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Fostering Awe to Enhance Public Well-Being: Proposed Interventions for a Nature and Science Museum Setting

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Abstract

Several scholars consider awe to be a universally experienced emotion that is associated with a variety of well-being outcomes. In the last two decades, research has revealed the many complicated, and often beneficial, effects of this self-transcendent emotion. In this paper, a review of the current theoretical and empirical understanding of awe is first discussed. This review is meant to provide context for the next section and primary aim of this paper, which is to propose a pilot study for implementing and evaluating awe-inducing interventions in a museum setting. The primary research question of this proposed pilot study is to determine if the proposed interventions are indeed effective at increasing feelings of awe for visitors of the museum. The anticipated outcomes of the proposed pilot study, limitations of the study, and directions for further research are also discussed.

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Fostering Awe to Enhance Public Well-Being: Proposed Interventions for a Nature and Science Museum Setting

Several scholars consider awe to be a universally experienced emotion that is associated with a variety of well-being outcomes (Bai et al., 2017; Keltner, 2023). In the last two decades, research has revealed the many complicated, and often beneficial, effects of this self-transcendent emotion. In this paper, a review of the current theoretical and empirical understanding of awe is first discussed. This review is meant to provide context for the next section and primary aim of this paper, which is to propose a pilot study for implementing and evaluating awe-inducing interventions in a museum setting. The primary research question of this proposed pilot study is to determine if the proposed interventions are indeed effective at increasing feelings of awe for visitors of the museum. The anticipated outcomes of the proposed pilot study, limitations of the study, and directions for further research are also discussed.

Awe

Awe is a complex emotion (Gordon et al., 2017) that has long been a focus of attention in the fields of sociology, religion, philosophy, and psychology alike (Keltner & Haidt, 2003). Keltner and Haidt (2003) more recently proposed a way of defining a prototypical experience of awe that is widely used and discussed in research. They posit that awe involves two cognitive appraisals: the perception of *vastness* and the need for *accommodation* (Ihm et al., 2019; Keltner & Haidt, 2003).

Vastness in the case of awe refers to a stimulus that dramatically expands an individual's accustomed frame of reference in some dimension or domain (Shiota et al., 2007). While vastness may, and often does, refer to physical size (e.g., a grand vista; a singer's voice bouncing around a colossal stadium), an awe-inducing stimulus can also be vast in other dimensions such

as time (e.g., the age of Earth), number (e.g., the number of atoms that make up a human being; being surrounded by thousands of people at a concert or sports event), sensory detail (e.g., an awe-inspiring piece of music), social importance (e.g., seeing a celebrity or learning of a historical figure who impacted many lives and events in human history), power (e.g., an imposing government building that implies power and threat; religious experiences like encountering or seeing the power of divinity), moral beauty (e.g., seeing another person's capacity for courage, kindness, or strength); a "volume of unexpected information" (e.g., a drop of pond water in a microscope that "contains an elaborate and detailed world of its own"), and more (Keltner & Haidt, 2003; Keltner, 2023; Shiota et al., 2007; Shiota et al., 2014, p. 363).

In the context of awe, accommodation refers to the Piagetian process of adjusting mental structures when encountering information that does not fit one's extant knowledge or internal mental frameworks (Keltner & Haidt, 2003). Piaget & Inhelder (1969) proposed that the process of accommodation occurs when one cannot easily assimilate a new experience and thus feels a need to revise one's beliefs (Ihm et al., 2019; Keltner & Haidt, 2003). While other emotions, like admiration, are considered a part of the "awe family" because they involve either perceived vastness or accommodation, awe is unique in that it involves both (Keltner & Haidt, 2003, p. 309). While it is often described as a subjectively positive, transcendent, or exhilarating experience, awe can also be felt in the presence of stimuli that elicit terror, threat, or helplessness, like a natural disaster, war, or a wrathful god; in these instances, awe takes on a negative valence (Gordon et al., 2017). Different stimuli elicit what Keltner & Haidt (2003) refer to as different "flavors" (p. 304) of awe that alter the emotional experience. These experiences of awe can be felt in both grand and lifechanging, transformative moments as well as smaller day-to-day moments (Chen & Mongrain, 2020).

Keltner and Haidt (2003) identified three categories of stimuli that elicit awe: physical, social, and cognitive. Experiences in nature, like looking at a sky full of stars or towering trees in a forest, are common physical sources of awe, particularly in Western cultures (Chen & Mongrain, 2020; Davis & Gatersleben, 2013; Keltner & Haidt, 2003; Shiota et al., 2014; Piff et al., 2015; Williams & Harvey, 2001). Collective social events (e.g., a concert, political rally, sporting event) and religious and spiritual experiences are common social sources of awe (Bai et al., 2017; Keltner & Haidt, 2003). Cognitive elicitors are conceptually vast concepts – people can feel awe from realizing the breadth and scope of a grand theory, like evolution, feminism, or a theory of physics (Keltner & Haidt, 2003; Shiota et al., 2014). Awe can also arise from contemplating concepts such as eternity or the complexity and fragility of life on one remote planet among the vastness of space (Yaden et al., 2016). Though the sources of awe are varied, elicitors are typically information-rich stimuli (Chen & Mongrain, 2020; Shiota et al., 2007).

Alternatively, based on in-depth, qualitative interviews, Schneider (2009) identified different "lenses" individuals use to cultivate a lifelong, enduring sense of awe. These lenses include:

> (a) an acute awareness of the passing nature of time; (b) the attunement to wonder and surprise; (c) the realization of a cosmic context to everyday experiences; (d) the perception of the intricacy and subtleties of life; (e) the experience of being deeply, emotionally moved; and (f) the appreciation for solitude. (Schneider, 2017; p. 105)

Schneider (2017) also contended that most of the methodologies for studying awe rely on quantitative measurement of discrete, momentary behavioral states and therefore miss the more complex, long-term experiences and effects of awe. Schneider argued that a more balanced combination of both quantitative and qualitative methodologies is needed to better understand

the complexity of awe and the enduring effects of awe beyond just narrow measurements of awe following brief exposures to awe inducing stimuli.

How Culture and Individual Differences Shape the Experience of Awe

Individual differences impact the effect that awe-inducing stimuli have on a person. Openness to experience is a personality dimension that is positively associated with the dispositional tendency to feel awe (Chen & Mongrain, 2020; Shiota et al., 2006). In one study in which participants were exposed to awe-inspiring images and music, those who scored higher in openness to experience reported greater feelings of awe (Silvia et al., 2015). Chen and Mongrain (2020) also posit that the trait "absorption"—the capacity to attend to stimuli—is an important facilitator of awe because awe occurs when one is able to pay attention to information-rich stimuli. Indeed, in one study, participants with higher trait absorption reported stronger feelings of awe relative to those who scored lower on trait absorption (Van Elk et al., 2016). Some individuals also appear more disposed to feeling awe in general. These individuals are considered to have dispositional awe, and those who score higher on dispositional awe also tend to experience awe more regularly (Chen & Mongrain, 2020; Li et al., 2019). Religiosity and spirituality, too, appear to mediate the experience of awe (Van Cappellen & Saroglou, 2012).

In addition to individual differences, how, when, and why one experiences awe is also shaped by culture (Bai et al., 2017; Keltner, 2023). For example, in a study that asked United States and Japanese participants to recall moments of awe and rate the valence of the emotion they felt, Nakayama et al. (2020) found that participants in the United States were more predisposed to feel positive aspects of awe compared to Japanese participants. Further, dispositional positive awe and negative awe were correlated for Japanese participants but independent for United States participants, suggesting that awe was more of a mixed emotion for

Japanese participants but not for participants in the United States (Nakayama et al., 2020). The authors note how culture's influence on emotions—specifically research that indicates that East Asian individuals experience emotions more dialectically and that North Americans have a positively bias—similarly impacts the experience of awe (Nakayama et al., 2020).

Razavi et al. (2016) also explored cultural differences in the experience of awe, finding that participants from the United States, Iran, Malaysia, and Poland all appeared to value and experience awe. The researchers also found considerable differences in the frequency that participants from different cultures experience awe, with participants in the United States reporting the highest mean dispositional awe (Razavi et al., 2016). However, this study used the Dispositional Positive Emotions Scale (DPES) awe subscale, which focuses only on positive aspects of awe (Nakayama et al., 2020), leaving room to wonder if this study's results are truly accurate if it did not measure negatively-valanced awe.

Bai et al. (2017) also observed cultural differences in the elicitors and experiences of awe, finding that awe was more frequently caused by personal actions in the United States compared to China and more by socially engaging events for participants in China compared to participants in the United States. Bai et al. (2017) note that collectivist versus individualistic cultures experience variations in awe experiences that may be explained by the interaction between culture and specific elicitors. Nakayama et al. (2020) also posit that, because East Asian individuals from collectivist cultures prefer socially-engaging emotions and evaluate emotions based on how socially-engaging they are (Kitayama et al., 2006), socially oriented awe experiences may be more important than other types of awe for individuals in East Asian cultures. Several authors (Bai et al., 2017; Guan et al., 2019; Nakayama et al., 2020) note that significantly more cross-cultural studies are needed to understand the nuanced effects that culture

has on the experience of awe. Indeed, many studies about awe feature participants from Western cultures (Nakayama et al., 2020). However, based on cross-cultural studies thus far, research has shown that positive effects of awe are able to be experienced by individuals from a variety of cultures (Bai et al., 2017; Dong & Ni, 2019; Nakayama et al., 2020; Yang et al., 2016). The experience of awe thus appears to be universal, though its valence, magnitude, and elicitors vary based on cultural contexts (Bai et al., 2017; Nakayama et al., 2020).

Effects of Awe on Physical and Mental Health

Awe has been shown to predict both well-being and life satisfaction in naturalistic and experimentally induced awe studies (Anderson et al., 2018; Dong & Ni, 2019; Rudd et al., 2012). Anderson et al. (2018) found that the amount of awe experienced by veterans and youth on a white-water rafting trip predicted positive improvements in well-being and stress-related symptoms observed one week later. Additionally, Gordon et al. (2017) found that self-reported well-being was rated higher on days when participants experienced non-threat based awe. Prototypical, positive awe experiences also elicit other positive emotions, such as love, compassion, wonder, optimism, and gratitude (Keltner, 2023; Nelson-Coffey et al., 2019). Taken together, these studies suggest that positive awe experiences, particularly those experienced in nature, can play a role in increasing an individual's well-being and life satisfaction (Allen, 2018; Anderson et al., 2018). Monroy and Keltner (2022) argue that awe engages five distinct processes that benefit well-being. Specifically, they note that awe a) results in shifts in neurophysiology that are known to be associated with enhanced mental health, b) reduces focus on the self and attenuates mental health struggles (e.g., depression; anxiety) and social problems that are associated with amplified self-focus, c) is a pathway to enhanced prosocial relationships

that enhance well-being, d) enhances the sense of being integrated into strong social networks, and e) elevates an individual's sense of meaning in life (Monroy & Keltner, 2022).

Physiological Effects of Awe

Experiences of awe are associated with physical changes in the body. Shiota et al. (2003) found that prototypical awe experiences elicit a unique facial expression that most frequently included raised inner eyebrows, widened eyes, and a slightly open, drop-jawed mouth. Other possible physical reactions include forming tears, feeling chilled (e.g., experiencing "goose bumps"), and expressing vocal bursts such as "whoa" or "aaah" (Keltner, 2023). Prototypical awe experiences are also associated with immobility (physically freezing in place) and changes in the nervous system (Averchi, 2017; Shiota et al., 2011). How the nervous system changes appears to be dependent on the flavor of awe experienced. Gordon et al. (2017) found that the experience of threat-based awe was associated with activation of the sympathetic nervous system, the system associated with the physical symptoms of "fight or flight" in the body. On the other hand, the authors found that exposure to positive awe stimuli was associated with activation of the parasympathetic nervous system, the physiological system typically activated during social connection and calm states (Gordon et al., 2017). Dispositional awe—to a greater extent than any other positive emotion—is negatively correlated with levels of inflammation in the body, indicating awe may have positive effects on physical health (Stellar et al., 2015). The study showing this link was correlational in nature, though the authors hypothesized that feelings of awe may reduce inflammation by promoting the desire to explore and enhancing feelings of connectedness to others (Stellar et al., 2015).

Psychological and Behavioral Effects of Awe

Beyond just physiological impacts, awe experiences produce behavioral and psychological changes as well. Awe is a complex emotion that can be both positively and negatively valanced and thus feel subjectively positive or negative—or both—depending on the context (Keltner & Haidt, 2003). In one study, a prototypical awe-inducing experience significantly raised levels of awe and other positive emotions, though there were also lesser but significant elevations in feelings of fear and disgust (Nelson-Coffey et al., 2019). In response to threat-based awe (e.g., a video of a tornado forming with ominous music), participants in another study experienced feelings of powerlessness and fear (Gordon et al., 2017). However, in the context of positive awe-inducing stimuli, research has generally revealed many positive effects of awe (Chen & Mongrain, 2020; Gordon et al., 2017).

Reduced Self-Focus. Awe has also been classified by some as a self-transcendent emotion (Stellar et al., 2017). These are emotions felt during experiences in which one transcends their own motivations and needs to focus on those of others; these experiences typically lead to feelings of connectedness— or even a sense of oneness—with something other than oneself (Stellar et al., 2017; Yaden et al., 2017). Awe has indeed been shown to diminish one's sense of self, resulting in what researchers refer to as the "small self" (Bai et al. 2017). The awe-induced small self seems to prompt individuals to identify more universally, shifting behaviors to assume more collective identities, orient themselves to the interest of others, and engage in more collaboration (Bai et al., 2017; Shiota et al., 2014). This integration of the individual into the collective appears to be an effect of awe for individuals from both collectivist and individualistic cultures (Bai et al., 2017). Further, while the feeling of a small self usually refers to a conceptual shift of an understanding of the self, one study found that feelings of awe predicted literal changes in body size estimates (van Elk et al., 2016). Ultimately, the small self is

typically defined as a positive experience that "puts an individual into a larger context and points them to the grand scheme of existence" (Chen & Mongrain, 2020, p. 772). Indeed, Bai et al. (2017) found that feelings of the small self did not dimmish self-esteem.

Prosocial Attitudes and Behaviors. Several studies have demonstrated the link between awe and humility. In one study, awe-prone individuals were rated as humbler by friends and reported greater humility, even when controlling for other emotions (Stellar et al., 2018). The authors also found that feelings of awe led participants to present a more balanced view of their strengths and weaknesses and to report feeling humbler relative to neutral conditions (Stellar et al., 2018). Other studies have demonstrated that inducing positive awe leads to decreased feelings of entitlement (Piff et al., 2015), reduced conviction of beliefs, and increased tolerance of those with differing opinions (Stancato & Keltner, 2021).

Consistent with the research that shows that awe results in the small self and greater humility, research indicates that awe increases altruistic and prosocial behaviors (Chen & Mongrain, 2020; Li et al., 2019; Rudd et al., 2012; Yaden et al., 2017). Piff et al. (2015) found that dispositional awe was correlated with prosocial behaviors, and that experientially inducing awe led participants to be more generous to strangers, report more prosocial values, and make more ethical decisions. Further, awe decreases aggression and increases prosocial behaviors such as the willingness to volunteer and help others (Rudd et al., 2012; Yang et al., 2016). Rudd et al. (2012) found that awe changed participants' perception of time, showing that awe, relative to both happiness and a neutral state, increased the perception that time is plentiful and reduced impatience. The authors posited that this change in the perception of time led participants to feel they had more time to give, which resulted in an increased willingness to spend some of that time supporting other people (Allen, 2018; Rudd et al., 2012).

Critical Thinking Skills. Emerging research suggests that awe also impacts critical thinking skills and scientific thinking. For example, one study found that experientially induced feelings of positive awe led participants to be more skeptical of weak arguments, which was a direct contrast to some positive emotions, like amusement, that actually led participants to be more easily persuaded by weak arguments (Griskevicius et al., 2010). Other research has demonstrated a relationship between awe and scientific thinking: one study found a positive correlation between dispositional awe and a more accurate understanding of nature and science (Gottlieb et al., 2018). Some have suggested that the expectation-violating experiences of awe drive individuals to feel dissatisfied with their understanding of the world and thus elicit greater interest in learning new scientific theories (Cuzzolino, 2021; Valdesolo et al., 2017). Others note that more research is needed to further elucidate what drives the complex relationship between awe and critical and scientific thinking (Allen, 2018; Gottlieb et al., 2018).

Meaning In Life. Having a sense of meaning in life correlated with both physical and mental health outcomes that promote general thriving and well-being (García-Alandete, 2015; Heintzelman & King, 2014; Roepke et al., 2013), and recent research has begun to demonstrate the complex effects that awe has on meaning in life (Dai et al., 2022). One particular source of meaning in life is having a sense of significance (Martela & Steger, 2016). Stellar (2021) argues that awe "toes the line carefully" (p. 82) by leading people to feel small, insignificant, and lacking control in a way that is not threatening. Stellar (2021) argues that awe does this by reducing the awareness of the self as a distinct, separate entity while also promoting feelings of connectivity, thus making feelings of insignificance feel less threatening. Though individual significance may diminish while experiencing awe, a higher-level of meaning in life may be found through the feelings of connectivity or perhaps even oneness that is experienced in feeling

connected to something larger than oneself (Bai et al., 2017; Li, 2019; Stellar, 2021; Yaden et al., 2016). This level of meaning obtained through self-transcendence can be profound, and Frankl (1984), along with others (e.g., Maslow, 1971; Reed, 2008), described it as an ultimate meaning in life:

> … the true meaning of life is to be discovered in the world rather than in man or his own psyche… The more one forgets himself—by giving himself to a cause to serve or another person to love—the more human he is and the more he actualizes himself. (p. 133)

William James (1908), one the first psychologists to formally study awe, similarly observed: "… we can experience union with something larger than ourselves and in that union find our greatest peace" (p. 525). Schneider (2017) even suggests that awe may be not just an emotion but also a shift in attitude (Chen & Mongrain, 2020), describing awe as an "ongoing appreciation for life in all its vicissitudes" (p. 105). Ultimately, awe fosters humility, connection, gratitude, self-transcendence, acknowledgement of one's limitations and uniqueness, and acceptance of life's gains and losses, all of which are attitudes and awareness of life, self, and other that can be inherently meaningful in their own right (Dai et al., 2022; Li et al., 2019; Piff et al., 2016; Vos, 2022).

Psychological Interventions in a Public, Community Setting

Knowledge from the field of psychology cannot be used to its full potential if it is only given out in formal clinical and medical settings. According to the principles of community psychology, preventative interventions aimed at improving well-being of an individual *before* they seek or need mental health treatment is far more effective than providing treatment to an individual only after a certain level of dysfunction has been reached (Felner et al., 2000). Additionally, reserving psychological knowledge only for those who seek clinical services means

that potentially beneficial information does not reach the many who cannot or do not seek services because of stigma, cost, lack of accessibility, and other barriers. Thus, providing psychological education and interventions in public settings can promote greater communal well-being by improving the functioning of those who may otherwise not be exposed to this information.

Museums are one type of public setting that are increasingly expanding their roles in community health and wellbeing (Dodd & Jones, 2014; Green, 2019). Wellbeing initiatives—ranging from art-therapy programs, outreach programs, community art displays, structured visits for specific populations, health promotion and education programs, and therapeutic interventions implemented in museum settings—are utilized by museums across the globe to promote both individual and communal thriving (Dodd & Jones, 2014; Green, 2019; Hamil, 2016; Morse et al., 2016; Salom, 2008). Camic and Chatterjee (2013) identified a variety of positive outcomes that engaging with museums appears to provide, including positive social experiences, opportunities for learning and acquiring news skills, increased positive emotions, increased sense of identity, and increased opportunities to engage in meaningful pursuits (Chatterjee & Camic, 2015; Green, 2019). Similarly, Silverman (2010) listed ways that museums promote an individual's pursuit of health, including promoting relaxation and introspection. In addition, Silverman (2010) noted that museums often foster knowledge, understanding, and behaviors that can help individuals better care for themselves and can further mobilize positive public health behaviors through raising public awareness of key health issues and promoting relevant prevention behavior.

The therapeutic role of the physical space of the museum is also a growing area of research (Green, 2019). Salom (2008) identified several therapeutic potentials of a museum visit, noting how the architecture and design of a museum itself can allow for a sense of safety in

which profound emotional experiences and introspection can occur. Further, Salom (2008) proposed that the unique, varied information presented in museums may promote appreciation and tolerance of the differences of others, feeling connected to the universal human experience, and experiencing the museum in a mindful, present-oriented manner. As Ioannides (2016) reflected, being in a museum,

> … surrounded by artworks and objects—away from the austerity of the hospital, the stigma of the mental health clinic, machines and white coats—makes people feel that they are in a more hospitable and friendly environment, which can lead to inspiration. (p. 102)

These benefits are also extended to all members of the community, and museums specifically seek to engage with groups with accessibility needs and/or minoritized status (Silverman, 2010). As noted by Silverman (2010), "museums are exploring ways they can assist people at risk for social and economic deprivation and oppression to adjust and to thrive in the face of challenging social circumstances" (p. 34). Just as they promote changes in public health, museums can educate and empower communities to recognize and change social inequities, presenting issues in a communally-minded way as not belonging to just subgroups of visitors that experience inequity and risk but as a shared social problem (Silverman, 2010).

Museums and Awe

The unique, therapeutic attributes of museums allow them to be potentially profound facilitators of experiences of awe. As noted by Salom (2008) and Silverman (2010), the atmosphere of a museum itself tends to be one that encourages mindfulness and focus, qualities that may allow for visitors to be more easily absorbed in their experiences. Museums are made up of informationally-rich stimuli that tend to be the kind of stimuli that elicits awe (Shiota et al.,

2007). Information learned or experienced at museums is also often new or surprising (Price et al., 2021). Chen and Mongrain (2020) posit that absorption is a key element of awe, and thus the atmosphere of a museum, in addition to the information-rich, vast, and novel stimuli it contains, is primed to elicit awe. Indeed, Price et al. (2021) found that feelings of awe are felt at museums of various kinds, with positive aspects of awe (specifically, feelings of connectivity and feelings of a diminished self) being the most reported facets of awe. However, positive awe is not the only type of awe felt; research indicates that museum exhibits elicit different flavors of awe (i.e., positively versus negatively valanced awe) based on the features of each exhibit (Krogh-Jespersen et al., 2020).

Nature and science museums in particular have the potential to stimulate awe through a variety of cognitive, visual, and interactive stimuli because they contain many of the main sources of awe identified by Keltner (2023), including nature, moral beauty, visual design, and epiphany. Nature is the most obvious source of awe in a nature and science museum, with no shortage of videos, photos, planetariums, replicas, and spaces, like a greenhouse, that expose visitors to the beauties and complexities of the universe. Even the visual design of a science museum, like a large atrium or rotunda, has been shown to increase feelings of small-self and other positive awe-related emotions (Krogh-Jespersen et al., 2020). Cognitive elicitors presented in nature and science museums, from scientific theories to facts about the species of the world, are also abundant and have the potential to produce awe-inspiring epiphanies. Information about the deeds or works of scientists or past civilizations may serve as examples of awe-inspiring moral beauty to some visitors. Interaction with science can also lead to changes in worldview, including an awareness of one's location among the vastness of the cosmos and appreciation for the subtleties of life; according to Schneider (2017), these perspectives can facilitate feelings of

ongoing awe. Indeed, in a qualitative study of professional scientists' experiences of awe, Cuzzolino (2021) found that scientists regularly experience awe in their work. Further, many participants reported that awe contributed to shifts in perspective, including increased humility and a greater appreciation for the complexities of the universe (Cuzzolino, 2021).

Designing Awe Interventions for a Nature and Science Museum

As noted above, interventions aimed to facilitate awe appear appropriate for a nature and science museum. Awe is considered by many to be a universally experienced emotion (Keltner, 2023) and thus a relevant emotional target for an institution that receives visitors from a variety of cultural backgrounds. There are also many benefits to experiencing awe, and facilitating awe in a museum may not only enhance a visitor's experiences in the moment but can also be used to encourage visitors to seek awe in their lives to promote ongoing wellbeing. This positive impact effects not just an individual but a community as a whole, as increased feelings of awe and self-transcendence have been shown to elicit greater prosocial behaviors and reduced aggression and prejudice towards others (Rudd et al., 2012; Yang et al., 2016).

In the following section, three interventions for inducing feelings of awe in a nature and science museum are discussed. First, the theoretical and empirical underpinnings for the design of the interventions are reviewed, followed by a detailed description of each intervention. Next, a proposed pilot study with a methodology for testing the effectiveness of the interventions is discussed. Finally, anticipated outcomes, limitations, and directions for future work are all considered.

The proposed interventions are designed to be integrated throughout various locations and exhibits in a museum of nature and science. While going through the visitor entrance station or ticket-purchase counter, a visitor would be informed of new experiential activities that have

been added to the museum called “Opportunities for Awe.” Interested visitors would receive a pamphlet to orient them to these activities. This pamphlet would be offered in multiple languages. Additionally, a QR code would be available so that visitors could access the pamphlet on their smart phones and have it read to them.

In this pamphlet, a visitor would briefly be introduced to the concept of awe and the benefits of experiencing awe in language targeted towards adult visitors. They would learn that “Opportunities for Awe” are guided activities that have been placed around the museum for them to connect with and reflect on the feeling of awe. Importantly, visitors would be informed that awe is a highly individual experience, and that they are encouraged to engage in activities that call to them and to skip activities that don’t feel meaningful. Each awe intervention would be marked on a map in the pamphlet and further identified by a large, physical icon in the museum. Each intervention would be numbered, and the pamphlet would include instructions for each activity. At the end of the pamphlet, additional resources would be provided, included recommended readings and websites one could visit to learn more about awe.

Bases for the Design of the Interventions

Most theoretical and empirical research in awe supports the idea that is no universal awe-eliciting stimulus – what fills one with awe is based on each person’s past experiences and the cultural contexts they grew up in (Bai et al., 2017; Luna & Bering, 2021). Silva and Luna (2019) point out that while learning about a scientific theory may leave some visitors with a sense of awe, others, particularly those not immersed in cultural systems that surround or value science communication, may primarily experience negatively valanced emotions such as anger, anxiety, or boredom. Therefore, the interventions in this study are designed to be flexible so that visitors with varying cultural beliefs and experiences with science can find their own way of

experiencing awe. Specifically, each intervention attempts to give visitors multiple stimuli to choose from, or in the case of intervention 3, relies on a visitor-chosen memory from their own lives. Additionally, an awe-informed museum would contain many opportunities for multiple awe-based experiences across many exhibits, allowing visitors to choose or avoid certain interventions based on their interests and comfort.

Awe research has also revealed that people experience awe differently, with some experiencing more awe than others (Chen & Mongrain, 2020; Li et al., 2019). In a nature and science museum, it seems that a greater familiarity with the information presented in exhibits predicts greater levels of awe (Price et al., 2021). The goal of each intervention is not to "force it" and aim for each visitor to feel the exact same level of intense awe, but rather to allow for individual differences and let each person feel awe at whatever level they feel it. Ultimately, the purpose is to help visitors foster what Dacher Keltner refers to as an "awe mindset" (Camp, 2024) as they move through different exhibits, not to obtain a specific intensity of emotion. While the interventions themselves provide relatively brief awe experiences, these experiences are meant to help visitors notice and foster their ongoing relationship with awe. Throughout the "Opportunities for Awe," visitors are encouraged to develop an enduring awe mindset and consider ways to slow down, notice vastness, connect with things beyond the self, and reflect on one's place within the greater systems and cosmos one resides (Camp, 2024; Schneider, 2009).

These interventions are also designed to elicit positive experiences around awe and buffer against potentially negative experiences. While negatively valanced types of awe can be experienced in certain museum exhibits (e.g., Krogh-Jespersen et al., 2020), the purpose of these interventions is to increase the well-being of the visitor. This is not to say that these interventions are designed to eliminate all negatively valanced feelings – awe is a complex emotion, and thus a

mixed experience with divergently-valanced feelings is expected, particularly for visitors from cultures that experience awe as a more mixed emotion. However, the interventions are meant to ultimately increase well-being and thus provide primarily positive, or at the very least, mixed-valence experiences. Thus, generally pleasant stimuli, as defined by the visitor, will be used to elicit awe, as opposed to stimuli that may primarily cause fear or dread, such as exhibits about a natural disaster or the technology of a war.

Past research has revealed several techniques that have been effective at inducing awe, and the interventions proposed in this paper are designed from these interventions. Specific interventions that were considered included: watching awe-inspiring videos (Nelson-Coffey et al., 2019; Van Cappellen & Saroglou, 2012), experiencing awe-inspiring VR environments (Chirico et al., 2017; Nelson-Coffey et al., 2019), walking around a *Tyrannosaurus rex* skeleton (Shiota et al., 2007), recalling past experiences of awe (Bai et al., 2017), standing in a grove of tall trees (Piff et al., 2015), and looking out at an awe-inspiring view from a 200 foot tower (Bai et al., 2021). Additionally, feeling present in an awe-inducing area of a science museum (Krogh-Jespersen et al., 2020) and feeling absorbed by the stimuli (Chen & Mongrain, 2020) seem to generate greater feelings of awe. Therefore, the interventions were designed to enhance mindfulness and absorption as much as possible, while again acknowledging that individual differences will result in varying levels of these experiences. Some of the reflection questions at the ends of the third intervention are meant to bolster additional, positive feelings that can be felt during awe experiences, namely a sense of meaning in life. In this way, the paper aims to contribute to the new but growing focus on the potentially positive interactions between awe and meaning in life.

Overview and Rationale for Intervention 1

Intervention 1 is based off the concept of an "awe walk" (Sturm et al., 2022), an activity in which the participant is encouraged to mindfully notice their surroundings in a way that increases opportunities to experience awe. Sturm et al. (2022) found that people who were instructed to engage in awe-enhancing behaviors experienced more awe while on a walk compared to participants who were instructed to go on a walk with no additional instruction. An awe walk could potentially be used throughout an entire museum, from different exhibits with exciting stimuli to remarkable and stimulating areas of the museum itself, like a sunny atrium filled with people. Additionally, this intervention aims to help visitors look through two of the lenses that Schneider (2017) found to cultivate awe, namely an attunement to surprise and wonder and the perception of the intricacy and subtleties of life. This intervention has been adapted from the awe walk instructions of Keltner (2017) and Sturm et al. (2022), and references to the instructions of Keltner (2017), the study by Sturm et al. (2022), Keltner (2023), and other appropriate resources about awe would be properly cited and included within the pamphlet.

This example intervention is designed to be implemented in the *Coors Gems and Minerals Hall* at the Denver Museum of Nature in Science. In this space, gems, minerals, and crystals of various sizes, shapes, and colors are displayed on both sides of a long corridor. There are hundreds of minerals on display, providing both new visitors and those returning to the museum many opportunities to engage with novel and information-rich stimuli. These minerals are vast in the intricate colors and shapes that they contain. Visitors are encouraged to use a magnifying glass during the intervention to further enhance the feeling of vastness while looking over the smallest details of the gems in a novel way. Over-the-ear headphones provide guided instructions for visitors in order to help them be more absorbed in the experience. The walk goes

at a self-guided pace and allows the user to select which stimuli they want to attend to, increasing the odds that each person will find an object that is personally stimulating and awe inspiring.

At the start of the exhibit hall, an "Opportunity for Awe" icon is displayed, and visitors are instructed to turn to the appropriate page in their pamphlet. This section is designed to orient visitors to the intervention and prime them to experience and notice feelings of awe. Next, visitors put on headphones and engage in the guided walk, moving from section to section at their own pace. Last, visitors are encouraged to write or discuss their answers to questions in the pamphlet. Visitors are also provided resources and suggestions for how to practice an awe walk in their lives.

Overview and Rationale for Intervention 2

This intervention is designed to expose visitors to physically vast and novel places, a prime setting to experience awe (e.g., Bai et al., 2021). Specifically, visitors immerse themselves in detail-rich natural and urban environments using a Virtual Reality (VR) headset. A variety of different locations are offered for the visitor to choose from. This intervention is once again designed to be highly flexible and adaptable to any numbers of exhibits. For example, an exhibit about space could allow for visitors to choose what planets and moons they want to float above, or it could offer a perspective of what it would be like to be as small as a bug in different environments in an exhibit about insects. Or, this intervention could be an entirely separate experience, not associated with any particular exhibit.

This proposed intervention is again designed to be situated in the Denver Museum of Nature and Science, and it would offer visitors the opportunity to be immersed within different areas of Colorado (see Table 1). The environments would be made of real footage obtained from cameras designed for VR. These scenes were selected because they are in the types of

environments that have been reported to facilitate awe experiences, including nature, an inspiring view (Bai et al., 2021), inspiring architecture, and collective social events (Keltner, 2023). They were also chosen because they are information-rich environments and places of physical vastness, further common sources of awe (Chen & Mongrain, 2020; Keltner, 2023). Additionally, some scenes offer perspectives of these places only possible in VR, allowing for novelty, another key component of awe (Shiota et al., 2007). Virtual environments were chosen based on research by Chirico et al. (2017) that demonstrated that, with the right stimuli, immersive VR environments are effective at creating feelings of awe and produce greater feelings of awe and presence relative to 2D video screens.

Table 1

Description of VR videos used in Intervention 2

Virtual Scene	Description
Rocky Mountain National Park	A view from just above Sky Pond, a frozen lake surrounded by towering mountains covered in snow. Visitors would have the option to be "lifted" slowly from the surface of the lake, ascending several hundred feet slowly to provide further views of the valley and mountains below.
Colorado Plains	A view in the sky, achieved by flying a drone or small plane through billowing clouds. The visitor would experience flying past and through clouds above rolling fields.
Rockies Game	A perspective from the upper stands of a Colorado Rockies game at Coors Stadium, allowing visitors to take in a view and watch a few plays of a game from the field, including a homerun and the crowd cheering.
Aspen Trees	Being among a grove of aspens above the city of Ouray, with leaves fluttering in a breeze. A visitor could observe the trees and look out and off of the mountainside, seeing further trees, mountains, and the town below.

Mt. Bierstadt	A timelapse of a sunrise from the top of Mt. Bierstadt, the sunrise edited to last approximately three minutes. View of other peaks and valleys.
Great Sand Dunes National Park	The view from the top of a tall dune, with rolling dunes all around, and views of the Sangre de Cristo Mountains and San Luis Valley beyond. This scene would be at night, under a sky full of stars and the milky way above.
Denver	A drone shot flying gently through downtown Denver, past tall buildings, at a height of about 200 feet.

Because sources of awe are highly individualized, each visitor can choose what kind of environment speaks most to them, enhancing the likelihood of experiencing awe; conversely, it allows each person to avoid choosing an environment that may produce a negatively-valence awe experience. For example, while some may love flying through the sky, others might find the experience anxiety-provoking. Some may find a view of the Colorado State Capitol Building inspiring, while others might see it as a symbol of oppression that elicits a sense of threat (Keltner, 2023). Once again, the intervention is designed to be a positive experience, so generally pleasant environments were chosen while potentially threatening ones were not included (e.g., an immersive video of a thunderstorm). The brief questions afterwards are meant to further help visitors identify their own internal experiences that may have occurred while experiencing awe, as well as learn more about common feelings and sensations of a prototypical awe experience.

Overview and Rationale for Intervention 3

Intervention three demonstrates that awe-based interventions can be implemented in simple, unobtrusive ways. Nearly any Nature and Science Museum has awe-inspiring stimuli, and adding awe-based activities to existing exhibits can be simple. This intervention is designed to take place at a cloud chamber, a chamber of alcohol vapor that may inspire awe (Delgado,

2016) in which one can see traces of particles like electrons, protons, and muons. While looking into a cloud of mist illuminated by a light, white lines of dense mist of different sizes and patterns appear and disappear, each one revealing where a particle just passed.

This display may produce awe not only in its novelty and visually rich display, but also in its conceptually-vast demonstration of how energy from distant places in our galaxy is constantly surrounding us. It is designed to help visitors look through another one of the lenses that Schneider (2017) found to cultivate awe, namely the awareness of the cosmic context in our everyday experiences. While this alone may produce a sense of oneness for certain people, the awe intervention asks people to connect with past moments of awe, a known technique to foster feelings of awe (Piff et al., 2015). This is again done with flexibility in mind, allowing as many people as possible to connect with a personal, internal stimulus to bring about the feeling of being a part of something larger than themselves.

The questions for reflection at the end of the exhibit attempt to link awe and meaning in life. As discussed, the feeling of small-self has many benefits (Bai et al., 2021) and may lead to a type of existential-philosophical (Vos, 2022) sense of meaning in life. An optional component of this intervention involves visitors writing down their moments of connectedness or oneness for others to see. This could potentially create an additional source of connectedness for a visitor observing that others find a sense of oneness in similar places as they do.

Detailed Description of Each Intervention

Intervention 1. Intervention 1 is a guided walk through an exhibit of gems and minerals

PAMPHLET:

Awe can be found almost anywhere, especially when we slow down and intentionally open up to it. Typically, feelings of awe are most likely to occur around places or objects that are "vast" and new to us. Physically vast places and objects are usually large, like a tall tree, a massive ocean, or a towering skyscraper. While vastness often is experienced in large places,

awe-inspiring objects and places can also be vast in other ways, like in number, age, or importance.

In this activity, you will have the opportunity to explore vastness in the many small, unique details of the gems, minerals, and crystals in this hall. You will do this through an "awe walk," a guided activity designed to enhance feelings of awe. This activity is self-guided but should take approximately five minutes. As always, don't feel like you must force yourself to feel a certain way or certain amount. Awe can be a powerful and profound feeling, and sometimes it can be smaller or more subtle. You may feel no awe here, and that is okay too – everyone feels awe differently and for different reasons. Simply engage in this activity with an open mind and notice what happens.

When you are finished, please return the headset and answer the questions below, either to yourself or with someone you are with, if you feel comfortable doing so. To begin, please pick up a headset and magnifying glass from the station in front of you.

GUIDED RECORDING

"We'll being this awe walk by first taking a moment to be mindful and present in this space. To help ground yourself and relax, take a few deep breaths, silently counting to six as you inhale and to 8 as you exhale. Feel the air move through your body, in your lungs, and through your nose. Continue to notice these sensations for a couple of breaths."

[pause]

"As you do this walk, always feel free to come back to noticing these deep breaths, especially if you notice your mind has wandered. Now, begin to shift your awareness to the room around you. Notice all of the people walking around… the noises you can hear through your headset… the feeling of the air on your skin… your feet on the ground… the lights… the shape of the room…

Now turn your attention to the gems and minerals around you, and slowly walk through the hall. As you move from display to display, try to tap into your childlike sense of wonder. Take a moment to take in the vastness of details in the minerals – their colors… unique shapes… sizes. You might even try to look at them as if you are looking at them for the first time, really being open to notice and appreciate how much detail they have to offer.

Take a minute or two to walk through a few rooms and be on the lookout for one mineral in particular that catches your eye or sparks awe for whatever reason. There is no right or wrong mineral to pick, just choose one that calls to you in some way. Perhaps it's the one that makes you go, 'wow.' Give yourself plenty of time. When you are standing in front of your mineral, hit the 'next' button to continue the activity."

PART TWO

"Begin to examine the mineral you chose with full attention and curiosity. Ask yourself, what about this mineral spoke to me? Be curious about what you liked about it… Now let's examine the vastness of this mineral. Take out your magnifying glass and begin to notice the world of detail this one mineral contains [20 second pause]… The valleys and peaks you might be able to

see through your magnifying glass [20s]… Look at the colors… Is it all one color, or is it many?... [20s] Look at the shape of it, its unique shape in all the world… [20s] Notice the different ways light bounces off of it depending on what angle you look at it… Consider the vast age of the mineral you are looking at, possibly millions of years old, forged in the earth and now right in front of you here [20s]… Please feel welcome to stay in this awe experience as long as you would like, noticing the crystal and your own internal experience. When you are ready to move on, please press the 'next' button."

PART THREE

"When you are finished looking at your mineral, please return the headset to the station, but feel welcome to repeat this exercise with any other crystal you wish to practice awe with."

PAMPHLET

What was it like to look at a crystal you found interesting or beautiful with curiosity and openness?

Where is one place accessible to you, new or familiar, that you could take an awe walk in sometime in the next week?

[Further instructions about how to incorporate awe walks and an "awe mindset" into one's life]

Intervention 2. Intervention 2 consists of viewing awe-inspiring vistas and environments.

PAMPHLET:

It is not unusual for people from all over the world to experience awe in large, vast places. In this activity, you will have the opportunity to experience vast settings from around Colorado using a Virtual Reality (VR) headset. Please select one or two scenes that would be most inspiring or appealing to you, and skip any that you think you would not enjoy. The aim is to allow yourself to be immersed in a place that you think you might find awe-inspiring.

As always, don't force yourself to feel anything or feel a certain amount. Just try to be present and mindful, paying attention to the details of the large vistas around you. When you are finished, reflect on the questions below, either through writing or discussing them with someone you are with.

[VR Experience]

PAMPHLET:

What sensations in your body did you notice while in the Virtual Reality experience?

What feelings or emotions did you notice while in the Virtual Reality experience?

[More information about common emotional and physical reactions people may have during a prototypical awe experience]

Intervention 3. Intervention 3 entails a cloud chamber viewing and recalling past awe experiences.

PAMPHLET

This cloud chamber in front of you is another great Opportunity for Awe. Before continuing, read the sign in front of you to learn more about what you are viewing.

[Plaque with information of the Cloud Chamber is displayed nearby. After reading, the visitor returns to the pamphlet].

Sometimes, people experience awe when they think about something conceptually vast, like a theory that explains the world or a concept, like infinity. Take a moment to consider what you just learned: that this cloud chamber is displaying the paths of particles and energy that are moving all around you.

As you watch the trails of these particles come and go in front of you, try to tap into the "awe mindset" you have been learning to cultivate today. Allow yourself to observe that you are constantly interacting with energy and matter from across our entire galaxy, whether it be the curly lines of the electrons that are buzzing around this room or the straight lines of the muons created from cosmic rays that have traveled from stars lightyears away to hit Earth's atmosphere. Perhaps you may want to close your eyes and see if you can imagine being surrounded by all these particles and energy, constantly passing harmlessly through you from all around.

A sense of feeling like you are a part of something bigger than yourself, or even a sense of "oneness", can often occur when one experiences awe. Take some time to recall if you have ever had an awe-inspiring experience where you felt a sense of oneness or a small part of something bigger than yourself. There is no "right" place to have felt this, though some common sources of this feeling include: being in nature, being surrounded by people or a community you cherish, learning about history, being inspired by others, attending communal events like a large concert or sports game, being in a religious or spiritual place, and participating in communal or individual spiritual or religious practices.

Once again, close your eyes and recall this experience and what it meant to you. You may answer this question for yourself: what does this experience say about what is most important or most meaningful in my life?

If you feel comfortable, briefly write where you experienced this feeling on the paper provided next to the cloud chamber and post it on the wall. Take a moment to read others' experiences. Are there any similar to yours? Are there any you have not participated in but feel may be meaningful to you, perhaps ones you may seek out in the future?

Pilot Study: Testing the Effectiveness of the Interventions

The purpose of the proposed pilot study is to test the feasibility and effectiveness of each of the three awe interventions described above. Though the "Opportunities for Awe" activities are designed to work together and allow visitors to pick and choose interventions that are of the most interest to them, attempting to discern the effects that all three interventions have on feelings of awe introduces a number of interfering factors. Namely, it would make it difficult to determine which specific interventions are effective without complicating the data collecting process and study design. Thus, in this proposed pilot study, each intervention will be evaluated individually. The Denver Museum of Nature and Science would serve as the location to test the interventions, as two of the three interventions are written specifically around existing exhibits of the museum.

The primary predictions of the study are that each intervention will increase positive feelings of awe (Hypothesis 1) and that the increase in feelings of awe will be greater for participants engaging with the museum exhibits while participating in the interventions compared to a control group of participants engaging with the museum exhibits only (Hypothesis 2). Additionally, exploratory analyses would be conducted to evaluate if the interventions were effective at increasing feelings of awe for the diverse range of visitors that frequent a public museum. Namely, exploring the effects that gender, age, race and ethnicity, and country of residence have on the effectiveness of the interventions would be of primary interest.

Method

Participants

Participants would include adult visitors of the Denver Museum of Nature and Science. These visitors would be approached at the entrance of the museum and asked if they were

interested in partaking in the study. Participation would be voluntary, though participants may be incentivized by a reward deemed financially feasible and mutually determined by the museum administration and principle investigator. Participants would be fully debriefed about the study after completion of the interventions and questionnaires.

Procedure

A two-group experimental design for each awe intervention appears most appropriate with three control and three experimental groups. Participants are randomly assigned. Regardless of group assignment, all participants would complete a demographics questionnaire. Before engaging in the interventions or control-group activities, all participants would complete the pre-trial questionnaires (see measurements section below). Participants in the control groups would complete the same questionnaires after participating in the control-group activities. Participants in the experimental groups would be handed a modified version of the "Opportunities for Awe" pamphlet that would include just the introductory page with the psychoeducational materials about awe and the instructions and reflection questions for the intervention they were assigned to. After completing the intervention, all participants in the experimental groups would also fill out the post-trial questionnaires.

Measurements

The Awe Experience Scale (AWE-S) developed by Yaden et al. (2018) would be the primary measure used to assess levels of awe during both the pre-trial and post-trial conditions. However, because the AWE-S lacks a method of measuring negatively-valanced awe, the "Oppression/Isolation" subscale of the Situational Awe Scale (SAS) developed by Krenzer (2018) would also be included. Though the pilot study would focus on how effective the interventions are at raising positively-valanced feelings of awe, exploratory analyses could be

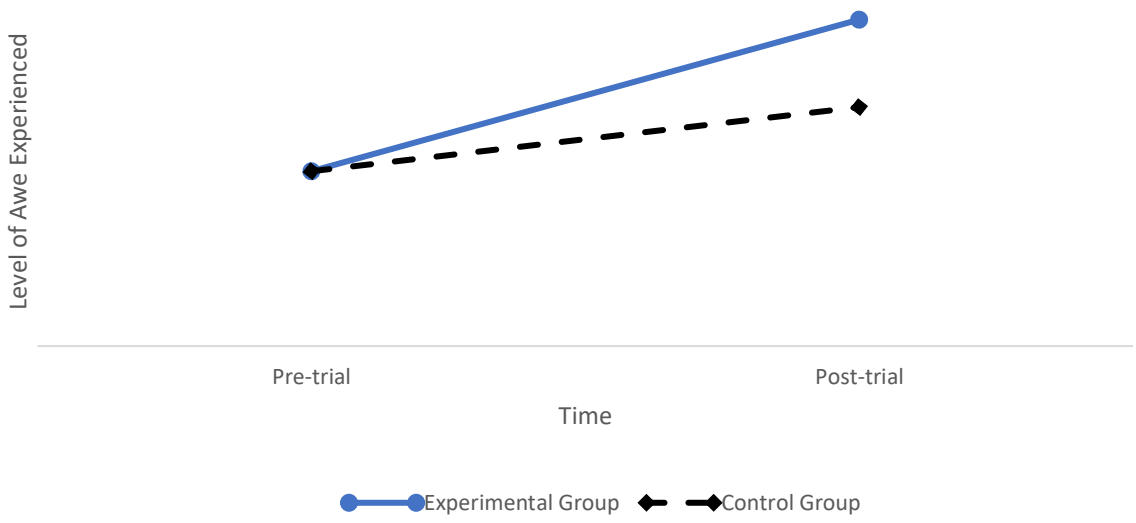
conducted to determine the extent of negatively-valanced awe that arose as well. Additionally, in keeping in line with a method of measuring awe utilized in previous studies (e.g., Bai et al., 2021), participants would indicate on a 7-point Likert scale the extent to which they experienced amusement, happiness, awe, fear, and anger. These scales would allow for another way to measure changes in level of awe and provide insight into changes in other emotions that may occur as a result of the interventions.

Anticipated Results

As previously noted, the main anticipated result of the pilot study would be that all three interventions are effective at raising levels of positively-valanced awe (Hypothesis 1). In addition, the level of change of experienced awe would be great for participants completing the interventions (experimental group) compared to participants experiencing the museum exhibits without the interventions (control group; Hypothesis 2). See Figure 1 for a visual representation of the expected outcomes of one intervention compared to the control group paired with that intervention. It would be expected that the results of all three interventions averaged together and the results of all three average control groups would also produce similar graph.

Figure 1

Representation of the anticipated results for Hypothesis 1 and Hypothesis 2



Discussion

Feelings of awe have been written about for millennia, sometimes described as nearly ineffable experiences of being connected to something larger than the self (Keltner, 2023). More recently, awe has been studied and found to be a widely experienced and distinct emotion that is associated with a variety of well-being outcomes (Chen & Mongrain, 2020; Keltner & Haidt, 2003). In this paper, three interventions designed to facilitate positive awe experiences for visitors of a nature and science museum were proposed. These interventions aim to harness the positive effects of awe by providing education and experiences of awe in an accessible setting to positively impact the lives of the visitors and community as a whole. Each method of eliciting awe was modeled after study designs of past research that were shown to be effective in increasing feelings of awe: one intervention was based off the concept of an "awe walk" (Sturm et al., 2022), the second used awe-inspiring VR environments (Chirico et al., 2017; Nelson-Coffey et al., 2019), and the third asked participants to recall a previous experience of awe (Piff et al., 2015). A pilot study for implementing and testing the effectiveness of the interventions was also proposed.

Limitations

One significant potential limitation of the proposed pilot study is the feasibility of the project. Even if a museum is interested in integrating the proposed interventions, the set-up and maintenance of the interventions may require too many resources (e.g., dedicated staff to monitor and operate the equipment) to be sustainable for the duration of a pilot study, let alone an indefinite period. The development of more interventions that require less equipment and staff, such as Intervention 3, could help ameliorate this issue. Additionally, the interventions and some measures proposed in the pilot study are currently available only in English, which would limit the accessibility of the interventions as well as dampen the ability to explore the cross-cultural effectiveness of the interventions. Translating the materials into a variety of non-English languages would go a long way in lessening this restriction, but careful attention would be required to translate the definitions and descriptions of awe in a culturally congruent, understandable way. Designing interventions that are effective at increasing feelings of awe for visitors from any culture or demographic group may also likely prove to be too broad of a task, despite the attempt to make the interventions as flexible and adaptable to individual preferences as possible. Interventions designed to discuss and target feelings of awe in more culturally specific ways for specific cultural groups and implementing these interventions outside a museum of nature and science may be more effective at increasing the range of the interventions.

Though use of the AWE-S and SAS is designed to capture the multi-faceted aspects of awe, the measures contain many questions, and participants' reliability in answering questions may drop due to disinterest in answering the same 30 questions within the span of a few minutes. Reducing the measure to just the 7-point scale that asks participants to rate the extent they feel awe would remove this issue and be in line with ways of measuring awe utilized by many past

studies. However, this runs the risk of over-simplifying the measurement, and thus, not accurately capturing the multi-faceted nature of the experience of awe. Also, the proposed pilot study only measures levels of awe immediately following engagement in just one intervention. It does not measure the cumulative effect of all interventions in tandem, nor does it measure long-term impacts of the interventions on well-being or enduring shifts in attitudes that awe experiences can inspire. Further research about the long-term effects of the interventions—including qualitative methodologies for which Schneider (2017) argues—would be beneficial.

Recommendations for Future Research

Many studies about awe implement one-time, awe-inducing techniques for the purpose of learning more about the emotion of awe and its effects. While one aim of the proposed pilot study is to contribute to this research, the ultimate goal of the project is to test and refine the interventions so that they can be implemented in a museum setting for an on-going period of time. Thus, following the implementation of the pilot study, the next steps would be to use the collected data to improve the current interventions and create additional ones that could be left running in the museum for an extended period. Exploratory analyses would help reveal if there are certain demographic groups for which the interventions are not particularly effective, and this information could be used to modify interventions or create additional interventions to better include these groups. Inter-disciplinary collaboration during this phase would likely greatly enhance the effectiveness of the interventions as well. Partnering with museum directors, educators, exhibit curators, and graphic designers could help find ways to better integrate the interventions into the museum and present the psychoeducational material in a clear, engaging manner. Such collaborations could set up exhibits in a way that maximizes feelings of awe and

leaves visitors with a positive, memorable impression of their visit, thus benefiting both the individual and the museum.

Though the proposed interventions in this paper are designed for a museum of nature and science, there are many potential venues in which awe interventions could be applied. For example, Pizzolante et al. (2023) recently explored preliminary design guidelines for creating awe-inducing experiences in a virtual social media environment. Additionally, the interventions proposed in this paper could be adapted for other types of museums or for children. Simple awe-enhancing interventions could even be implemented in other public environments, such as a community center, a library, or even a public park. It is the hope that the proposed interventions serve as just one of many ways that knowledge about awe can be extended beyond the realm of academic research and be applied to improve the well-being of the public.

Conclusion

The proposed interventions only scratch the surface of the numerous ways that awe can be experienced. Keltner (2023) recently expanded common sources of awe into eight categories, and even this is not an exhaustive list. The aim of these interventions is to foster feelings of awe in the moment, but beyond that, it is to remind visitors that opportunities for awe are potentially accessible around every corner. In a museum of nature and science, they are waiting to be found in the eyepiece of the public telescope when we cannot help but involuntarily gasp as we peer at the rings of Saturn. Awe is waiting on the time-worn plaque in a quiet corner of the museum when we read about the inspirational actions and thoughts of a scientist or leader, and it unexpectedly moves us. We run into awe while we sip coffee in the visitor's café and quietly contemplate, with astonishment, the breadth and depth of the lives of the museum visitors

walking around us and the extraordinary circumstances that have brought this group of strangers briefly together.

The proposed interventions ideally serve as a reminder of something we likely already know: there are things in this world that move us sometimes even beyond words and leave us feeling connected to something much larger than just our self. Each person is unique in what brings them awe and how exactly awe comes to them, but we all appear to share the capacity to experience it and be deeply moved by these experiences. A primary aim of the interventions proposed in this paper is to reinforce this knowledge and encourage individuals to seek, experience, and embrace awe in their everyday lives.

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