars, the high mass ones among them, went unstable in their later years; they collapsed and then exploded scattering their enriched guts across the galaxy—guts made of carbon, nitrogen, oxygen and all the fundamental ingredients of life itself. These ingredients become part of gas clouds that condense, collapse, form the next generation of solar systems—stars with orbiting planets, and those planets now have the ingredients for life itself."*

On the next page, participants will read the following instructions:

> *"Dr. Neil DeGrasse Tyson was talking about the Universe, but what he said later in the interview was targeted toward the human experience. You will now be presented with two additional sentences from Dr. DeGrasse Tyson's interview, one at a time. In each case, think about how it applies to your own personal experiences."*

[Connected/Disconnected]

> *"When I look up at the night sky and I know that yes,* ***[each of us is connected to / I am alone in]*** *this universe,* ***[each of us is a part of / I am isolated in]*** *this universe, but perhaps more important than both of those facts is that the Universe* ***[is in each of us / continues with or without me]****.*

> *Now, **explain how or why** this statement describes the human experience—how **everyone can be [connected/separated]**—using your personal experiences as an example. How would you **persuade** someone who doesn't believe this to change their mind?"*

[Significant/Insignificant]

> *"When I reflect on the Universe, I look up. I feel **[big/small]** because I know that my actions play **[a significant / an insignificant]** role in the grand scheme of things, and that my day-to-day concerns **[do deserve / don't deserve]** the weight I give them."*
>
> *Now, **explain how or why** this statement describes the human experience—**how [everyone / no one] has a significant role** in the grand scheme of things——using your personal experiences as an example. How would you **persuade** someone who doesn't believe this to change their mind?*

Both prompts will follow with:

> *"Aim to write at least 8 sentences to make a coherent argument. The strength of your argument will be coded by experimenters."*

Video Task [Both versions of study]

Cosmos Video

Next, the participant will watch a video that starts off showing a close-up of a person and the video gradually zooms out to the city level, country level, planet level, galaxy level, and so on until it displays an animation of the entire universe [https://youtu.be/W15zvZE9IVU].

[Eye-Tracking Version Only]

Before watching the video, participants will be calibrated on a desktop computer equipped with a mobile eye-tracker (Tobii x3-120). This will track participants' eye-gaze behaviors so we will be able to tell which part of the computer monitor they are focusing on. It will also provide us data on the number of eye fixations they make, their average fixation duration, and their blink rate. The data collected from the mobile eye-tracking unit will be correlated with questionnaire responses regarding appraisals, valence, and emotions felt during the video.

Self-Report Measures [Both versions of study]:

Instructions

“Rate the extent to which you felt each of the following during the video.”

Rating Scale (Self-diminishment, Connection, Need for accommodation, Vastness, Personal control/responsibility, Other control/responsibility, Situational control/responsibility, Certainty, Self-awareness, Situational awareness, Valence, Emotions): 0 = *not at all*; 1 = *slightly*; 2 = *moderately*; 3 = *very*; 4 = *extremely*

Appraisals

Self-Diminishment.

I felt like my own issues and concerns do not matter that much.
I felt small.
I felt like my current concerns are important. [R]
I felt like what I accomplish in the world is impactful in the grand scheme of things. [R]

Connection.

I felt isolated. [R]
I felt alone. [R]
I felt connected.
I felt like I was a part of something.

Need for accommodation.

I found it difficult to fully understand the situation.
I felt my view of the world challenged.

Vastness.

I perceived the situation as physically/psychologically vast.
I perceived the situation as physically/psychologically significant.

Personal control/responsibility.

I felt that I had the ability to control the situation.
I felt responsible for having brought about the situation.

Other control/responsibility.

I felt that someone or something else was controlling the situation.
I felt that someone or something other than myself was responsible for having brought about the situation.

Situational control/responsibility.

I felt that the situation was directed by circumstances beyond anyone's control.
I felt that the situation was brought on by chance.

Certainty.

I felt certain of what was happening.
I felt I could predict what was going to happen.

Self-awareness.

I was keenly aware of myself.
I was conscious of my thoughts and feelings.

Situational awareness.

I was keenly aware of everything in the situation.
I was conscious of what was going on around me.

Valence

How **positive** was your experience watching the video?
How **negative** was your experience watching the video?

Emotions

To what extent did you feel each of these emotions?

Awe
Wonder
Amusement
Gratitude
Pride
Hope
Anxiety
Sadness
Boredom
Fear

Demographic Information

Age (in years): [open-ended response]

Which gender do you identify with the most?

- Female
- Male
- Non-binary
- I prefer a different description (specify): [open-ended response]
- I prefer not to self-identify

Are you of Hispanic origin?

- Yes
- No

Which of the following describe you? (Select all that apply)

- Alaskan Native/American Indian/Indigenous
- Black/African
- East Asian
- LatinX/Latiné
- Middle Eastern/North African
- Native Hawaiian/Pacific Islander
- South Asian/Southeast Asian
- White
- I describe myself in another way (specify): [open-ended response]
- I prefer not to report this information

Attention Checks

In order for our analyses to be valid, we need to know that our participants (1) followed the instructions (e.g., watching the full video), (2) made an effort to be careful and honest in their responding, and (3) were not distracted. If for any reason you believe your responses might not meet these criteria, please tell us so that we can delete your data from our records. This will not affect your subject pool credits; you will receive your credits regardless of your answer.

- I followed the instructions and was careful and attentive; you may keep my data.
- I did not follow the instructions / I was distracted; you should delete my data.

Appendix G: Eye-Tracking Sample Analyses and Tables, Experiment 2

Negative Emotion Ratings

The reliability analysis for the threat index yielded a McDonald's Omega of 0.82, so the anxiety and fear items were averaged together. The reliability analysis for the negative emotion index yielded a McDonald's Omega of 0.07, so boredom and sadness items were analyzed separately. The data reduction procedures support a single factor for a threat emotion index (*fear, anxiety*) but not for negative emotion index (*sadness, boredom*), so sadness and boredom items were analyzed separately.

For both sadness and boredom ratings versus threat index ratings, the analyses yielded significant main effects for emotion type, such that threat index ratings were greater than sadness and boredom ratings across conditions.

The ANOVA with self-significance (low, high) and connectedness (low, high) as fixed factors and threat index ratings as the dependent variable, did not yield any significant effects.

The regression model with self-reported significance and connection, and their interaction term as fixed effects did not yield any significant effects.

Table F1.

Results for Appraisals, Attentional Engagement, Cognitive Load (Experiment 2 - Eye-Tracking Sample)

	High Self-Significance		Low Self-Significance		Overall F	*p*
	High Connection	Low Connection	High Connection	Low Connection		
Vastness: I perceived the situation as physically/psychologically vast.	2.92 (0.95)	2.86 (1.29)	3.00 (1.28)	2.73 (1.42)	0.10	.96
Vastness: I perceived the situation as physically/psychologically significant.	2.77 (0.83)	2.71 (0.83)	3.17 (0.58)	2.73 (1.27)	0.71	.55
Need for accommodation: I found it difficult to fully understand the situation.	1.31 (1.18)	0.79 (0.98)	0.67 (0.65)	1.09 (1.22)	1.01	.40
Need for accommodation: I felt my view of the world challenged.	2.00 (1.53)	1.38 (1.19)	2.42 (1.44)	2.45 (1.51)	1.52	.22
Certainty	2.35 (0.88)	2.07 (1.14)	1.83 (0.65)	1.59 (0.83)	1.54	.22
Personal control/responsibility	1.46 (1.20)	1.14 (0.66)	1.38 (0.83)	1.73 (1.13)	0.77	.52
Situational control/responsibility: I felt that the situation was directed by circumstances beyond anyone's control.	1.46 (1.13)	1.93 (1.49)	2.08 (1.16)	2.82 (0.98)	2.50	.07
Situational control/responsibility: I felt that the situation was brought on by chance.	1.46 (1.20)	1.43 (0.94)	1.08 (0.90)	1.27 (1.42)	0.30	.83
Other control/responsibility	1.38 (1.10)	1.36 (0.86)	1.04 (0.78)	1.36 (1.40)	0.30	.83
Self-awareness	2.62 (0.98)	2.64 (0.82)	2.54 (0.75)	2.55 (1.21)	0.04	.99
Situational awareness	2.15 (1.03)	2.68 (0.93)	2.04 (0.96)	1.95 (0.96)	1.47	.24
Attentional engagement: Number of gaze fixations.	349 (51.0)	364 (54.8)	345 (79.6)	333 (59.0)	.53	.66
Attentional engagement: Average fixation duration (ms).	273 (88.5)	242 (63.2)	289 (118.0)	272 (93.2)	0.63	.60
Cognitive load: Blink rate.	7.17 (6.89)	8.79 (8.43)	9.04 (6.64)	14.0 (7.76)	1.78	.16
Total time spent attending to the distance AOI (sec)	6.11 (8.76)	1.98 (1.25)	5.39 (5.55)	4.20 (3.60)	1.44	.24

Note. Standard deviations are in parentheses. Appraisal scales are from 0 (*Not at all)* to 4 (*Extremely*). N = 50. For threat index N = 37.

Table F2.

ANOVA Table for Appraisals, Threat Index, Attentional Engagement, Cognitive Load (Experiment 2 - Eye-Tracking Sample)

Appraisal	Effect	df	*F*	*p*	η_p^2
Vastness: I perceived the situation as physically/psychologically vast.	Self-Significance	(1, 46)	0.01	.94	0.00
	Connectedness	(1, 46)	0.23	.63	0.01
	Interaction	(1, 46)	0.09	.77	0.00
Vastness: I perceived the situation as physically/psychologically significant.	Self-Significance	(1, 46)	0.65	.43	0.01
	Connectedness	(1, 46)	0.94	.34	0.02
	Interaction	(1, 46)	0.57	.45	0.01
Need for Accommodation: I found it difficult to fully understand the situation.	Self-Significance	(1, 46)	0.33	.57	0.01
	Connectedness	(1, 46)	0.03	.87	0.00
	Interaction	(1, 46)	2.62	.11	0.05
Need for Accommodation: I felt my view of the world challenged.	Self-Significance	(1, 45)	3.34	.07	0.07
	Connectedness	(1, 45)	0.50	.48	0.01
	Interaction	(1, 45)	0.65	.43	0.01
Certainty	Self-Significance	(1, 46)	3.73	.06	0.08
	Connectedness	(1, 46)	1.01	.32	0.02
	Interaction	(1, 46)	0.00	.95	0.00
Personal Control/Responsibility	Self-Significance	(1, 46)	0.82	.37	0.02
	Connectedness	(1, 46)	0.00	.95	0.00
	Interaction	(1, 46)	1.49	.23	0.03
Situational Control/Responsibility: I felt that the situation was directed by circumstances beyond anyone's control.	Self-Significance	(1, 46)	4.74	.035	0.09
	Connectedness	(1, 46)	3.00	.09	0.06
	Interaction	(1, 46)	0.15	.70	0.00
Situational Control/Responsibility: I felt that the situation was brought on by chance.	Self-Significance	(1, 46)	0.70	.41	0.02
	Connectedness	(1, 46)	0.06	.81	0.00
	Interaction	(1, 46)	0.12	.73	0.00
Other Control/Responsibility	Self-Significance	(1, 46)	0.32	.58	0.01
	Connectedness	(1, 46)	0.25	.62	0.01
	Interaction	(1, 46)	0.34	.56	0.01
Self-Awareness	Self-Significance	(1, 46)	0.10	.75	0.00
	Connectedness	(1, 46)	0.00	.95	0.00
	Interaction	(1, 46)	0.00	.97	0.00
Situational Awareness	Self-Significance	(1, 46)	2.30	.14	0.05
	Connectedness	(1, 46)	0.63	.43	0.01
	Interaction	(1, 46)	1.23	.27	0.03
Threat Index	Self-Significance	(1, 33)	0.61	.44	0.02
	Connectedness	(1, 33)	0.99	.33	0.03
	Interaction	(1, 33)	0.79	.38	0.02
Attentional Engagement: Number of gaze fixations	Self-Significance	(1, 46)	1.02	.32	0.02
	Connectedness	(1, 46)	0.00	.95	0.00
	Interaction	(1, 46)	0.55	.46	0.01
Attentional Engagement: Average fixation duration	Self-Significance	(1, 46)	0.82	.37	0.02
	Connectedness	(1, 46)	0.87	.36	0.02
	Interaction	(1, 46)	0.07	.79	0.00
Cognitive Load: Blink rate	Self-Significance	(1, 45)	2.75	.10	0.06
	Connectedness	(1, 45)	2.37	.13	0.05
	Interaction	(1, 45)	0.62	0.44	0.01

Note. N = 50. A sensitivity analysis with the same parameters as the online sample (except N = 50) suggested power to observe a partial eta-squared effect size of 0.18.

Table F3.

Results for Self-Significance Factors, Connectedness Factors, Valence, Emotions (Experiment 2 - Eye-Tracking Sample)

	High Self-Significance		Low Self-Significance				
	High Connection	Low Connection	High Connection	Low Connection	Overall F	*p*	n
Significance Factor	2.23 (1.03)	2.04 (1.03)	1.04 (0.45)	1.00 (0.89)	6.47	<.001	50
Insignificance Factor	1.65 (1.09)	1.71 (0.99)	2.42 (0.79)	2.18 (1.25)	1.58	.21	50
Connection Factor	2.65 (0.97)	2.61 (0.79)	2.46 (1.03)	1.82 (0.98)	1.96	.13	50
Isolation Factor	1.04 (1.01)	1.04 (1.08)	1.00 (0.74)	1.32 (1.38)	0.22	.88	50
Positive Valence	3.15 (0.99)	2.93 (1.00)	2.75 (0.97)	2.00 (1.10)	2.86	.047	50
Negative Valence	0.23 (0.60)	0.43 (0.51)	0.50 (0.67)	1.09 (1.04)	3.10	.036	50
Awe Index	3.20 (0.84)	3.04 (0.92)	2.79 (1.11)	3.33 (0.61)	0.44	.73	30
Positive Emotion Index	1.96 (1.21)	1.75 (1.00)	1.88 (0.93)	1.75 (0.72)	0.09	.97	37
Threat Index	1.17 (1.57)	1.21 (1.14)	1.13 (0.96)	1.86 (0.95)	0.72	.55	37
Sadness	0.33 (0.52)	1.17 (0.94)	0.67 (0.89)	1.00 (1.15)	1.34	.28	37
Boredom	0.00 (0.00)	0.25 (0.45)	0.33 (0.49)	0.57 (1.13)	0.96	.43	37

Note. Standard deviations are in parentheses. Scales are from 0 (*Not at all)* to 4 (*Extremely*).

Table F4.

ANOVA Table for Positive and Negative Valence Items (Experiment 2 - Eye-Tracking Sample)

Variable	Effect	df	*F*	*p*	η_p^2
Positive Valence	Main effect: Self-Significance	(1, 46)	5.23	.027	0.10
	Main effect: Connectedness	(1, 46)	1.93	.059	0.08
	Interaction	(1, 46)	0.93	.34	0.02
Negative Valence	Main effect: Self-Significance	(1, 46)	5.23	.027	0.10
	Main effect: Connectedness	(1, 46)	3.75	.059	0.08
	Interaction	(1, 46)	0.93	.34	0.02

Note. N = 50. A sensitivity analysis with the same parameters as the online sample (except N = 50) suggested power to observe a partial eta-squared effect size of 0.18.

Table F5.

Results from CFA on Self-Diminishment Items (Experiment 2 - Eye-Tracking Sample)

Item	Factor Loading	
	1	2
Factor 1: Significance		
I felt like my current concerns are important.	0.85	
I felt like what I accomplish in the world is impactful in the grand scheme of things.	0.81	
Factor 2: Insignificance		
I felt like my own issues and concerns do not matter that much.		0.65
I felt small.		0.64

Note. N = 50.

Table F6.

Results from CFA on Connection Items (Experiment 2 - Eye-Tracking Sample)

Item	Factor Loading	
	1	2
Factor 1: Connection		
I felt connected.	1.12	
I felt like I was a part of something.	0.63	
Factor 2: Isolation		
I felt isolated.		0.94
I felt alone.		0.90

Note. N = 50.

Table F7.

ANOVA Table for Manipulation Checks: Self-Diminishment and Connection (Experiment 2 - Eye-Tracking Sample)

Variable	Effect	df	*F*	*p*	η_p^2
Self-Diminishment					
Significance Factor	Main effect: Self-Significance	(1, 46)	19.20	<.001	0.29
	Main effect: Connectedness	(1, 46)	0.22	.64	0.01
	Interaction	(1, 46)	0.09	.76	0.002
Insignificance Factor	Main effect: Self-Significance	(1, 46)	4.35	.04	0.09
	Main effect: Connectedness	(1, 46)	0.09	.77	0.002
	Interaction	(1, 46)	0.25	.62	0.01
Connection					
Connection Factor	Main effect: Self-Significance	(1, 46)	3.40	.07	0.07
	Main effect: Connectedness	(1, 46)	1.66	.21	0.04
	Interaction	(1, 46)	1.24	.27	0.03
Isolation Factor	Main effect: Self-Significance	(1, 46)	0.16	.69	0.003
	Main effect: Connectedness	(1, 46)	0.27	.61	0.01
	Interaction	(1, 46)	0.28	.60	0.01

Note. N = 50.

Table F8.

Exploratory Factor Analysis of Positive Emotion Items (Experiment 2 - Eye-Tracking Sample)

	Factor	
	1	Uniqueness
1. Amusement	0.29	0.92
2. Gratitude	0.77	0.40
3. Pride	0.52	0.73
4. Hope	0.76	0.42

Note. 'Minimum residual' extraction method was used in combination with a "oblimin" rotation.

Table F9.

Results for the Linear Mixed Model for Awe Ratings versus the Positive Emotion Index (Experiment 2 - Eye-Tracking Sample)

Effect	df	*F*	*p*
Self-Significance	(1, 37)	0.29	.60
Connectedness	(1, 37)	0.00	.98
Emotion Type	(1, 37)	27.41	<.001
Connectedness*Self-Significance	(1, 37)	0.01	.92
Connectedness*Emotion Type	(1, 37)	0.57	.46
Self-Significance*Emotion Type	(1, 37)	0.72	.40
Connectedness*Self-Significance*Emotion Type	(1, 37)	0.10	.75

Note . The mixed model was conducted with self-significance, connectedness, and emotion type (awe, positive emotion index) as fixed factors, rating as the dependent variable, and participant ID as a random intercept. Satterthwaite method for degrees of freedom.

Table F10.

Results for the Linear Mixed Model for Wonder Ratings versus the Positive Emotion Index (Experiment 2 - Eye-Tracking Sample)

Effect	df	*F*	*p*
Self-Significance	(1, 33.1)	0.23	.63
Connectedness	(1, 33.1)	0.01	.94
Emotion Type	(1, 29.6)	68.66	<.001
Connectedness*Self-Significance	(1, 33.1)	1.48	.23
Connectedness*Emotion Type	(1, 29.6)	0.70	.41
Self-Significance*Emotion Type	(1, 29.6)	0.23	.63
Connectedness*Self-Significance*Emotion Type	(1, 29.6)	2.48	.13

Note . The mixed model was conducted with self-significance, connectedness, and emotion type (wonder, positive emotion index) as fixed factors, rating as the dependent variable, and participant ID as a random intercept. Satterthwaite method for degrees of freedom.

Table F11.

Results for the Linear Mixed Model for the Threat Index versus Sadness Ratings (Experiment 2 - Online Sample)

Effect	df	*F*	*p*
Self-Significance	(1, 37)	0.42	.52
Connectedness	(1, 37)	2.63	.11
Emotion Type	(1, 37)	13.24	<.001
Connectedness*Self-Significance	(1, 37)	0.03	.87
Connectedness*Emotion Type	(1, 37)	0.43	.52
Self-Significance*Emotion Type	(1, 37)	0.54	.47
Connectedness*Self-Significance*Emotion Type	(1, 37)	3.91	.06

Note. The mixed model was conducted with self-significance, connectedness, and emotion type (threat index, sadness) as fixed factors, rating as the dependent variable, and participant ID as a random intercept. Satterthwaite method for degrees of freedom.

Table F12.

Results for the Linear Mixed Model for the Threat Index versus Boredom Ratings (Experiment 2 - Eye-Tracking Sample)

Effect	df	*F*	*p*
Self-Significance	(1, 37)	2.08	.16
Connectedness	(1, 37)	2.08	.16
Emotion Type	(1, 37)	27.60	<.001
Connectedness*Self-Significance	(1, 37)	0.60	.44
Connectedness*Emotion Type	(1, 37)	0.13	.72
Self-Significance*Emotion Type	(1, 37)	0.00	.95
Connectedness*Self-Significance*Emotion Type	(1, 37)	0.77	.39

Note. The mixed model was conducted with self-significance, connectedness, and emotion type (threat index, boredom) as fixed factors, rating as the dependent variable, and participant ID as a random intercept. Satterthwaite method for degrees of freedom.

Table F13.

Reliability for Appraisals (Experiment 2 - Eye-Tracking Sample)

Variable	ω	*r*
Vastness	0.51	0.34
Need for Accommodation	0.49	0.32
Certainty	0.52	0.35
Personal Control/Responsibility	0.52	0.35
Situational Control/Responsibility	0.15	0.08
Other Control/Responsibility	0.74	0.58
Self-Awareness	0.74	0.59
Situational Awareness	0.64	0.47

Note. N = 50. ω = McDonald's Omega. *r* = Pearon's correlation.

Regression Analyses Tables

Table F14.

Regression Table for Appraisals, Threat Index, Attentional Engagement, Cognitive Load (Experiment 2 - Eye-Tracking Sample)

Appraisal	R^2	Effect	Estimate	Std. Error	*t*	*p*
Vastness: I perceived the situation as physically/psychologically vast.	0.16	Significance	–0.22	0.43	–0.52	.61
		Connection	0.51	0.30	1.73	.09
		Interaction	0.02	0.16	0.16	.88
Vastness: I perceived the situation as physically/psychologically significant.	0.13	Significance	–0.60	0.33	–1.84	.07
		Connection	0.00	0.22	0.01	.99
		Interaction	0.20	0.12	1.66	.10
Need for Accommodation: I found it difficult to fully understand the situation.	0.13	Significance	–0.24	0.38	–0.64	.53
		Connection	–0.58	0.26	–2.26	.029
		Interaction	0.13	0.14	0.97	.34
Need for Accommodation: I felt my view of the world challenged.	0.06	Significance	–0.19	0.56	–0.34	.74
		Connection	0.01	0.38	0.02	.99
		Interaction	–0.04	0.20	–0.22	.83
Certainty	0.09	Significance	–0.30	0.34	–0.86	.40
		Connection	0.03	0.24	0.15	.88
		Interaction	0.13	0.13	1.04	.30
Personal Control/Responsibility	0.09	Significance	–0.52	0.36	–1.44	.16
		Connection	–0.08	0.24	–0.31	.76
		Interaction	0.20	0.13	1.56	.13
Situational Control/Responsibility: I felt that the situation was directed by circumstances beyond anyone's control.	0.07	Significance	–0.05	0.48	–0.11	.91
		Connection	–0.20	0.33	–0.59	.56
		Interaction	–0.03	0.18	–0.20	.85
Situational Control/Responsibility: I felt that the situation was brought on by chance.	0.04	Significance	–0.46	0.42	–1.11	.27
		Connection	–0.37	0.29	–1.30	.20
		Interaction	0.21	0.15	1.39	.17
Other Control/Responsibility	0.01	Significance	–0.23	0.40	–0.57	.57
		Connection	–0.04	0.27	–0.14	.89
		Interaction	0.08	0.15	0.57	.57
Self-Awareness	0.16	Significance	0.03	0.33	0.08	.94
		Connection	0.35	0.23	1.56	0.13
		Interaction	0.01	0.12	0.05	.96
Situational Awareness	0.06	Significance	0.14	0.37	0.37	.71
		Connection	0.31	0.26	1.22	.23
		Interaction	–0.05	0.14	–0.35	.73
Threat Index	0.18	Significance	–1.02	0.58	–1.75	.09
		Connection	–0.51	0.35	–1.45	.16
		Interaction	0.24	0.20	1.19	.24
Attentional engagement: Number of gaze fixations.	0.11	Significance	5.95	22.40	0.27	.79
		Connection	20.31	15.29	1.33	.19
		Interaction	–0.93	8.14	–0.12	.91
Attentional engagement: Average fixation duration (ms).	0.06	Significance	10.16	34.30	0.30	.77
		Connection	–16.39	23.40	–0.70	.49
		Interaction	–4.24	12.50	–0.34	.74
Cognitive load: Blink rate.	0.25	Significance	3.28	2.65	1.24	.22
		Connection	–2.73	1.82	–1.50	.14
		Interaction	–0.97	0.96	–1.02	.32

Note . N = 50.

Table F15.

Regression Table for Positive and Negative Valence Items (Experiment 2 - Eye-Tracking Sample)

Variable	R^2	Effect	Estimate	Std. Error	*t*	*p*
Positive Valence	0.34	Significance	0.18	0.34	0.53	.60
		Connection	0.66	0.23	2.85	.006
		Significance*Connection	–0.04	0.12	–0.32	.75
Negative Valence	0.26	Significance	–0.45	0.26	–1.77	.08
		Connection	–0.43	0.17	–2.48	.017
		Significance*Connection	0.11	0.09	1.22	.23

Note . N = 50.

Table F16.

Correlations Between Total Time Spent Attending to AOI and Dependent Measures *(Experiment 2 - Eye-Tracking Sample)*

	Total Time Spent Attending to Distance AOI	
	r	df
Connection Composite	–0.04	48
Isolation Composite	0.08	48
Significance Composite	–0.05	48
Insignificance Composite	0.17	48
Awe Index	–0.37*	28
Threat Index	–0.15	35
Positive Valence	–0.003	48
Negative Valence	–0.16	48
Vastness: I perceived the situation as physically/psychologically vast.	–0.12	48
Vastness: I perceived the situation as physically/psychologically significant.	0.21	48
Need for accommodation: I found it difficult to fully understand the situation.	–0.12	48
Need for accommodation: I felt my view of the world challenged.	–0.06	47
Certainty	0.14	48
Personal control/responsibility	0.09	48
Situational control/responsibility: I felt that the situation was directed by circumstances beyond anyone's control.	–0.13	48
Situational control/responsibility: I felt that the situation was brought on by chance.	–0.06	48
Other control/responsibility	–0.24	48
Self-awareness	0.19	48
Situational awareness	0.14	48
Attentional engagement: Number of gaze fixations.	–0.16	48
Attentional engagement: Average fixation duration (ms).	0.18	48
Cognitive load: Blink rate.	–0.11	47

Note. * $p < .05$.