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Assessing the Experience of Awe: Validating the Situational Awe Scale

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Assessing the Experience of Awe: Validating the Situational Awe Scale

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Biography

The author was born in Garden City, South Carolina, August 7, 1987. He graduated from Freedom High School, in Oakley, California, in 2005. He received a Certificate of Completion's in Culinary Arts, Baking and Pastry, and Hotel Restaurant Management from the Culinary Arts program at Diablo Valley College in Pleasant Hill, California in 2008. Additionally, he received an Associate of Science degree (Culinary Arts) and Associate of Arts degree (Transfer Studies) from Diablo Valley College in 2010. He received his Bachelor of Arts degree from San Francisco State University in 2012, and his Master of Arts degree in Mind, Brain, and Behavior (Psychology) from San Francisco State University in 2014.

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Abstract

Awe is an overwhelming feeling of admiration sometimes mixed with wonder or fear. Inspired by a cross-disciplinary review of perspectives on awe, we constructed a new measure that would reflect all of these perspectives. In this dissertation, I introduce the Situational Awe Scale (SAS) and report a set of studies designed to validate the measure. An exploratory factor analysis in Study 1 suggested a four-factor structure (i.e., liberation/connection, oppression/isolation, chills, and small-self/vast-world); the study also provided initial evidence of the measure's convergent and criterion validity. Study 2 provided evidence for the structural validity of the SAS, by confirming the factor structure uncovered in Study 1, and replicated the convergent and criterion validity evidence. Study 3 established that the SAS truly assesses *situational* awe by demonstrating that SAS scores varied in response to situations that elicit more versus less awe; Study 3 also provided evidence that the SAS possesses discriminant validity. Study 4 extended the construct (structural, convergent, criterion, and discriminant) validity of the SAS to a field setting (Museum of Science and Industry, Chicago). Study 5 again provided evidence for the convergent, criterion, and discriminant validity of the SAS. Studies 4–5 also attempted to investigate the role of prior knowledge in the experience of awe, with mixed results. Across five studies, we constructed and validated the SAS, and began to explore its relationship with knowledge. The research reported in this dissertation supports the construct validity of the SAS and lays the

groundwork for fruitful future investigation into the determinants and outcomes of awe.

Keywords: awe, scale development, construct validity, prior knowledge

Assessing the Experience of Awe: Validating the Situational Awe Scale

He to whom this emotion is a stranger, who can no longer wonder and stand rapt in awe, is as good as dead, a snuffed-out candle.

Albert Einstein (1930), "What I Believe"

Awe is generally defined as an overwhelming feeling of admiration sometimes mixed with wonder and fear. However, throughout the centuries many scholars have taken awe to also mean a feeling that overwhelms the senses with its size and vastness in the grand scheme of things. Inspired by a cross-disciplinary review of perspectives on awe, we aimed to construct a new measure of awe that would reflect all of these perspectives. In this dissertation, I introduce the Situational Awe Scale (SAS) and report a set of studies designed to validate the measure. The dissertation ends with a preliminary exploration of how a theoretically consistent but to-date unstudied construct—prior knowledge—contributes to the experience of awe.

Defining Awe

As with any emotion, attempts to define awe have been numerous, and different perspectives have highlighted different definitions. The Merriam-Webster dictionary (https://www.merriam-webster.com/dictionary/awe) defines awe as "an emotion variously combining dread, veneration, and wonder that is inspired by authority or by the sacred and sublime." The Free Dictionary (https://www.thefreedictionary.com/awe) defines awe as "A feeling of respect or

reverence mixed with dread and wonder, often inspired by something majestic or powerful." Aside from these dictionary definitions, theoretical analyses of awe can be found in philosophy, religion, and psychology. In general, philosophy associates awe with the fear of sublime (Beardsley, 1966; Burke, 1757/2008; Eskine, Kacinik, & Prinz, 2012; Walhout, 2009), religious studies associate awe with the fear of something greater than the self (Keltner & Haidt, 2003; Meyer, 2016; Piff et al., 2015), and psychology has referred to awe as experiences that are perceived as vast and that require cognitive accommodation (Darbor, Lench, Davis, & Hicks, 2015; Ketlner & Haidt, 2003; Shiota et al., 2007).

Philosophical conceptualizations of awe. Philosophy is a field rich in history, and within that history the topic of awe has been discussed, in some form or another, over the span of many centuries. In most contexts, awe is not discussed as a standalone topic, but as a commonly ascribed occurrence to a sublime event. It is not until the work of more modern philosophers that we begin to see the discussion of awe as being a separate experience from the sublime. These connections with the sublime are an intricate part to how awe is interpreted today, and how we interpreted awe in our research.

The notion of the sublime can be traced back to a Roman-era Greek writing *On the Sublime*, (possibly) authored by Longinus. In this work, the sublime is illustrated as a grand type of speech that transports individuals through the orator's wondrous and astonishing linguistic skill (Lochhead, 2008). Examples of this type of speech can be thought of throughout history: Lincoln's *Gettysburg Address*, JFK's *Inauguration Address*, or MLK's *I Have a Dream*. All

of these speeches are connected to important events in American history, and one could still be whisked away all these years later by these speeches and the individuals who delivered them. Longinus viewed all experiences of the sublime as rhetoric events; it was not until much later that other philosophers connected the sublime to include experiences in nature (Trigg, 2004).

Edmund Burke and Immanuel Kant are the philosophers who have shaped our understanding of the sublime to what it is today. Burke was the first to develop his concept of the sublime in his work, *A Philosophical Enquiry into the Origin of Our Ideas of the Sublime and Beautiful* (Burke, 1757/2008). In Burke's work, he discussed how experiencing natural events (e.g., thunderclouds, tornados, etc.) instills fear by causing individuals to acknowledge their vulnerabilities and how short life can be (Bleiker & Leet, 2003; Zuckert, 2003). Burke further interpreted the sublime as something that "elicits" the idea of pain and horror but does not actually cause pain or horror (Bleiker & Leet, 2003; Trigg, 2004). Individuals can experience the sublime through more physical experiences; the more terrifying that natural experience is (i.e., realize how insignificant one is), the stronger that sublime feeling would be.

It was not until Kant's (1790) work *Critique of Judgment* that he addressed Burke's view on the sublime being something physical (e.g., natural events), and built upon it by saying that there are two types sublime: dynamical and mathematical. The dynamical sublime is an event of such force and power that the terror overwhelms one's consciousness, while the mathematical sublime pushes the imagination to the point of awe (Trigg, 2004). With this split definition

of the sublime, Kant expands Burke's definition by arguing that the sublime is also experienced through one's own perception of their experience in the world (Bleiker & Leet, 2003; Forsey, 2007; Walhout, 2009). Kant's addition to what the sublime means showed that subjective experiences (along with objective ones) can lead to experiences that would be described as sublime. While Burke believed that individuals needed the fearful experience (e.g., a thunderstorm), Kant believed that the beauty or sheer size of something (e.g., Grand Canyon) would induce introspection about the experience, which would promote awe, fear, and wonder. Later philosophers used this perspective on awe to guide their reasoning.

Late in the 18th century, German philosophers Johann Herder and Arthur Schopenhauer expanded Kant's definition of the sublime. Herder described the experience of sublime as an uncomprehending experience of awe that humbles the individual (Zuckert, 2003). Schopenhauer, on the other hand, believed that the sublime helped individuals escape pain through aesthetic experiences (Trigg, 2004). More recent philosophers have further expanded the definition of the sublime to include unexplainable experiences in which astonishment, awe, fear, and wonder lead our attention towards inward feelings instead of outward objects (Bleiker & Leet, 2003; Forsey, 2007; Ivanhoe, 1997).

The work of all of these philosophers is what has led to today's understanding that the sublime is a powerful experience in which both fascination and fear are experienced because of something out of the norm that overwhelms our existential understanding. Taking this definition from an experience of fascination and fear, to something outside of the self, connects the emotion of awe

with the feeling (Bleiker & Leet, 2003; Walhout, 2009). Therefore, awe is one of the primary emotions people feel when they experience the Grand Canyon, thunderstorms, or Lou Gehrig's *Farewell to Baseball* address.

Religious and spiritual conceptualizations of awe. Within religion, awe is believed to be a powerful religious emotion experienced in response to the beauty in what God has created, and with the of fear in God one has without suspicion or being afraid (Halstead & Halstead, 2004; Ivanhoe, 1997; Krause & Hayward, 2015; Walhout, 2009). Even in some religious translations, awe and fear are synonyms for each other (Halstead & Halstead, 2004). Judaic scripture refers to God as "awesome" in the sense of being holy and fear inducing, rather than the sense of wonder individuals feel from awe. While modern Christianity has depicted God as more loving and nurturing, there is still that overwhelming fear that God is capable of utter annihilation (Ashley, 2006). Outside of organized religion (e.g., Christianity, Buddhism), atheists experience awe even when it is described as an emotion that "religious people" often feel in the presence of god or gods work (Caldwell-Harris, Wilson, LoTempio, & Beit-Hallahmi, 2011).

Individuals experience spirituality and religion in different ways, so their connection with awe does as well. Individuals who are spiritual view the emotion of awe as an internal feeling or external experience that moves you but cannot be comprehended (Caranfa, 2003; Forsey, 2007; Kale, 2004; Mitroff, 2003). For instance, experiencing the vastness and timelessness of nature for instance helps lift individuals out of the mundane, and gives them a spiritual experience of awe in the sense of being part of something bigger than oneself (Ecklund & Long,

2011; Krause & Hayward, 2015; Yuen, 2007). The experience of spirituality and religion do not need to be separate ones. Christian writings say that one sign of growing spiritually is through experiencing and reflecting on the natural work around yourself (Halstead & Halstead, 2004). Similarly, atheists and agnostics view that experiencing moments of awe is a strong part of them being spiritually connected to their beliefs (O'Connell & Skevington, 2005).

While religion's and spirituality's versions of awe may differ in some respects, both argue that there is something greater than us in the universe that we cannot really comprehend. This sense of something greater is what helps individuals experience awe in its more physical form. For instance, St. Peter's Basilica in Vatican City is a building that elicits awe architecturally and through connecting individuals to God with the spiritual beauty of the structure. However, it is not just the beauty of the basilica (or churches for that matter) that elicits the awe; it is also the ability to make people aware of an omnipotent and all-powerful god that makes them experience awe (Bleiker & Leet, 2003; Zuckert, 2003). Similar feelings are felt spiritually with artwork and how it can capture incomprehensible aspects of life like fate, divinity, and death (Walhout 2009; Zuckert, 2003). These themes of vastness and incomprehensible experiences from religion and spiritualty, and beauty and fear taken from philosophy, we begin to paint a better picture of how awe has evolved into what psychologists have been researching for some time now.

Psychological conceptualizations of awe. The first references to awe in psychology date back to early in the 20th century, but research into awe did not

begin until the 21st century. One of the first psychological accounts of awe was forwarded by William McDougall (1910/2015), who described awe as an emotion felt when viewing sights like Victoria Falls, the aurora borealis, or a thunderstorm. McDougall explained that these types of experiences cause individuals to simultaneously experience admiration and fear, the combination of which he referred to as the emotion of awe. Richard Lazarus (1991) argued that awe could also be elicited when viewing pieces of art, having a religious experience, or being in nature. Both of these psychological perspectives were consistent with philosophical and religious perspectives, but it was not until relatively recently that psychologists devoted significant attention to investigating awe.

Awe as a two-factor emotion. Keltner and Haidt (2003) added to our understanding of awe by breaking the experience of awe into two main themes: a sense of vastness and the need for accommodation. A sense of vastness referred to as something larger in scope than the self that challenges one's accustomed frame of reference. A need for accommodation is the motivation to update one's schema of the experience to better understand the world (Keltner & Haidt, 2003; Rudd et al., 2012; Shiota et al., 2007; Zhang & Keltner, 2016). These additions to our understanding of awe helps us understand why individuals feel awe when they are surrounded by California Redwood trees. Not only are these trees extremely vast in size, but viewing one leads individuals update their schema of a tree (to being much larger than normally experienced) to fully understand what they are experiencing. The same experience occurs when viewing incredibly negative or

fearful experiences like an exploding volcano; the individual gets get a sense of vastness of a volcano's power, which leads to a need to accommodate their understanding of natural disasters (Darbor et al., 2015).

Physiological correlates of awe. Awe might also be associated with its own characteristic physiological profile. Shiota, Neufeld, Yeung, Moser, and Perea (2011) investigated the connections between the experience of positive emotions and autonomic responses. Participants viewed a series of positive emotion-eliciting photos while their physiological responses (e.g., heart rate, skin conductance, etc.) were recorded. Based on participants' self-reported emotional responses to the photos, Shiota et al. determined that individuals viewing awe-eliciting photos (compared to neutral photos) experienced increased heart rate and respiration, showing that experiencing awe affects us physiologically, as well as emotionally.

Awe's unique expression. Finally, awe has a characteristic facial expression, which might speak to what the experience is. Campos, Shiota, Keltner, Gonzaga, and Goetz (2013) recently recorded participants' facial expressions as they talked about a personal experience of awe and found, using the Facial Affect Coding System (FACS; Ekman & Friesen, 1978), that the awe expression was a combination of fear and surprise. This shows that awe has both positive and negative expression components, suggesting that the experience may be similarly complex.

Awe as a Correlate of Prosociality, Wellbeing, and Motivation to Learn

The importance of understanding awe derives from its various positive effects, which include prosociality, wellbeing, and a motivation to learn.

Awe promotes prosociality. In brief, awe turns our minds outward rather than inward: toward other people, ideas, and the environment, and away from the self and personal concerns (Shiota, Thrash, Danvers, & Dombrowski, 2014; Stellar et al., 2017).

Awe is a self-transcendent emotion. Recent research has begun looking at the benefits of self-transcendent emotions—those emotions that encourage individuals to momentarily think about others rather than themselves. As a self-transcendent emotion, awe is hypothesized to encourage group cohesion by leading individuals to prioritize group goals over one's own goals, and thereby promoting prosocial behavior (Shiota et al., 2014; Stellar et al., 2017).

Evidence for awe as a self-transcendent emotion, directing individuals to consider others and their own relationships to the outer world, is reflected in how awe is associated with self-description. For instance, Shiota, Keltner, and Mossman (2007, Study 2) found that the dispositional tendency to experience awe correlated with abstract, non-trait "individuated" and "universal" self-descriptors (e.g., "special" and "inhabitant of Earth," respectively); the non-trait nature of these self-descriptors suggests a non-self-focused orientation. In a follow-up experiment that induced awe in some participants but not others, Shiota et al. (2007, Study 3) demonstrated that individuals who experienced more awe (i.e., standing next to a replica Tyrannosaurus Rex compared to a control condition)

again used more individuated non-trait descriptors. Bai et al. (2017) found results that also pointed to awe as influencing self-definition, in that reports of awe experiences correlated with scores on verbal and pictorial measures of self-diminishment. Bai et al. also linked awe to social group integration. Study 5 showed that individuals in China and the U.S. who experience awe (e.g., nature video) versus amusement (e.g., human voices dubbed over animals in the wild), reported more connection with their social groups (in Chinese participants, expressed in terms of greater closeness to others in one's social network; in American participants, expressed in terms of more social ties reported).

Awe promotes prosocial intentions and behavior. Evidence also suggests that awe promotes other-oriented behavior. Rudd, Vohs, and Aaker (2012), for example, recently found that individuals experiencing awe were willing to volunteer more time to help a researcher. Participants wrote about a personal experience in which they felt either awe (i.e., vast and overwhelming) or happiness (i.e., contentment or joy) before being given a questionnaire to assess how much time they would be willing to volunteer. Participants in the awe condition (compared to the happiness condition) were willing to volunteer more of their time, showing that the experience of awe (compared to other positive emotions) leads to prosocial behavior.

More recently, Piff, Dietze, Feinberg, Stancato, and Keltner (2015) investigated the role the experiences of awe played in having a sense of small self and prosocial tendencies. Across five studies, the researchers measured or induced awe in the participants before asking them to complete surveys and tasks

assessing their ethicality, generosity, and prosocial tendencies. In Study 5, for example, participants either spent a minute looking up at a eucalyptus grove (awe condition) or a tall building (control condition); the researchers subsequently recorded participants' prosocial tendencies as indexed by the number of pens they picked up that the researcher "accidentally" dropped. Participants who spent a minute looking up in the eucalyptus grove (compared to looking at the building) showed greater levels of prosocial tendencies by picking up more pens for the researcher. Similar trends were seen across all studies, with individuals who experience awe being more prosocial.

Awe is associated with greater wellbeing. Shoita, Keltner, and John (2006) assessed how a set of positive emotions (e.g., joy, contentment, compassion, pride, amusement, love, and awe) correlated with different personality traits (e.g., extraversion, conscientiousness, agreeableness, openness to experience, and neuroticism), and found that awe was positively correlated openness to experience and extraversion. Given that openness to experience promotes a variety of positive outcomes, this association suggests (indirectly) a positive association between awe and wellbeing. As more direct evidence, stronger tendencies to experience awe have also been shown to be a social-emotional resource for adult children of divorced parents (compared to non-divorced adult children; Bernstein, Keltner, & Laurent, 2012).

Stellar and colleagues (2017) have also argued that awe, as a self-transcendent emotion, promotes humility. Humility "involves holding a realistic, secure, and open view of the self" (p. 258) and has been associated with healthier

social relationships (Peters, Rowatt, & Johnson, 2011), increased altruism (LaBouff, Rowatt, Johnson, Tsang, & Willerton, 2012), as well as with greater wellbeing (Krause, Pargament, Hill, & Ironson, 2016) and resilience (Kesebir, 2014). Across five studies, Stellar et al. demonstrated that participants who experienced more verses less awe reported being humbler. In one experiment, for example, participants either went to the top of a bell tower (i.e., an awe experience because of its expansive view) or to the outside of a library (i.e., control condition); and found that those experiencing awe felt a smaller sense of self and reported feeling humbler than those in the control condition.

Awe may act as a catalyst for learning. Valdesolo, Shtulman, and Baron (2017) recently proposed that awe can be a catalyst for learning. The researchers discuss how the experience of awe is something that is perceived as a major violation to one's schemas, and that this violation allows individuals to identify the gap between knowledge and explanation. This gap in one's knowledge allows individuals to explore and expand, both crucial to the aspects of learning. Valdesolo et al. suggest further that making this knowledge gap salient to individuals (e.g., children learning science) will motivate them to want to learn more about awe-inducing science topics like atoms, electricity, genes, and gravity.

Supporting this perspective, Danvers and Shiota (2017) showed over a series of studies that awe led to reduced reliance on prototypical event scripts. In Study 1, for example, participants watched a video either eliciting awe (e.g., video of the universe), general positive emotion (e.g., Olympic figure skater long program), or neutral state (e.g., building tutorial video) before listening to a 5-

minute story. Danvers and Shiota found that individuals that watched the awe video (compared to positive and neutral) subsequently performed better at responding to knowledge-irrelevant questions, showing that awe assisted in individuals' retention of new, unexpected information.

Defining and Measuring Awe

Taking into account the various dictionary definitions and the different accounts of awe—philosophical, religious, and psychological—we speculate that there are four to five dimensions that contribute to the experience of awe. First, there are likely both positive and negative dimensions, in which awe is experienced as feeling wonder (e.g., at the Grand Canyon) or fear (e.g., of a severe thunderstorm). Second, awe likely involves overwhelming sensations (e.g., heart racing) and perceptions (e.g., time slowing). Finally, awe likely encompasses both self-diminishment and perceived vastness, in which individuals feel or recognize their smallness in the grand scheme of things.

There currently exist only two measures of awe—one dispositional and one situational. Examination of these measures, however, reveal a lack of fit with the complex construct definition suggested by the foregoing review.

Dispositional awe. To investigate the relationships between positive emotions and personality traits, Shiota and colleagues (2006) created the dispositional positive emotion scale (DPES), a 38-item self-report measure that assesses chronic tendencies to experience joy, contentment, compassion, pride, amusement, love, and awe. The 6-item awe subscale (DPES-awe) is a unidimensional measure with items such "I often feel awe" and "I feel wonder

almost every day." A reviewed earlier, Shiota et al. demonstrated that DPES-awe scores were associated with openness to experience. They were also associated with extraversion in this research, and other research using the DPES has linked awe to humility (Stellar et al., 2015, 2017), specific attachment styles (Nabi & Rizvi, 2015), and coping (Bernstein et al., 2012). Moreover, the DPES (including the DPES-awe) has been successfully translated and validated in countries like Iran, Malaysia, Poland, and Turkey (Akin, Akin, Turan, Kaya, & Altundag, 2014; Razavi, Zhang, Hekiert, Yoo, & Howell, 2016).

Despite the clear utility of the DPES-awe for identifying correlates of awe, however, it is nonetheless a dispositional measure. As a result, it provides little insight into what awe is or how it is experienced—that is, in how people experience awe in the moment or relive it when reflecting back of awe-inspiring experiences.

Situational awe. Piff and colleague (2015; Study 4) created a two-factor "small-self" scale to measure the extent to which awe-inducing experiences influence perceived vastness and self-diminishment. Examples of perceived vastness items included "I feel like I am in the presence of something grand," and examples of self-diminishment included "I feel small or insignificant." Both of these aspects of the small self are in line with Keltner and Haidt's (2003) two-factor model of awe (i.e., perceived vastness and need for accommodation). Moreover, attesting to the measure's utility, scores on the measure reliably differentiated participants exposed to awe-inducing versus baseline stimuli, and predicted subsequent prosocial behavior.

Nonetheless, the measure is not without limitations. Despite generating items to correspond to two factors, Piff et al. (2015) treated the scale as unidimensional, and indeed reported an internal consistency coefficient that supported this view. High alpha coefficients are no guarantee of unidimensionality (John & Benet-Martinez, 2000), however, providing a potential challenge to the structural validity of the measure. Moreover, Piff et al. make no reference to any attempts to validate the measure; they merely generated items that fit the two-factor model and assumed validity on the basis of results that supported their study hypotheses.

Perhaps more importantly, while the measure is in line with the dominant two-factor definition of awe provided by Keltner and Haidt (2003), it neglects the additional content suggested by treatments of awe conducted outside of psychology. For instance, Piff et al.'s (2015) measure does not reflect dictionary definitions that refer to awe as encompassing admiration mixed with wonder and fear; there is no "dark awe" component to the measure. Nor do they acknowledge the connection between the sublime and awe that the philosophers have been discussing for decades. Lastly, neither measure addresses research within psychology that connects physiological reactions to the experience of awe. This lack of comprehensive coverage of the construct suggests a measure that is incomplete.

The Current Research: Constructing and Validating a New Measure

Given the lack of a validated measure that reflects the full scope of the awe experience suggested by our review of extant literature, we sought to create a

comprehensive measure of awe. The item generation process involved informal focus group-type discussions with research group members who were not directly involved with the project. Across several weeks, we used the construct definition derived from the literature review and personal anecdotes to generate as many words and phrases as possible that (1) described our experiences accurately and (2) covered all of the dimensions of the construct definition. To keep the number of items manageable for administration and analysis, we identified and eliminated synonyms. This process resulted in 56 words and short phrases (depicted in Table 1).

Armed with the items generated on the basis of our construct definition, we conducted five studies. In Study 1, we conducted exploratory factor analysis to derive our dimensions and construct a preliminary measure. To validate our new measure, we examined the relationships between scores on our measure and other awe measures (to establish convergent validity), as well as several measures of wellbeing (to establish criterion validity). In Study 2, we conducted confirmatory factor analysis, and again tested convergent and criterion validity. Study 3 was a lab-based experiment in which participants watched awe-inducing videos designed to provide evidence of criterion, convergent, and discriminant validity. Study 4 explored awe "in the wild," examining the factor structure, convergent validity, and criterion validity of our measure in guests at the Museum of Science and Industry–Chicago. Finally, Study 5 explored the role of prior knowledge in the experience of awe, in an effort to increase the precision of our construct definition.

Table 1
Words and Phrases Used in Exploratory Factor Analysis, Study 1

Category	Items	Category	Items	Category	Items
Positive Affect	Amazed	Sensation	Heart racing	Self	Physically smaller
	Elevated		Breath taken away		Physically larger
	Enlightened		Chills		Clearer sense of my identity, who I am
	Excited		Goosebumps		Diluted sense of my identity, who I am
	Fearless		Floating		Feel like I am important, in the grand scheme of thi
	Free				Feel like I am trivial, in the grand scheme of things
	Grateful	Perception	More aware of body		Psychologically connected to everything/everyone
	Humbled		Less aware of body		Psychologically isolated from everything/everyone
	Inspired		Senses (sight, sound, etc.) heightened		Physically connected to everything/everyone aroun
	Liberated		Senses (sight, sound, etc.) diminished		Physically isolated from everything/everyone arour
	Relaxed		Time distorted		
	Serene		Time expanded	World	World as vast
			Time contracted		World as small
			Attention diffused		World as coherent/clear
			Attention sharpened		World as chaotic
			More focused		Everything seems connected
			Less focused		Everything seems disjointed
			People/objects moving strangely in relation to each other		
			Focused on small details		
			Seeing everything all at once		

Study 1: Construction and Preliminary Validation of the SAS

The goal of the first study was to construct a self-report measure of awe (the SAS), based on our theoretical analysis of the construct. We also sought to provide preliminary validation of the measure. To this end, we asked study participants to describe a time when they experienced awe, with instructions that encouraged them to recall specific details (e.g., where they were, who they were with) and thus to relive the experience more fully. Participants then rated this experience according to the 56 words or phrases that were generated to cover our theoretical analysis of awe; exploratory factor analysis was used to determine the structure of participants' awe experiences. Participants also completed two preexisting measures of awe (Piff et al., 2015; Shiota et al., 2006) to enable the assessment of convergent validity, and several measures of wellbeing to enable the assessment of criterion validity.

Research Question

Research question I. What is the structure of the awe experience? That is, how many factors are needed to characterize the experience?

Hypotheses

Hypothesis I. We predict that the SAS will show good convergent validity, correlating positively with other measures of awe.

Hypothesis Ia. We predict there to be a positive correlation between SAS composite and subscale scores and the DPES-awe (Shiota et al., 2006) scores. Although the DPES-awe measure is a trait-level measure and the SAS is a state-level measure, individuals who report experiencing awe more frequently (high

DPES-awe) should also be more likely to report awe in response to a specific experience (SAS).

Hypothesis Ib. We predict there to be a positive correlation between SAS composite and subscale scores and small-self awe (Piff et al., 2015) scores.

Hypothesis II. We predict that the SAS will show good criterion validity, correlating positively with wellbeing scores.

Hypothesis IIa. We predict that there will be a positive correlation between SAS composite and subscale scores and meaning in life (Steger, Frazier, Oishi, & Kaler, 2006) subscale scores.

Hypothesis IIb. We predict that there will be a positive correlation between SAS composite and subscale scores and satisfaction with life (Diener, Emmons, Larsen, & Griffin, 1985) scores.

Hypothesis IIc. We predict that there will be a positive correlation between SAS composite and subscale scores and subjective happiness (Lyubomirsky & Lepper, 1999) scores.

Hypothesis IId. We predict that there will be a positive correlation between SAS composite and subscale scores and gratitude (McCullough, Emmons, & Tsang, 2002) scores.

Method

Participants. Participants were 701[1] individuals recruited from the DePaul University Psychology Participant Pool and Amazon.com's Mechanical

[1] Subject numbers varied per analysis due to missing responses. To minimize data loss, we used pairwise deletion; the lowest *n* was 619.

Turk (MTurk) service. DePaul University students completed the study in exchange for partial course credit; MTurk participants were paid $2. Participant demographics are presented in Table 2.

Table 2
Sample Demographics as a Function of Source, Study 1

	DPU (n = 400)	MTurk (n = 301)
Age		
Mean (SD) in years	20.19 (3.03)	33.67 (9.45)
Range	18–50	19–69
Gender		
Female	313	125
Male	79	176
Other	3	0
Unspecified	5	0
Race/Ethnicity		
American Indian/Native	1	5
Black/African American	27	25
Asian/Pacific Islander	32	22
Hispanic/LatinX	76	18
Middle Eastern	12	1
White	216	228
Multiracial	27	6
Other	4	1
Unspecified	5	0

Note. DPU = DePaul University; MTurk = Amazon Mechanical Turk.

In accordance with IRB requirements, all participants received information on the experimental procedure prior to participating. Following the completion of all tasks, participants were debriefed and compensated accordingly.

Procedure and materials. Participants completed a study on *Understanding Awe* online. The study was hosted on Qualtrics

(http://www.qualtrics.com), enabling each participant to complete the study at their own convenience and in their preferred location.

Data were collected in three waves. With the exception of the target measures, there were minor differences across waves in the measures that were administered. Table 3 provides an overview of the target measures and the resultant sample sizes for each. Appendix A provides an exhaustive list of all of the Study 1 measures, and the full materials are presented in Appendix B.

The following describes only the measures that were used in the current research.

Describing awe. Participants described an awe experience. The specific instructions, which were tailored to encourage participants to relive the experience in as much detail as possible, read as follows:

> Describe, as vividly as possible, a time when you felt awe. What triggered it? What were you doing? Where were you? Who were you with?

Small-self awe. Participants complete a small-self awe measure (Piff et al., 2015). Participants rated the extent to which the disagreed versus agreed with each of 10 statements along a 7-point scale anchored by *disagree strongly* and *agree strongly*. The *vastness* subscale includes items such as “I felt like I was part of a greater whole” and the *self-diminishment* subscale includes items such as “I felt small or insignificant.”

Table 3
Sample Size per Questionnaire, Study 1

Measure	*N*
Awe Ratings	
Centrality/Importance	697
Valence	77
Small Self	
Vastness	609
Self-Diminishment	611
DPES-Awe	608
Meaning in Life	
Presence of Meaning	698
Search of Meaning	698
Satisfaction with Life Scale	698
Happiness	698
Gratitude	697
Nature Relatedness Scale	
NR–Self	620
NR–Perspective	620
NR–Experience	620
Liking of Awe	621
Ideal Affect	
Ideal Ratings	76
Typical Ratings	77
Proneness to Awe	77
Situational Self-Awareness Scale	77
Need for Cognitive Closure Scale	77
Ten-Item Personality Inventory	77
Coping	73

Note. Sample sizes for each measure were calculated using listwise deletion.

Situational awe. Participants rated the extent to which each of 56 words or phrases (see Table 1) were central/important to their experience of awe, along a 5-

point scale anchored by *not at all* and *extremely*.[2] Participants were then given the opportunity to list up to 10 additional words or phrases that they believed were important to describe awe.

Dispositional awe. Participants completed the awe subscale of the Dispositional Positive Emotion Scale (DPES-awe; Shiota et al., 2006). They rated the extent to which they disagreed versus agreed with six items, such as "I often feel awe" and "I feel wonder almost every day." Ratings were made along a 7-point scale anchored by *disagree strongly* and *agree strongly*.

Wellbeing. Participants completed four measures of wellbeing, presented in random order.

Meaning in life. Participants completed a two-factor meaning in life scale (Steger et al., 2006). Participants rated the extent to which each of 10 statements were true, along a 7-point scale anchored by *not at all true* and *completely true*. The *presence of meaning* subscale includes items such as "I understand my life's meaning;" the *search for meaning* subscale includes items such as "I am seeking a purpose of mission for my life."

Daily gratitude. Participants responded to six items assessing their daily gratitude (McCullough et al., 2002). They rated the extent to which they disagreed versus agreed with statements such as "I have so much in life to be thankful for" and "Long amounts of time can go by before I feel grateful to something or

[2] Participants also rated the extent to which each of the same items were negative versus positive in the context of awe, along a 7-point scale anchored by *extremely negative* and *extremely positive.* These ratings were included for exploratory purposes and were not analyzed for this dissertation.

someone" (reverse-scored). Ratings were made along a 7-point scale anchored by *disagree strongly* and *agree strongly*.

Life satisfaction. Participants completed a five-item satisfaction with life scale (SWLS; Diener et al., 1985). They indicated the extent to which they disagreed versus agreed with statements such as "In most ways my life is close to my ideal" and "If I could live my life over, I would change almost nothing" (reverse-scored). Ratings were made along a 7-point scale anchored by *disagree strongly* and *agree strongly*.

Subjective happiness. Participants completed a four-item subjective happiness scale (Lyubomirsky & Lepper, 1999). Using 7-point scales, they responded to items such as "In general I consider myself…" (anchored by *not a very happy person* and *a very happy person*) and "Compared to most of my peers, I consider myself…" (anchored by *less happy* and *more happy*).

Results

Exploratory factor analysis. The situational awe ratings were analyzed using common factor analysis, specifically a principal axis factoring (PAF). Common factor analysis is recommended for analyses intended to aid in development, and PAF is specifically recommended if one expects multivariate normality to be violated (Costello & Osborne, 2005; Yong & Pearce, 2013). Because we specifically asked participants to generate memories of high-awe experiences, we did not expect to obtain normally distributed ratings of those experiences.

The factorability of the 56 items was examined to ensure that the data could be analyzed. Bartlett's test of sphericity (Barlett, 1950) was significant, $\chi 2$ (1,540) = 18,839.02, $p < .001$, and Kaiser-Meyer-Olkin (KMO; Kaiser & USCG, 1974) measure of sampling adequacy was .96, well above the .8 we set as our criteria.

Since these conditions were satisfied, we fit our data using an oblimin rotation (Kaiser, 1958). The key reason for this choice was that it was reasonable to expect that there would be correlations among the factors, given that they were designed to reflect different components of one central construct. We set our delta level (i.e., ranging from -4 to 1, such that higher values allow more highly correlated factors) to 0, which allowed a moderate level of factor correlation.

We extracted the factors with eigenvalues at 1.00 or higher (Guttman, 1954; Kaiser, 1960, 1970; Nunnally & Bernstein, 1994). Because of the large number of items in our study, we obtained a total of seven factors with eigenvalues above 1.05 (Gorsuch, 1983) that accounted for 54.46% of the total variance. Thus, we looked at the scree plot visually identify the ideal number of factors for the model based on the number of factors to the left of the inflection point in the eigenvalue plot (Cattell, 1966). Based on this we determined that the inflection point on the graph occurred at the five-factor mark, which gives us a scale made up of four factors.

Finally, we conducted a parallel analysis, which allows eigenvalues from the PAF to be compared to eigenvalues randomly generated to represent the mean and 95th percentile, providing a third check on the appropriate number of factors

to use (Glorfeld, 1995; Horn, 1965). Similar to our initial analysis of factors with eigenvalues at 1.00 or higher, the parallel analysis showed that of the total possible number of factors, seven factors were greater than the mean and 95th percentile eigenvalues randomly generated. However, of these seven, only four had eigenvalues that were greater than 1.00, once again leading us to conclude that the scale is a four-factor measure. These four factors accounted for 47.99% of the total variance with the variance breakdown across the factors as follows: the first factor (liberation/connection) accounted for 28.00% of the variance, the second factor (oppression/isolation) accounted for 12.81% of the variance, the third factor (chills) accounted for 3.69% of the variance, and the fourth factor (small-self/vast-world) accounted for 3.49% of the variance.

Looking at the pattern matrix (the coefficients that represent the unique relationship of a factor to a variable), we identified the items that loaded on to each factor according to both empirical and theoretical criteria. Empirically, we initially set the required factor loading for each item to be at least .40, but also considered items slightly below this threshold to ensure that each factor was represented by a reasonable number of items. The content of the factors was then examined with the goal of identifying the underlying construct or theme. In cases of items that loaded on to multiple factors, we either retained them for the factor for which they seemed thematically appropriate or discarded them if there was no clear thematic relationship.

Table 4
Factor Loadings for Principal Axis Factoring Analysis, Study 1

	Factor			
	1	2	3	4
Physically connected to everyone/everything around me	.662			
Everything seems connected	.625			
Closer sense of my identity, who I am	.552			
Feel like I am important, in the grand scheme of things	.527			
Psychologically connected to everyone/everything around me	.520			
Grateful	.452			
Enlightened	.424			
Liberated	.414			
Free	.406			
Relaxed	.404			
Afraid		.805		
Tense		.752		
Anxious		.711		
Confined		.621		
Oppressed		.590		
Suffocated		.565		
World as Chaotic		.454		
Everything seems disjointed		.385		
Goosebumps			.702	
Chills			.676	
Heart racing			.533	
Breath taken away			.498	
Excited			.480	
Amazed			.423	
Physically smaller				.665
Feel like I am trivial in the grand scheme of things				.547
World as vast				.440

Note: Obliman ($\delta = 0$); rotation converged in 23 iterations. Items retained for the scale are indicated in bold.

As depicted in Table 4, across the four factors, there were a total of 25 items with factor loadings about .40; based on our interpretation of the factor themes, we determined that 18 of the 25 items were consistent with the identified themes.

Liberation/connection. Ten items initially loaded onto this factor. Examination of the items suggested two major, related themes: liberation and connection. There were four items that loaded onto this factor (e.g., *feel like I am important in the grand scheme of things*, *grateful*,[3] *enlightened*, and *relaxed*) but did not fit well with these themes. Removing these four items gave this factor greater coherence, and also increased the factor's inter-item correlation mean (from .48 to .54) and lowered its inter-item correlation range (from .35 to .17). There was a small but unproblematic decrease in Cronbach's alpha (from .90 to .88).

Oppression/isolation. Eight items initially loaded onto this factor. Examination of the items suggested two major, related themes: oppression and isolation. Three items (*afraid*, *anxious*, and *world as chaotic*) were judged to not fit the themes. By removing these items, we achieved greater coherence and a lower inter-item correlation range (.25 to .12). Cronbach's alpha decreased (from .88 to .85) but was still very good.

Chills. Six items initially loaded onto this factor. Examination of the items suggested that two items (*amazed*, *excited*) did not reflect the underlying theme of

[3] In fact, this item was included in error; because gratitude is an indicator of wellbeing, it is better conceptualized as a correlate rather than component of awe.

physiological response. By removing these items, we achieved greater coherence, as well as increasing the mean inter-item correlation (from .402 to .510), lowering the inter-item correlation range (from .574 to .313), and increasing Cronbach's alpha (from .80 to .81).

Small-self/vast-world. Three items initially loaded onto this factor. Examination of the items suggested that they all cohered around one theme: one's own size or importance relative to the broader "world." All items were retained.

Once the final items were chosen, composite and subscale scores were calculated by averaging across the relevant items, reverse-scoring where necessary; higher scores indicated stronger awe. Scale descriptives and inter-scale correlations for the SAS and all other measures are presented in Table 5.

Convergent validity. To establish convergent validity, we examined whether the SAS composite and subscale scores correlated with small-self and dispositional awe scores. All scales and subscale scores were calculated by averaging across the relevant items, reverse-scoring items where necessary, such that higher scores indicated stronger awe.

The small-self and dispositional awe measures both showed good reliability (α = .87 and .82, respectively). Mean inter-item correlations were .405 and .436, respectively (BrckaLorenz, Chiang, & Nelson Laird, 2013). The range of inter-item correlations were within the desired range for the DPES-awe (.308), but higher than recommended for the small-self awe (.786; Clark & Watson, 1995). The range of inter-item correlations for the small-self awe measure suggests that scale might not be unidimensional; however, given that it has been

Table 5
(Sub)Scale Means, Standard Deviations, and Reliability Coefficients, and Inter-Scale Correlations, Study 1

	M	*SD*	α	1	2	3	4	5	6	7	8	9	10	11
1. SAS Total	2.79	0.71	.88											
2. SAS Liberation/Connection	3.21	1.05	.87	.795**										
3. SAS Oppression/Isolation	1.73	0.86	.85	.543**	.074									
4. SAS Chills	3.43	1.02	.81	.788**	.523**	.315**								
5. SAS Small Self/Vast World	2.92	1.04	.69	.677**	.427**	.268**	.398*							
6. Small-Self Awe	5.08	1.24	.87	.450**	.466**	- .006	.277**	.545**	.					
7. DPES Awe	4.83	1.13	.82	.293**	.356**	.070	.223**	.092*	.185**					
8. Search for Meaning in Life	4.79	1.62	.94	.300**	.281**	.168**	.206**	.147**	.174**	.220**				
9. Presence of Meaning in Life	4.77	1.44	.90	.099**	.174**	- .006	.086*	- .033	.017	.342**	- .193**			
10. Subjective Happiness	4.64	1.42	.89	.120**	.178**	- .019	.108**	.030	.081*	.414**	- .180**	.530**		
11. Daily Gratitude	5.74	1.15	.86	.096*	.214**	- .167**	.160**	- .005	.163**	.449**	.000	.450**	.506**	
12. Satisfaction with Life	4.64	1.49	.90	.121*	.149**	.044	.094*	.021	.093*	.392**	- .121**	.562**	.657**	.502**

Note. SAS = Situational Affect Scale. DPES = Dispositional Positive Emotion Scale. For all scales and subscales, possible range = 1 to 7. * $p < .05$; ** $p < .01$.

used in prior research as a unidimensional measure, we elected to treat it as such here.

As depicted in Table 5, scores on the small-self awe measure correlated positively with SAS composite score, as well as with scores on the liberation/connection, chills, and small-self/vast-world subscales. Scores on the DPES-awe measure correlated positively with SAS composite scores, as well as with scores on the liberation/connection, chills, and small-self/vast-world subscales. Scores on neither measure correlated with scores on the oppression/isolation subscale.

Criterion validity. To establish criterion validity, we examined whether the SAS composite and subscale scores correlated with the wellbeing scale and subscale scores, based on the reasoning that awe promotes wellbeing. All scales and subscales were calculated by averaging across the relevant items, reverse-scoring items where necessary, such that higher scores indicated stronger awe.

All of the well-being measures showed good reliability (all $\alpha > .86$). Mean inter-item correlations were all greater than .547 (BrckaLorenz et al., 2013), and the range of inter-item correlations for all of the measures was below .426, well within the desired range (Clark & Watson, 1995).

As depicted in Table 5, composite SAS scores and scores on the liberation/connection subscale correlated positively with scores on all of the wellbeing measures. The results were mixed for the oppression/isolation, chills, and small self/vast world subscales: Scores on the oppression/isolation subscale correlated positively with search for meaning in life, but negatively with presence

for meaning in life and daily gratitude. Scores on the chills subscale correlated positively with search for meaning in life and gratitude. Scores on the small self/vast world subscale correlated positively with search for meaning in life.

Discussion

The primary aim of this study was to construct a self-report measure of awe (the SAS), based on our theoretical analysis of the construct. We sought to provide preliminary validation of the measure by having participants describe a time when they experienced awe, and then to rate this experience according to the 56 words or phrases that were generated to cover our theoretical analysis of awe. The results of an exploratory factor analysis suggested that awe experiences could be captured by 18 items reflecting four factors: liberation/connection, oppression/isolation, chills, and small self in a vast world.

We also conducted a preliminary assessment of the criterion and convergent validity of our new measure. For the convergent validity analysis, we examined the pattern of correlations between composite and subscale scores for our measure with two preexisting measures of awe: Piff et al.'s (2015) situational small-self measure, and Shiota et al.'s (2006) dispositional awe tendency measure. Both measures correlated positively with the SAS composite score, as well as with scores on the liberation/connection, chills, and small self/vast world subscales, providing supportive evidence that our new measure taps into a similar underlying construct as previously used measure.

Of particular interest were the results of the criterion validity analysis, in which we assessed the correlations between composite and subscale scores for our

measure with measures of wellbeing (i.e., presence of meaning in life, search for meaning in life, subjective happiness, daily gratitude, and satisfaction with life). The analysis provided clear evidence for associations between the facets of awe related to feeling liberated/connected and experiencing chills on the one hand, and all targeted measures of wellbeing on the other. The results were less clear for the oppression/isolation and small self/vast world factors, in that there was no evidence that either factor was associated with presence of meaning in life, subjective happiness, or satisfaction with life.

Importantly, however, scores on both the oppression/isolation and small self/vast world subscales correlated positively with the search for meaning. That all four of the SAS subscales correlated positively with search for meaning is encouraging, given that awe is purportedly in response to an experience so vast that it cannot be fully understood and the update of ones schema is required. If awe truly is accompanied by a need to derive meaning from the experience, then the consistent correlations between all four awe subscales and search from meaning observed in this study provide evidence in favor of the construct validity of the SAS.

This pattern also somewhat mitigates against concerns about the lack of observed correlation between scores on the oppression/isolation subscale with scores on the preexisting awe measures. With the oppression/isolation subscale showing significant positive correlations with the search for meaning subscale, we can infer tentatively that the oppression/isolation factor is an aspect of awe. Why there was no evidence for a relationship between oppression/isolation and either

small-self or DPES-awe, however, remains unclear.

Although this study provided encouraging evidence for the validity of our proposed measure of situational awe, the results are nonetheless preliminary. Additional research is required to confirm the proposed four-factor structure of awe, and to replicate the evidence for convergent and criterion validity.

Study 2: Confirmatory Factor Analysis and Additional Validation

The goal of Study 2 was to provide evidence for the structural validity of the SAS, by confirming the factor structure uncovered in Study 1 and comparing it against a two factor structure (cf. Keltner & Haidt, 2003). We also sought to provide additional evidence of the measures convergent and criterion validity, using the same awe and wellbeing measures as in Study 1.

Hypotheses

Hypothesis I. We expected to replicate the factor structure from Study 1; that is, we predicted that a solution in the confirmatory factor analysis (CFA) with the same number of factors as extracted in the EFA (i.e., four) would provide a good fit to participants' responses on the SAS.

Hypothesis Ia. We predicted that the identified factors would be adequately described with the same subscale labels as in Study 1 (liberation/connection, oppression/isolation, chills, small-self/vast-world) and that the items would show adequate loadings on their specified factors.

Hypothesis II. We predicted that the SAS would show good convergent validity, correlating positively with other measures of awe.

Hypothesis IIa. We predicted that there to be a positive correlation between SAS composite and subscale scores and DPES-awe (Shiota et al., 2006) scores.

Hypothesis IIb. We predicted there to be a positive correlation between SAS composite and subscale scores and situational awe (Piff et al., 2015) scores.

Hypothesis III. We predicted that the SAS would show good criterion validity, correlating positively with wellbeing scores.

Hypothesis IIIa. We predicted that there would be a positive correlation between SAS composite and subscale scores and meaning in life (Steger et al., 2006) subscale scores.

Hypothesis IIIb. We predicted that there would be a positive correlation between SAS composite and subscale scores and satisfaction with life scale (Diener et al., 1985) scores.

Hypothesis IIIc. We predicted that there would be a positive correlation between SAS composite and subscale scores and subjective happiness (Lyubomirsky & Lepper, 1999) scores.

Hypothesis IIId. We predicted that there would be a positive correlation between SAS composite and subscale scores and gratitude (McCullough et al., 2002) scores.

Method

Participants. Participants were 672 individuals recruited from the DePaul University Psychology Participant Pool (N = 425) and Amazon.com's MTurk service (N = 247). DePaul University students completed the study in exchange

for partial course credit; MTurk participants were paid $2. Participant demographics are presented in Table 6.

Table 6
Sample Demographics as a Function of Sample, Study 2

	DPU (n = 425)	MTurk (n = 247)
Age		
Mean (SD) in years	20.07 (2.96)	35.68 (10.89)
Range	17–55	19–73
Gender		
Female	315	114
Male	108	133
Other	1	0
Unspecified	1	0
Race/Ethnicity		
American Indian/Native	1	5
Black/African American	36	31
Asian/Pacific Islander	39	7
Hispanic/LatinX	80	16
Middle Eastern	15	1
White	230	178
Multiracial	19	8
Other	5	1
Unspecified	1	0

Note. DPU = DePaul University; MTurk = Amazon Mechanical Turk.

In accordance with IRB requirements, all participants received information on the experimental procedure prior to participating. Following the completion of all tasks, participants were debriefed and compensated accordingly.

Procedure and materials. The survey for the CFA was nearly identical to that of the PAF, with the main difference being that participants' ratings of their own awe experiences were made using only the words or phrases to describe awe

that were extracted from the PAF. Participants described an awe experience, rated that experience according to the words and phrases extracted in Study 1, and completed the same awe and wellbeing measures as in Study 1.

Results

Structural validity. The SAS ratings were subjected to CFA using the Lavaan software package within R, using maximum likelihood estimation because of the size of our sample and its common use with a CFA. Based on the results of Study 1, we specified our model so that the appropriate latent variables (i.e., factors) correlated with one another, enabling us to account for more of the variance in the model. The theoretical model that we tested is depicted in Figure 1.

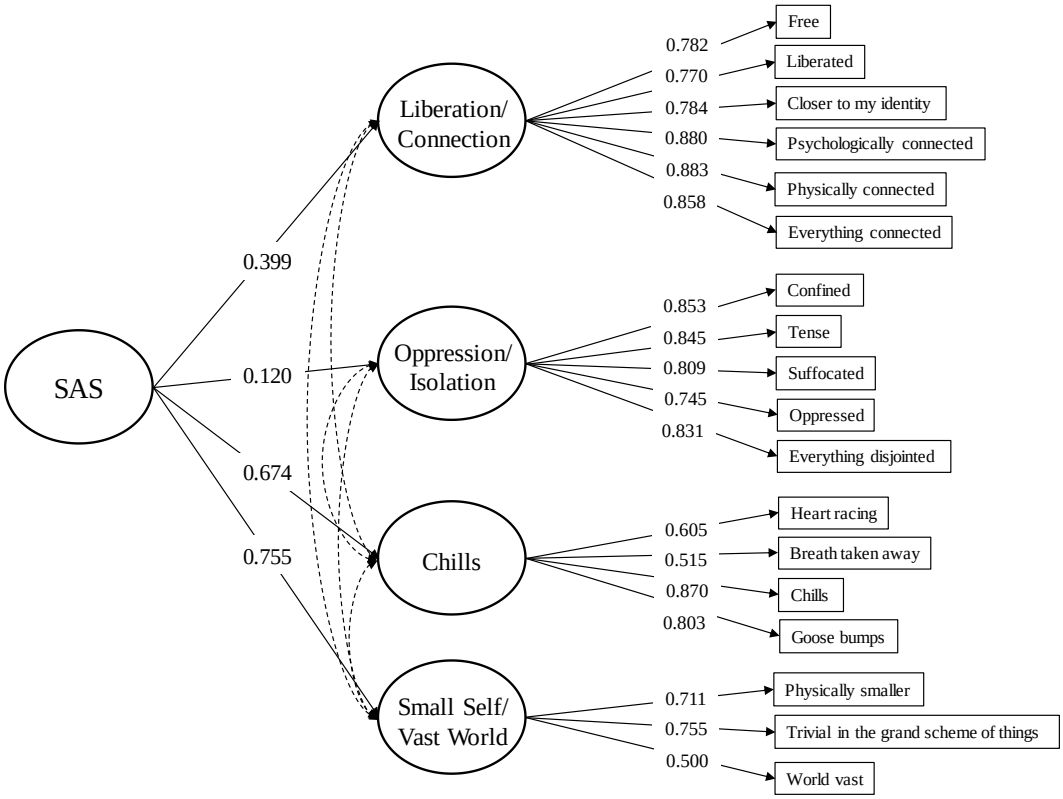

Figure 1. Theoretical structural model, Study 2.

Several checks on the data were done to assess the fit of the model. First, a Chi Square (χ^2) test of model fit was conducted in which we rejected the null hypothesis, $\chi^2(126) = 661.557$, $p < .001$. While we had aimed to retain the null hypothesis, it is not uncommon to reject the null hypothesis with smaller discrepancies between the data and the predicted model as the sample size increases (Bandalos, 2018). The root mean square error of approximation (RMSEA) and the standardized root mean square residual (SRMR) were both acceptable, at or below the .08 threshold for model fit (Hu & Bentler, 1999): RMSEA = .08 (95% CI [.074, .086], $p < .001$) and SRMR = .072. The comparative fit index (CFI) and Tucker-Lewis index (TLI) were slightly below threshold (.95; Hu & Bentler, 1999) at .89 and .87, respectively.

We also examined the Akaike information criteria (AIC) and Bayesian information criteria (BIC), which assess the model's parsimony. The values for the AIC and BIC were 34,061 and 34,322, respectively. These numbers, as well as the Chi square test, were used to assess whether our model is a better fit than a two-factor model. Such a model might be expected given the presence of positively and negatively valenced items, but also on the basis of Keltner and Haidt's (2006) formulation of awe as reflecting vastness and need for accommodation. A Chi-Square difference test compared the chi-square and degrees of freedom values associated with the two models (i.e., our four factor SAS model and the theoretical two factor model) and determined that our SAS model was a significantly better model than the theoretical two factor model, $\chi^2(8) = 671.33$, $p < .001$.

Thus, the fit indices suggested a good but not perfect replication of the factor structure uncovered in Study 1's EFA. Examination of the item loadings, however, mitigated against concerns about the fit, in that the 18 items loaded adequately on the factors specified in Study 1 (see Figure 1). Overall, then, the structural validity of the SAS was confirmed.

Once the final items were chosen, composite and subscale scores were calculated by averaging across the relevant items, reverse-scoring where necessary; higher scores indicated stronger awe. Scale descriptives and inter-scale correlations for the SAS and all other measures are presented in Table 7.

Convergent validity. To establish convergent validity, we examined whether the SAS composite and subscale scores correlated with small-self (Piff et al., 2015) and DPES-awe (Shiota et al., 2006) scores. All scales and subscale scores were calculated by averaging across the relevant items, reverse-scoring items where necessary, such that higher scores indicated stronger awe.

The small-self and dispositional awe measures both showed good reliability (α = .86 and .81, respectively). Mean inter-item correlations were .387 and .418, respectively (BrckaLorenz et al., 2013). The range of inter-item correlations were within the desired range for the DPES-awe (.282), but once again higher than recommended for the small-self awe (.698; Clark & Watson, 1995). The range of inter-item correlations for the small-self awe measure suggests that scale might not be unidimensional; given that it has been used in prior research as a unidimensional measure, however, we elected to treat it as such here.

Table 7
(Sub)Scale Means, Standard Deviations, and Reliability Coefficients, and Inter-Scale Correlations, Study 2

	M	*SD*	α	1	2	3	4	5	6	7	8	9	10	11
1. SAS Total	2.89	0.65	.84											
2. SAS Liberation/Connection	3.35	0.96	.86	.760**										
3. SAS Oppression/Isolation	1.82	0.89	.86	.555**	.040									
4. SAS Chills	3.46	0.96	.78	.729**	.445**	.246**								
5. SAS Small Self/Vast World	3.01	1.00	.66	.639**	.372**	.246**	.294**							
6. Small-Self Awe	5.08	1.24	.87	.369**	.367**	- .023	.165**	.573**	.					
7. DPES Awe	4.83	1.13	.82	.253**	.324**	.030	.142**	.162*	.189**					
8. Search for Meaning in Life	4.91	1.56	.88	.273**	.241**	.122**	.225**	.142**	.117**	.282**				
9. Presence of Meaning in Life	4.78	1.36	.94	.013	.124**	- .076*	- . 008	- .045	.102**	.309**	- .174**			
10. Subjective Happiness	4.56	1.33	.85	.073	.132**	- .019	.054	.003	.021	.351**	- .136**	.567**		
11. Daily Gratitude	5.69	1.16	.84	- .019	.168**	- .304**	.079*	- .032	.149**	.289**	.124**	.403**	.410**	
12. Satisfaction with Life	4.68	1.37	.87	.141**	.208**	.007	.074	.049	.154*	.316**	- .007	.560**	.620**	.389**

Note. SAS = Situational Affect Scale. DPES = Dispositional Positive Emotion Scale. For all scales and subscales, possible range = 1 to 7. * $p < .05$; ** $p < .01$.

As depicted in Table 7, scores on both the small-self awe and DPES-awe measures correlated positively with SAS composite score, as well as with scores on the liberation/connection, chills, and small-self/vast-world subscales. Scores on neither measure correlated with scores on the oppression/isolation subscale.

Criterion validity. To establish criterion validity, we examined whether the SAS composite and subscale scores correlated with the wellbeing scale and subscale scores, based on the reasoning that awe promotes wellbeing. All scales and subscales were calculated by averaging across the relevant items, reverse-scoring items where necessary, such that higher scores indicated stronger awe.

All of the well-being measures showed good reliability (all $\alpha > .84$). Mean inter-item correlations were all greater than .504 (BrckaLorenz et al., 2013), and the range of inter-item correlations for all of the measures was below .504, well within the desired range (Clark & Watson, 1995).

As depicted in Table 7, composite SAS scores and scores on the liberation/connection and chills subscales correlated positively with scores on all of the wellbeing measures. The results were mixed for the oppression/isolation and small self/vast world subscales: Scores on the oppression/isolation subscale correlated positively with search for meaning in life, but negatively with daily gratitude. Scores on the small self/vast world subscale correlated positively with search for meaning in life.

Discussion

The primary aim of this study was to validate the SAS, specifically to confirm the factor structure uncovered in Study 1. The results were largely

supportive: Although some of the model fit indices (Chi square, CFI, and TLI) suggested that our model was shy of adequately fitting the data, two key indices (RMSEA and SRMR) provided good support. Moreover, the items loaded onto the same factors as in Study 1, confirming our interpretation of those factors (i.e., as reflecting liberation/connection, oppression/isolation, chills, and small self/vast world). In addition, a model comparison analysis demonstrated that our model was a better fit to the data than a two-factor model, as proposed by Keltner and Haidt (2003). Together, these results reassure us that awe is indeed a four-factor construct and that the SAS has good content validity.

Looking at the figure of our model, a few things standout. First, looking at the latent variables, we see that two of the four (liberation/connection and oppression/isolation) appear to load poorly onto the overall SAS structure. While at first glance this may be concerning, there are both statistical and theoretical reasons to argue otherwise. Statistically, the weak loading for liberation/connection makes sense because of the correlations between this latent variable and the other latent variables in the model. Because liberation/connection is highly correlated with chills and small-self/vast-world, we see a diminishment in its factor loading onto SAS. Indeed, in the alternative two-factor model that was used for model comparison purposes, the liberation/connection, chills, and small-self/vast-world items all loaded onto one factor. Recall, however, that this two-factor model was a poorer overall fit for the data than our proposed four-factor model. Theoretically, there is good reason to separate the liberation/connection, chills, and small-self/vast-world constructs while

simultaneously expecting them to be correlated: While feelings of liberation and connection might describe the actual emotional experience, feeling chills or feeling small given the vastness of the world might reflect the physical and psychological appraisals that evoke the emotion (Keltner & Haidt, 2003).[4]

We also conducted an assessment of the criterion and convergent validity of the SAS. The results were remarkably consistent with Study 1: As in Study 1, scores on Piff et al.'s (2015) situational small-self measure and Shiota et al.'s (2006) dispositional tendency to experience awe (DPES-awe) measure correlated positively with the SAS composite score, as well as with scores on the liberation/connection, chills, and small self/vast world subscales, providing further evidence for convergent validity. Similarly, we replicated the pattern of criterion validity, providing clear evidence for positive associations between the facets of awe related to feeling liberated/connected on the one hand, and all targeted measures of wellbeing on the other. We also replicated the positive correlations between scores on the oppression/isolation, chills, and small self/vast world subscales on the one hand, and scores on the search for meaning subscale on the other.

In sum, this study supported the four-factor structure of awe suggested by Study 1's results and replicated the evidence for convergent and criterion validity. In Study 3, we examined the predictive validity of the SAS.

[4] The weak loading for the latent oppression/isolation construct may reflect the challenge of inducing dark awe in empirical tests. We will revisit this point in the General Discussion.

Study 3: Situational Awe in the Lab

In Studies 1 and 2, participants recalled an awe experience before responding to the SAS items. Providing evidence of convergent validity, SAS scores correlated with previous measures of both dispositional and situational awe (DPES-awe and small-self awe, respectively). To establish that the SAS truly assesses *situational* awe, we need to demonstrate that SAS scores vary in response to situations that elicit more versus less awe. In Study 3, we provide this evidence. In Study 3a, participants viewed a video intended to induce positively valenced awe, or a baseline video. In Study 3b, participants viewed the same videos; Study 3b was conducted to address an error in Study 3a in which one of the SAS items was inadvertently omitted. Finally, in Study 3c, participants viewed a video intended to induce negatively valenced awe, or a baseline video. In all studies, participants then completed the SAS, the DPES-awe, and the small-self awe measures.

Hypotheses

Hypothesis I. The awe and baseline videos will induce different emotions.

Hypothesis Ia. Participants' exposed to the awe video will report more awe than participants exposed to the baseline video.

Hypothesis Ib. Participants' reports of non-awe emotions (positive and negative) will not differ as a function of video seen.

Hypothesis II. Participants' SAS scores will vary as a function of video.

Hypothesis IIa. In Study 3a and Study 3b, participants exposed to the positive awe versus baseline video will report higher scores on the

liberation/connection, chills, and small self/vast world SAS subscales; scores on the oppression/isolation subscale will not differ as a function of video.

Hypothesis IIb. In Study 3c, participants exposed to the negative awe versus baseline video will report higher scores on the oppression/isolation, chills, and small self/vast world SAS subscales; scores on the liberation/connection subscale will not differ as a function of video.

Hypothesis III. We predicted that the SAS will show good convergent validity, correlating positively with other measures of awe.

Hypothesis IIIa. We predicted there to be a positive correlation between SAS composite and subscale scores and the DPES-awe (Shiota et al., 2006) scores.

Hypothesis IIIb. We predicted there to be a positive correlation between SAS composite and subscale scores and small-self awe (Piff et al., 2015) composite and subscale scores.

Hypothesis IV. We predicted that there will be no difference in participants' DPES-awe score across the different conditions. Although DPES-awe and SAS scores should correlate positively because individuals who report experiencing awe more frequently (high DPES-awe) should also be more likely to report awe in response to a specific experience (SAS), DPES-awe measures a trait-level construct and thus should not respond to specific experiences.

Method

Participants. Participants were 139 individuals (40 in Study 3a, 43 in Study 3b, and 56 in Study 3c) recruited from the DePaul University Psychology

Participant Pool in exchange for partial course credit. A total of 6 participants (3 each in Study 3a and Study 3b) were excluded from analysis for failing the manipulation check, bringing our final participant count to 133 (i.e., 37 in Study 3a, 40 in Study 3b, and 56 in Study 3c). Participant demographics are presented in Table 8.

Table 8
Sample Demographics as a Function of Substudy, Study 3

	Study 3a (n = 37)	Study 3b (n = 40)	Study 3c (n = 56)
Age			
Mean (SD) in years	19.19 (1.88)	20.35 (3.00)	19.71 (1.522)
Range	18–28	18–31	18–25
Gender			
Female	28	28	42
Male	9	12	14
Other	0	0	0
Unspecified	0	0	0
Race/Ethnicity			
American Indian/Native	0	0	0
Black/African American	4	2	6
Asian/Pacific Islander	4	2	2
Hispanic/LatinX	6	5	9
Middle Eastern	1	1	2
White	16	23	32
Multiracial	5	6	4
Other	0	0	0
Unspecified	1	1	1

Note. Studies 3a and 3b = positive versus baseline; Study 3c = negative versus baseline.

In accordance with IRB requirements, all participants received information on the experimental procedure prior to participating. Following the completion of all tasks, participants were debriefed and compensated accordingly.

Procedure and materials. The procedure for all three studies was almost identical. All individuals watched a nature video and then completed several measures: an emotion manipulation check (rating the extent to which they felt *amusement*, *anger*, *awe*, *disgust*, *fear*, *happiness*, and *sadness*, along 7-point scales anchored by 0 (*not at all*) and 6 (*very much*)), the sentence-formatted SAS (see Appendix C), the small-self awe measure (Piff et al., 2015), and the DPES-awe (Shiota et al., 2006). Finally, included within the demographics questionnaire was manipulation check question that asked participants to indicate what type of video they just watched (mountain scenery, thunder storms, or close-up nature images). Failure to respond accurately to this question excluded the participant from any analysis.

Differences across studies. It is important to note that across the studies, the administration of the awe measures differed in minor ways. First, one SAS item was omitted in error in Study 3a. Second, the scale anchors and labels were changed. In Study 3a, participants responded to all three awe measures along a 0 (*not at all*) to 6 (*very much*) scale; in Study 3b and Study 3c, they responded along a -3 (*disagree strongly*) to +3 (*agree strongly*) scale. We were simply interested in whether the pattern of responses would differ as a function of scale labeling.

Stimulus videos. Participants in Study 3a and Study 3b were assigned randomly to view either a video intended to elicit positively valenced awe or a baseline video, whereas participants in Study 3c were assigned randomly to view either a video intended to elicit negatively valenced awe or a baseline video.

Studies 3a, 3b: Positive awe and baseline videos. The positive awe video depicted landscape scenes that dynamically shifted in scope from close up to far away to convey vastness (one of the known elicitors of awe; Keltner & Haidt, 2003) and that had a music soundtrack with similar "scope" shifts (e.g., in loudness and intensity, presence of crescendos, sudden changes in dynamics). For the baseline condition, the video also depicted nature scenes and had a music soundtrack, but without the visual or auditory dynamism known to heighten the experience of awe. The videos were presented via computer, with participants wearing headphones to intensify the auditory experience.

Study 3c: Negative awe and baseline videos. The negative awe video depicted a black and white prairie landscape with numerous tornado storms. For the baseline condition, the video also depicted nature scenes in black and white, but without the visual dynamism known to heighten the experience of awe. As in Studies 3a and 3b, the videos included a music soundtrack that was meant to heighten (or not) the experience of awe. The videos were presented via computer, with participants wearing headphones to intensify the auditory experience.

Results

Manipulation check. Following Piff et al. (2015), we conducted an independent-samples *t*-tests on each of the emotion ratings as a function of video condition. Descriptive statistics are presented in Table 9.

Study 3a. Participants who watched the positive awe video reported higher levels of awe than those who watched the baseline video, $t(20.99) = 6.30$, $p < .001$, 95% CI [1.74, 3.46], with a correction for violating Levene's test for

equality of variances. Participants who watched the positive awe video also reported higher levels of amusement and happiness than those who watched the baseline video, $t(35) = 3.05$, $p = .004$, 95% CI [0.47, 2.32] and $t(35) = 2.15$, $p = .039$, 95% CI [0.05, 1.85], respectively. Participants' self-reports for the other emotion words did not reveal significant differences between the conditions, all $t(35) < 1.36$, all $p > .184$, and all BF_{01} were between 0.33 and 3.05.

Table 9

Emotion Word Mean Ratings (and SDs) as a Function of Substudy and Video, Study 3

	Study 3a		Study 3b		Study 3c	
	Positive (n = 20)	Baseline (n = 17)	Positive (n = 21)	Baseline (n = 19)	Negative (n = 26)	Baseline (n = 30)
Amusement	4.10 (1.33)	2.71 (1.45)	4.00 (1.52)	2.42 (1.54)	3.15 (2.05)	1.43 (1.41)
Anger	0.20 (0.89)	0.35 (1.22)	0.24 (0.89)	0.47 (0.96)	0.73 (1.49)	0.37 (0.85)
Awe	5.60 (0.68)	3.00 (1.58)	5.29 (1.01)	2.95 (1.68)	4.31 (1.26)	2.00 (1.55)
Disgust	0.30 (1.34)	0.53 (1.13)	0.29 (1.10)	0.63 (1.54)	0.54 (1.27)	0.53 (1.22)
Fear	0.55 (1.28)	0.12 (0.33)	0.19 (0.60)	0.42 (1.02)	2.27 (1.91)	0.90 (1.27)
Happiness	4.95 (1.10)	4.00 (1.58)	5.14 (1.19)	3.84 (1.39)	2.23 (1.14)	2.00 (1.62)
Sadness	0.60 (1.09)	0.35 (0.79)	0.67 (107)	0.58 (1.17)	2.15 (1.57)	2.27 (1.66)

Note. Possible range = 0 to 6.

Study 3b. Participants who watched the positive awe video reported higher levels of awe than those who watched the baseline video, $t(38) = 5.32$, $p < .001$, 95% CI [1.45, 3.23]. Participants who watched the positive awe video also reported higher levels of amusement and happiness than those who watched the baseline video, $t(38) = 3.27$, $p = .002$, 95% CI [0.60, 2.56] and $t(38) = 3.19$, $p = .003$, 95% CI [0.48, 2.13], respectively. Participants' self-reports for the other emotional words did not reveal significant differences between the conditions, all $t(38) < 0.88$, $p > .383$, and all $BF_{01} = 0.14–3.26$.

Study 3c. Participants who watched the negative awe video reported higher levels of awe than those who watched the baseline video, $t(54) = 6.05$, $p < .001$, 95% CI [1.54, 3.07]. Participants who watched the negative awe video also reported higher levels of amusement and fear than those who watched the baseline video, $t(43.297) = 3.6$, $p = .001$, 95% CI [0.76, 2.68] and $t(54) = 3.2$, $p = .002$, 95% CI [0.51, 2.23], respectively. Participants' self-reports for the other emotional words did not reveal significant differences between the conditions, all $t(54) < 1.15$, $p > .257$, and all BF_{01} were between 2.15 and 3.7.

Criterion validity. Subscale scores were calculated by averaging across the relevant items, reverse-scoring items as necessary, such that higher scores reflect more of the relevant construct. Cronbach's alpha and inter-item correlations were also calculated for each study.

Subscale scores were analyzed using a 4 (Subscale: liberation/connection, oppression/isolation, chills, small-self/vast-world) × 2 (Video: awe, baseline) MANOVA, and Bayes factors were calculated to assess the relative likelihood of

the null and alternative hypotheses. Descriptive statistics are presented in Table 10.

Table 10
SAS Subscale Means (and SDs) as a Function of Substudy and Video, Study 3

	Study 3a		Study 3b		Study 3c	
	Positive (n = 20)	Baseline (n = 17)	Positive (n = 21)	Baseline (n = 19)	Negative (n = 26)	Baseline (n = 30)
Liberation/ Connection	3.40 (1.55)	1.87 (1.25)	1.19 (0.97)	0.55 (0.74)	0.45 (0.67)	0.09 (0.98)
Oppression/ Isolation	0.61 (0.72)	0.51 (0.54)	0.25 (0.83)	0.31 (0.61)	- 0.09 (0.82)	0.17 (0.79)
Chills	2.72 (1.69)	0.91 (0.79)	1.17 (0.76)	0.28 (0.82)	0.68 (0.82)	0.15 (0.89)
Small-Self/Vast-World	3.50 (1.82)	2.09 (1.38)	1.41 (0.60)	0.65 (0.91)	0.94 (1.17)	0.17 (0.98)

Note. Possible range = 0 to 6 for Study 3a, -3 to +3 for Studies 3b and 3c.

Study 3a. Three of the four SAS subscales (i.e., liberation/connection, chills, and small-self/vast-world) showed good reliability ($\alpha > .837$), good mean of inter-item correlations (all > .563), and inter-item range of correlations (all < .455; BrckaLorenz et al., 2013; Clark & Watson, 1995). The oppression/isolation subscale did not show good reliability ($\alpha = .426$) or inter-item mean and range correlation scores (.129 and .395 respectively). However, this would be expected given that participants in this study viewed positive and baseline videos, not negative videos.

The MANOVA yielded an effect of video, $F(4, 32) = 4.71$, $p = .004$, Wilks' $\Lambda = 0.63$, $\eta_p^2 = .37$. Scores on three subscales showed an effect of video:

liberation/connection ($F(1, 35) = 10.69$, $p = .002$, $\eta_p^2 = .23$, $BF_{10} = 15.18$), chills ($F(1, 35) = 16.34$, $p < .001$, $\eta_p^2 = .32$, $BF_{10} = 90.44$), and small-self/vast-world ($F(1, 35) = 6.75$, $p = .003$, $\eta_p^2 = .11$, $BF_{10} = 3.96$). Specifically, we see that participants in the positive awe video condition reported higher ratings of liberation/connection, chills, and small-self/vast-world perceptions than those in the baseline condition. As we predicted, there was no difference between the conditions in participants' oppression/isolation ratings, $F(1, 35) = 0.24$, $p = .628$, $BF_{01} = 2.75$.

Study 3b. The liberation/connection SAS showed good reliability ($\alpha = .816$), good mean of inter-item correlations (.411), and inter-item range of correlations (.802; BrckaLorenz et al., 2013; Clark & Watson, 1995). The remaining three SAS subscales (i.e., oppression/isolation, chills, small-self/vast-world) did not show as good response reliability ($\alpha < .643$) or inter-item mean and range correlation scores (< .378 and < .522, respectively).

The MANOVA yielded an effect of video, $F(4, 35) = 4.78$, $p = .003$, Wilks' $\Lambda = 0.65$, $\eta_p^2 = .35$. Scores on three subscales showed an effect of video: liberation/connection ($F(1, 35) = 5.42$, $p = .025$, , $\eta_p^2 = 13$, $BF_{10} = 2.464$), chills ($F(1, 35) = 12.7$, $p = .001$, , $\eta_p^2 = .25$, $BF_{10} = 31.052$), and small-self/vast-world ($F(1, 35) = 9.91$, $p = .003$, , $\eta_p^2 = .21$, $BF_{10} = 12.14$). Specifically, we see that participants in the positive awe video condition reported higher ratings of liberation/connection, chills, and small-self/vast-world perceptions than those in the baseline condition. As we predicted, there was no difference between the

conditions in participants' oppression/isolation ratings, $F(1, 35) = 0.04$, $p = .837$, $BF_{10} = 3.23$.

Study 3c. The liberation/connection SAS showed good reliability ($\alpha = .716$), good mean of inter-item correlations (.301), and inter-item range of correlations (.428; BrckaLorenz et al., 2013; Clark & Watson, 1995). The remaining three SAS subscales (i.e., oppression/isolation, chills, small-self/vast-world) did not show as good response reliability ($\alpha < .697$) or inter-item mean and range correlation scores (< .374 and < .253 respectively).

The MANOVA yielded an effect of video, $F(4, 51) = 3.46$, $p = .014$, Wilks' $\Lambda = 0.79$, $\eta_p^2 = .21$. However, only two of the subscales showed an effect of video: chills ($F(1, 54) = 5.33$, $p = .025$, $\eta_p^2 = .09$, $BF_{10} = 2.36$), and small-self/vast-world ($F(1, 54) = 7.43$, $p = .009$, $\eta_p^2 = .12$, $BF_{10} = 5.36$). Specifically, we see that participants in the negative awe video condition reported higher ratings of chills and small-self/vast-world perceptions than those in the baseline condition. Somewhat surprisingly, there was no difference between the conditions in their oppression/isolation ratings, $F(1, 54) = 1.45$, $p = .235$, $BF_{10} = 0.49$. As we predicted, there was no difference between the conditions in participants' liberation/connection ratings, $F(1, 54) = 2.41$, $p = .127$, $BF_{01} = 1.37$.

Convergent validity. All scale and subscale scores were calculated by averaging across the relevant items, reverse-scoring items as necessary, such that higher scores reflect more of the relevant construct. For the dispositional awe and small-self awe measures, Cronbach's alpha and inter-item correlations were also calculated for each study.

Table 11
(Sub)Scale Means, Standard Deviations, and Reliability Coefficients, and Inter-Scale Correlations, Study 3a

	M	*SD*	α	1	2	3	4	5	6
1. SAS Total	1.91	1.01	.87						
2. SAS Liberation/Connection	2.69	1.59	.88	.916**					
3. SAS Oppression/Isolation	0.56	0.64	.43	.248	.114				
4. SAS Chills	1.89	1.62	.84	.826**	.723**	- .017			
5. SAS Small Self/Vast World	2.86	1.76	.84	.685**	.495**	.046	.359*		
6. Small-Self Awe	3.01	1.51	.93	.771**	.717**	- .096	.570**	.769**	
7. DPES-Awe	4.03	1.09	.76	.343*	.309	.064	.312	.219	.266

Note. SAS = Situational Affect Scale. DPES = Dispositional Positive Emotion Scale. For all scales and subscales, possible range = 0 to 6. * $p < .05$; ** $p < .01$.

Study 3a. Both the small-self awe and the DPES-awe subscale showed good reliability (α = .93 and .76 respectively). The mean inter-item correlations were .546 and .365 respectively, and the range of the inter-item correlations were .779 and .573 respectively (BrckaLorenz et al., 2013; Clark & Watson, 1995).

Correlations among the SAS composite and subscale scores, and the small-self awe composite and the DPES-awe scores are presented in Table 11. Correlations between the SAS composite and subscale scores, small-self subscales, and DPES-awe measure found significant positive correlations across a variety of variables. In relationship to the SAS, the DPES-awe measure was only significantly positively correlated with SAS composite score ($r(36) = .343$, $p = .038$). Both of the small-self subscales (i.e., perceived vastness and self-diminishment) significantly positively correlated with the SAS composite score and three (i.e., liberation/connection, chills, small-self/vast-world) of the four SAS Subscales ($r(36) > .489$, $p < .002$). Neither of the small-self subscales correlated with the oppression/isolation subscale of the SAS ($r(36) < -.204$, $p > .226$).

Study 3b. Both the small-self awe and the DPES-awe subscale showed good reliability (α = .88 and .75 respectively). The mean inter-item correlations were .414 and .349 respectively, and the range of the inter-item correlations were .894 and .524 respectively (BrckaLorenz et al., 2013; Clark & Watson, 1995).

Correlations among the SAS composite and subscale scores, and the small-self awe composite and the DPES-awe scores are presented in Table 12. Correlations between the SAS composite and subscale scores, small-self

Table 12
(Sub)Scale Means, Standard Deviations, and Reliability Coefficients, and Inter-Scale Correlations, Study 3b

	M	*SD*	α	1	2	3	4	5	6
1. SAS Total	0.71	0.59	.81						
2. SAS Liberation/Connection	0.89	0.91	.82	.856**					
3. SAS Oppression/Isolation	0.28	0.72	.58	.519**	.235				
4. SAS Chills	0.74	0.89	.62	.731**	.560**	.058			
5. SAS Small Self/Vast World	1.05	0.85	.64	.582**	.316*	.172	.367*		
6. Small-Self Awe	0.85	0.99	.88	.704**	.579**	.221	.466**	.734**	.
7. DPES-Awe	1.41	0.91	.75	.442**	.363*	.352*	.130	.389*	.484**

Note. SAS = Situational Affect Scale. DPES = Dispositional Positive Emotion Scale. For all scales and subscales, possible range = -3 to 3. * $p < .05$; ** $p < .01$.

subscales, and DPES-awe measure found significant positive correlations across a multiple variable. In relationship to the SAS, the DPES-awe subscale significantly correlated with SAS composite score and three (i.e., liberation/connection, oppression/isolation, and small-self/vast-world) of the four SAS subscales, $r(39) > .352$, $p < .026$, but not the chills subscale, $r(39) = .130$, $p = .425$. The small-self subscales differed in which aspects of the SAS they correlated with. The perceived vastness subscale correlated will the SAS composite and three (i.e., liberation/connection, chills, and small-self/vast-world) of the four SAS Subscales ($r(39) > .521$, $p < .001$). The self-diminishment subscale correlated with the SAS composite and the small-self/vast-world SAS subscale ($r(39) > .483$, $p < .002$).

Study 3c. Both the small-self awe and the DPES-awe subscale showed good reliability ($\alpha = .88$ and .77 respectively). The mean inter-item correlations were .414 and .366 respectively, and the range of the inter-item correlations were .763 and .740 respectively (BrckaLorenz et al., 2013; Clark & Watson, 1995).

Correlations among the SAS composite and subscale scores, and the small-self awe composite and the DPES-awe scores are presented in Table 13. Correlations between the SAS composite and subscale scores, small-self subscales, and DPES-awe measure found significant positive correlations across a handful variables. In relationship to the SAS, the DPES-awe subscale only significantly positively correlated with the small-self/vast-world SAS subscale ($r(55) = .332$, $p < .012$). Both of the small-self subscales (i.e., perceived vastness and self-diminishment) significantly correlated will the SAS composite and two

Table 13
(Sub)Scale Means, Standard Deviations, and Reliability Coefficients, and Inter-Scale Correlations, Study 3c

	M	*SD*	α	1	2	3	4	5	6
1. SAS Total	0.27	0.59	.77						
2. SAS Liberation/Connection	0.26	0.86	.72	.721**					
3. SAS Oppression/Isolation	0.05	0.81	.63	.551**	.111				
4. SAS Chills	0.39	0.89	.69	.737**	.355**	.293*			
5. SAS Small Self/Vast World	0.53	1.13	.64	.596**	.381**	- .015	.333*		
6. Small-Self Awe	0.56	0.97	.88	.532**	.550**	- .023	.192	.690**	.
7. DPES Awe	1.12	0.88	.77	.235	.049	.160	.147	.332*	.241

Note. SAS = Situational Affect Scale. DPES = Dispositional Positive Emotion Scale. For all scales and subscales, possible range = -3 to 3. * $p < .05$; ** $p < .01$.

(i.e., liberation/connection and small-self/vast-world) of the four SAS Subscales ($r(55) > .289$, $p < .031$).

Discriminant validity. DPES-awe scores were analyzed using an independent-samples *t*-test as a function of video; Bayes factors were calculated to assess the strength of the evidence for the null versus alternative hypotheses. Descriptive statistics are presented in Table 14.

Table 14
DPES-Awe Means (and Standard Deviations) as a Function of Substudy and Video, Study 3

Study 3a		Study 3b		Study 3c	
Positive (n = 20)	Baseline (n = 17)	Positive (n = 21)	Baseline (n = 19)	Negative (n = 26)	Baseline (n = 30)
4.23 (1.19)	3.79 (0.93)	1.44 (0.86)	1.39 (0.98)	1.21 (0.81)	1.03 (0.95)

Note. Possible range = 0 to 6 for Study 3a, -3 to +3 for Studies 3b and 3c.

Study 3a. Unlike the SAS, there was no evidence that DPES-awe scores varied as a function of video, $t(35) = 1.23$, $p = .227$, 95% CI [-0.29, 1.17], $BF_{01} = 1.89$.

Study 3b. Unlike the SAS, there was no evidence that DPES-awe scores varied as a function of video, $t(38) = 0.14$, $p = .887$, 95% CI [-0.55, 0.63], $BF_{01} = 2.96$.

Study 3c. Unlike the SAS, there was no evidence that DPES-awe scores varied as a function of video, $t(54) = 0.75$, $p = .457$, 95% CI [-0.29, 0.66], $BF_{01} = 2.93$.

Discussion

The primary aim of this study was to establish that SAS scores would vary in response to situations that elicit more versus less awe—that is, to demonstrate that it does assess state or situational awe. Across three studies, we showed that the SAS accurately measured different aspects of awe that individuals felt while watching the different video. Additionally, where the SAS was able to show significant differences in the awe that individuals felt, the dispositional awe scale failed to detect a difference across conditions.

We also sought to provide construct validity evidence that SAS scores would reflect the *type* of awe, positive or negative. That is, we aimed to demonstrate that the SAS would be able to differentiate between differently valenced videos (i.e., positive and negative). Two of the three studies provided strong support: For Studies 3a and 3b, we hypothesized and found that participants in the positive awe condition (compared to baseline) reported higher levels of liberation/connection, chills, and small-self/vast-world perceptions than those in the baseline condition.

Study 3c, however, yielded only moderate support: We hypothesized and found that participants in the negative awe condition (compared to baseline) reported higher levels of chills and small-self/vast-world perceptions than those in the baseline condition. However, we also hypothesized, but did not find, that participants in the negative awe condition (compared to baseline) would report higher levels of oppression/isolation than those in the baseline condition. One possible explanation for this null effect could be due to our stimuli not activating

this aspect of awe. While the tornados participants watched may be fear inducing in person, watching them from the safety of the lab allowed participants to appreciate the beauty of the natural disasters.

Our final goal was to reconfirm the convergent and discriminant validity evidence found in Studies 1 and 2. In terms of convergent validity, we saw significant positive correlations with the SAS subscales and other emasures of awe across the three studies. As we predicted, the small-self scores (Piff et al., 2015) correlated positively with the SAS composite scores across all three studies. Similarly, the DPES-awe scores (Shiota et al., 2006) correlated positively with various SAS subscale scores across the three different studies. Overall, these results establish that our SAS measure has convergent validity when comparing it to previously validated measures.

Lastly, we aimed to check discriminant validity of the SAS by demonstrating that it provides information *not* provided by another measure of awe. We demonstrated that SAS scores were sensitive to video condition, and thus examined whether DPES-awe scores would also differ as a function of video condition. As we predicted, there was no difference across all three studies in the amount of dispositional awe participants reported in the awe versus baseline conditions. Thus, the SAS differentiates between situations that induce more versus less awe whereas the DPES-awe does not; this corroborates our assertion that the SAS differs importantly from the DPES-awe in that it measures state levels of awe whereas the DPES-awe measures dispositional tendencies toward awe.

Study 4: Situational Awe in the Wild

Study 3 provided evidence that the SAS responds to carefully controlled situational differences in a laboratory setting. The goal of Study 4 was to extend this construct validity evidence to field settings. Admittedly, moving to the field limits the extent to which we can control participants' experience—there will be variability across participants in terms of factors such as the number of other people present, for example— but we could nonetheless select locations that have the capacity to induce more versus less awe. We collected data at the Museum of Science and Industry, Chicago (MSI–Chicago) to investigate whether different locations within the museum would elicit predictably different emotions and whether the SAS would reflect these differences.

We sampled three locations in the MSI-Chicago. For positively valenced awe, we chose the museums rotunda. The rotunda is in the center of the museum and gives off a sense of vastness from one taking the escalator up from a lower floor and viewing the height of the domed ceiling puts one's own size into perspective. For negatively valenced awe, we chose the U-505 exhibit. The U-505 exhibit puts guests face-to-face with an authentic German U-boat by having them walk around the bow and stern of the boat. This walk around the boat puts into perspective the sheer size of a submarine. While vastness is present in both locations, the rotunda has an aesthetic beauty to it while the U-505 exhibit has more of a historical importance component to it. Both of these characteristics have been noted to be awe elicitors (Keltner & Haidt, 2004; Shiota et al., 2006). Lastly, our baseline location was the parking garage, which allowed us to collect

data from museum guests before they entered the museum and interacted with any exhibits. Museum guests were approached at each location and asked to complete a survey; the survey included the SAS and DPES-awe, as well as emotion ratings and ratings of their prior knowledge and interest in topics relevant to the locations in which they were approached (i.e., art and architecture for the rotunda, military technology and history for the U-505 exhibit).

In addition, we were interested in exploring the role of prior knowledge in how one experiences awe. Knowledge can help individuals to understand the vastness and complexity of their experience (Caranfa, 2003; Ecklund & Long, 2011; Krause & Hayward, 2015), and awe arises in response to perceiving vastness and being motivated to make sense of the experience (Keltner & Haidt, 2003). Together, these considers suggest that knowledge can heighten the awe experience.

However, it is possible that knowledge might play different roles as function of what elicits the awe. In the current study, the features that were expected to elicit awe differed as a function of location: For the rotunda, awe was expected to be elicited because of the vast height of the dome and its aesthetic beauty; for the U-505, awe was expected to be elicited because of the massive scale of the submarine and its historical significance. Thus, while the rotunda was expected to elicit awe for purely perceptual reasons, the U-505 was expected to rely to some extent on cognitive input, such that experiencing awe would depend on understanding the importance of the submarine. We thus thought knowledge would play a more important role for guests in the U-505 exhibit than guests in

the rotunda.

Hypotheses

Hypothesis I. We predicted that guests in the rotunda and U-505 would report higher levels of awe than guests in the baseline location.

Hypothesis II. We expected to replicate the factor structure from Study 1; that is, we predicted that a four-factor CFA solution would provide a good fit to participants' responses on the SAS.

Hypothesis IIa. We predicted that the identified factors would be adequately described with the same subscale labels as in Study 1 (liberation/connection, oppression/isolation, chills, small-self/vast-world) and that the items would load appropriately onto their specified factors.

Hypothesis III. We predicted that the SAS would show good convergent validity, correlating positively with other measures of awe.

Hypothesis IIIa. We predicted that there would be a positive correlation between SAS composite and subscale scores and DPES-awe (Shiota et al., 2006) scores.

Hypothesis IV. We expected that the SAS would show good criterion validity, showing significant differences across locations.

Hypothesis IVa. We predicted that guests in the rotunda would report significantly more liberation/connection, chills, and small-self/vast-world perceptions than would participants in the baseline location.

Hypothesis IVb. We predicted that guests in the U-505 exhibit would report significantly more oppression/isolation, chills, and small-self/vast-world perceptions than guests in the baseline location.

Hypothesis V. We expected that the SAS would show good discriminant validity from the DPES-awe, with DPES-awe scores showing no significant difference across locations.

Hypothesis VI. We expected to see difference in the correlations between the SAS and knowledge scores based on condition.

Hypothesis VIa. We predicted that there would be no correlation between SAS composite and subscale scores and knowledge scores among guests in the rotunda.

Hypothesis VIb. We predicted that there would be a positive correlation between SAS composite and subscale scores and knowledge scores among guests in the U-505 exhibit.

Method

Participants. Participants were 504 individuals who visited the Museum of Science and Industry, Chicago (MSI-Chicago) on the days of data collection. Participation in the research study was voluntary; however, after completing the survey individuals were offered a small gift (e.g., stickers, pencil) as a way of thanking them for their participation. Participant demographics are presented in Table 15.

Table 15
Sample Demographics as a Function of Location, Study 4

	Garage (n = 227)	Rotunda (n = 188)	U-505 (n = 89)
Age			
Mean (SD) in years	39.41 (17.78)	37.73 (17.03)	31.30 (16.37)
Range	12–100	13–87	12–85
Gender			
Female	141	103	43
Male	83	82	44
Other	1	1	0
Unspecified	2	2	2
Race/Ethnicity			
American Indian/Native	0	1	0
Black/African American	3	4	4
Asian/Pacific Islander	9	3	6
Hispanic/LatinX	24	11	8
Middle Eastern	0	0	1
White	74	56	25
Multiracial	102	103	2
Other	2	0	0
Unspecified	13	10	43

In accordance with IRB requirements, all participants received information on the experimental procedure prior to participating. Following the completion of all tasks, participants were debriefed and compensated accordingly.

Procedure. All materials were administered via internet-enabled tablets and using the Survey Monkey service (http://www.surveymonkey.com). Guests were approached[5] in three separate locations within MSI: the parking garage, the rotunda, or the U-505 exhibit. For the garage, guests were approached upon

[5] We targeted small groups (fewer than four people) and groups without small children in an effort to increase willingness to participate.

arriving to the museum. At the rotunda, guests were approached as they were exiting the main area towards another exhibit. Lastly, U-505 guests were recruited at the end of the exhibit.

The survey was structured as follows: First, participants rated the extent to which they experienced each of nine emotions (*awe*, *confusion*, *amazement*, *disorientation*, *wonder*, *fascination*, *astonishment*, *curiosity*, and *bewilderment*) along a scale anchored from 0 (*not at all*) to 6 (*very much*). Next, they completed the 18-item SAS questionnaire, and a subset of participants also complete the 6-item DPES-awe subscale (Shiota et al., 2006).[6] Participants in the rotunda and U-505 then responded to four items assessing prior knowledge and experience (detailed below). Finally, participants responded to additional surveys and tasks chosen by our collaborators at MSI–Chicago[7], and a set of demographic questions. The full list of measures can be found in Appendix D, and the full materials are presented in Appendix E.

Prior knowledge and interest. Participants in the rotunda and the U-505 exhibit responded to two items assessing how much they enjoy learning about location-relevant topics: "To what extent do you enjoy learning about art [architecture]?" in the rotunda and "To what extent do you enjoy learning about military history [military technology]?" in the U-505 exhibit. They also responded to two items assessing their self-perceived knowledgeability about the same topics: "To what extent do you consider yourself knowledgeable about art

[6] The decision to add the DPES-awe for comparison purposes was made part way through data collection.
[7] These measures will not be analyzed for this dissertation.

[architecture]?" in the rotunda, and "To what extent do you consider yourself knowledgeable about military history [military technology]?" in the U-505 exhibit. All ratings were made along 7-point scales anchored by 0 (*not at all*) and 6 (*very much*).

Results

Manipulation check. The emotion items for this study were all meant to reflect awe. An exploratory factor analysis, however, indicated that 6 of the 9 items (i.e., *awe*, *amazement*, *wonder*, *fascination*, *astonishment*, and *curiosity*) loaded onto a single factor; the other items were not reliably correlated. This factor showed good reliability ($\alpha = .92$), good mean inter-item correlations (.657), and an acceptable range of the inter-item correlations (.295; BrckaLorenz et al., 2013; Clark & Watson, 1995). An awe scores was created by averaging across the relevant items.

Scores were subjected to a single-factor ANOVA as a function of location (garage, rotunda, and U-505), with Bonferroni-corrected *t*-tests to probe significant effects. While the analysis did violate Levene's test of homogeneity of variances ($F(2, 498) = 18.74$, $p < .001$), we did find that there was statistically significant effect of location, $F(2, 498) = 43.63$, $p < .001$. As we predicted, guests in the rotunda ($M = 4.47$, SD = 1.17), and U-505 ($M = 4.73$, SD = 0.94) reported higher levels of awe than those in the garage ($M = 3.45$, SD = 1.57), both $t(498) > 7.75$, $p < .001$.

Structural validity. Next, we conducted a CFA on a portion of the data collected at the museum using the same techniques used in Study 2. Based on

sample sizes per location, we conducted a CFA on the rotunda data; only in this location did we have a sufficient number of respondents given the number of items on the SAS to justify CFA.

Several checks on the data were done to assess the fit of the model. First, a Chi Square (χ^2) test of model fit was conducted in which we rejected the null hypothesis, $\chi^2(126) = 328.517$, $p < .001$. While we had aimed to retain the null hypothesis, it is not uncommon to reject the null hypothesis with smaller discrepancies between the data and the predicted model as the sample size increases (Bandalos, 2018). The RMSEA and the SRMR were nearly acceptable: RMSEA = .086 (95% CI [.075, .098], $p < .001$) and SRMR = .087 (< .08; Hu & Bentler, 1999). The comparative fit index (CFI) and Tucker-Lewis index (TLI) were below threshold (.95; Hu & Bentler, 1999) at .85 and .82, respectively.

Thus, the fit indices suggested a good but not perfect replication of the factor structure uncovered in Study 1's EFA. Examination of the item loadings, however, mitigated against concerns about the fit, in that the 18 items loaded adequately onto the factors specified in Study 1 (standardized item loadings range = 0.564 to 1.193). Overall, then, the structural validity of the SAS was confirmed.

Composite and subscale scores were calculated by averaging across the relevant items, reverse-scoring where necessary; higher scores indicated stronger awe. Scale descriptives and inter-scale correlations for the SAS and all other measures are presented in Table 16.

Table 16
(Sub)Scale Means, Standard Deviations, and Reliability Coefficients, and Inter-Scale Correlations, Study 4

	M	*SD*	α	1	2	3	4	5	6
1. SAS Total	- 0.15	0.79	.80						
2. SAS Liberation/Connection	0.68	1.08	.83	.589**					
3. SAS Oppression/Isolation	- 1.25	1.25	.82	.547**	- .129**				
4. SAS Chills	- 0.44	1.47	.85	.799**	.322**	.280**			
5. SAS Small Self/Vast World	0.41	1.18	.49	.641**	.227**	.215**	.465*		
6. DPES-Awe	1.51	0.89	.78	.266**	.362**	- .065	.231**	.211**	
7. Knowledge	3.37	1.47	.82	.225**	.242**	- .003	234**	.067	.386**

Note. SAS = Situational Affect Scale. DPES = Dispositional Positive Emotion Scale. Possible range = -3 to +3 for SAS, DPES-awe, 0 to 6 for knowledge. * $p < .05$; ** $p < .01$.

Convergent validity. Prior to conducting the correlation analysis, we checked the reliability of the SAS subscales and the DPES-awe subscale. Across three of the four SAS subscales (i.e., liberation/connection, oppression/isolation, and chills) and the DPES-awe subscale, we found high reliability (all $\alpha > .78$), good inter-item correlation means (> .369), and an acceptable range of the inter-item correlations (< .314; BrckaLorenz et al., 2013; Clark & Watson, 1995). The small-self/vast-world subscale did not show good reliability (Cronbach's $\alpha = .49$). However, because of the strong performance of this subscale in previous studies, we continued to use the subscale in the current analysis.

Correlations between the SAS composite and subscale scores, and DPES-awe scores found significant positive correlations across a handful of variables. As in the previous studies, DPES-awe scores correlated positively with SAS composite scores and liberation/connection, chills, and small-self/vast-world scores, all $r(285) > .211$, all $p < .001$. DPES-awe scores did not correlate with oppression/isolation scores, $r(285) = -.065$, $p = .275$.

Criterion validity. SAS scores were subjected to a 4 (Subscale: liberation/connection, oppression/isolation, chills, small-self/vast-world) × 3 (Location: rotunda, U-505, garage) MANOVA; significant effects were probed with Bonferroni-corrected *t*-tests.

There was a statistically significant multivariate main effect in location, $F(8, 992) = 16.665$, $p < .001$, Wilks' $\Lambda = .777$, $\eta_p^2 = .118$. The univariate effect of location was significant for oppression/isolation, $F(2, 499) = 7.41$, $p = .001$, $\eta_p^2 = .029$, $BF_{10} = 7.413$; chills, $F(2, 499) = 30.50$, $p < .001$, $\eta_p^2 = .109$, $BF_{10} =$

1.950e+8]; and small-self/vast-world, $F(2, 499) = 13.53$, $p < .001$, $\eta_p^2 = .051$, $BF_{10} = 2{,}307.08$ scores.

Means are depicted in Table 17. Guests reported less oppression/isolation in the rotunda than in the U-505 or garage (both $p < .017$), more chills in the rotunda and U-505 than in the garage (both $p < .001$), and more small-self/vast-world perceptions in the rotunda and U-505 than in the garage (both $p < .001$).

Table 17
SAS Subscale Means (Standard Deviations) as a Function of Location, Study 4

	Rotunda	U-505	Garage
Liberation/Connection	0.62 (0.96)	0.61 (1.09)	0.77 (1.17)
Oppression/Isolation	-1.50 (1.19)	-0.94 (1.22)	-1.17 (1.27)
Chills	-0.08 (1.30)	0.15 (1.36)	-0.97 (1.47)
Small-Self/Vast-World	0.64 (1.05)	0.67 (1.22)	0.11 (1.20)

Note: Possible range = -3 to +3.

Discriminant validity. DPES-awe scores were analyzed using an ANOVA as a function of location (i.e., garage, rotunda, U-505). As predicted, there was no evidence that DPES-awe scores varied as a function of location, $F(2, 283) = 1.975$, $p = .141$, $BF_{01} = 7.129$.

Knowledge and awe. For data reduction purposes, we conducted EFAs separately for the rotunda and U-505 items and found in both cases that the four items loaded onto a single factor in both cases. We averaged across the four items to calculate a mean knowledge score ($\alpha = .80$ and .89 for participants in the rotunda and U-505, respectively).

We calculated correlations between the SAS composite and subscale scores and the knowledge composite scores separately for the two locations (see Table 18). For the rotunda, contrary to predictions, the knowledge composite score correlated positively with the SAS composite score the liberation/connection, and chills subscale scores, all $r(188) > .192$, all $p < .008$]. For the U-505, the knowledge composite score correlated positively with the SAS composite score and the liberation/connection subscale score, both $r(89) > .320$, both $p < .002$.

Table 18
Awe–Knowledge Correlations as a Function of SAS Subscale and Location, Study 4

	Rotunda	U-505
Liberation/Connection	.192**	.488**
Oppression/Isolation	.001	.103
Chills	.292**	.204
Small-Self/Vast-World	.139	.016

Note. ** $p < .001$.

Discussion

The aim of this study was to extend the construct validity evidence for the SAS to field settings in which the only control we had over the experience was when we approached participants, but where we nonetheless selected locations that had the capacity to induce more versus less awe. Data collected at the Museum of Science and Industry, Chicago (MSI–Chicago) confirmed the structural validity of the SAS and thus the four-factor structure of awe.

These data also demonstrated that different locations within the museum (i.e., rotunda and U-505) do indeed elicit more awe than others (i.e., garage). Further, we showed that even within awe-inducing locations of the museum, the pattern of responses on the SAS subscales differed: Both so-called positive and negative awe locations (rotunda and U-505, respective) induced more chills and small-self/vast-world perceptions and the positive awe location induced more liberation/connection, compared to the baseline garage location. Thus, patterns of scores on the SAS largely confirmed predictions, suggesting again that the SAS does reflect *situational* or momentary awe experience. That the DPES-awe did not vary as a function of location makes sense given its purported status as a measure of dispositional awe, but also provides evidence for the discriminant validity of the SAS.

One deviation from our hypotheses was that oppression/isolation scores were no higher in the U-505 exhibit than in the garage. One possible reason for this could be the physical attribute of the garage. Because it is a dark and confining location, it is possible that guests had heightened oppression/isolation while in the garage. Although we conceptualize awe as including an oppression/isolation component, it is equally possible to experience these states without awe.

Beyond extending the validity of the SAS in this study, we were also interested in conducting a preliminary investigation of the role that knowledge plays in the awe experience. We expected to see no relationship between knowledge and awe in an aesthetically enriched environment (presumably

because the beauty and scale of the environment could induce awe without additional domain knowledge), and a positive correlation between knowledge and awe in a historically significant environment (presumably because the vastness of the experience could only be understood with cognitive input). In actuality, we found that for both the rotunda and U-505, knowledge and SAS composite scores were positively correlated with one another; the more knowledge individuals brought into the experience, the more awe guests felt. This evidence, however, was correlational, and could reflect a self-report bias such that guests who felt awe might be led to perceive themselves as more knowledgeable (rather than prior knowledge leading to more awe). In Study 5, we capitalized on our finding that prior knowledge and awe are correlated and investigated how providing information to individuals prior to an experience of awe would affect their experience.

Study 5: Knowledge and the Experience of Awe

Study 4 aimed to explore when knowledge would enhance the awe experience, hypothesizing that awe induced by aesthetically beautiful stimuli would not need the cognitive input of knowledge but that awe induced by historically significant events would. The actual results, however, were contrary to predictions, with prior knowledge correlating with awe in response to beauty (rotunda) and not with awe in response to historical significance (U-505). Nonetheless, the results did provide support for prior knowledge as having the potential to enhance an awe experience.

The goal of Study 5 was to explore how type of knowledge shapes the awe experience. Specifically, we were interest in the question of whether relevant knowledge (compared to irrelevant knowledge) would change the experience. By "relevant," we mean knowledge that gives the individual's direct experience more meaningful, versus knowledge that does not relate to the individual's direct experience. To the extent that situational awe—our construct of interest—should be evoked by experiences of vastness that challenge us to seek meaning (Kelter & Haidt, 2003), then knowledge that can be more easily connected to the experience should have a different impact than knowledge that is more removed from the experience.

In Study 5, as in Study 3, participants watched one of two videos—one designed to induce awe and the other to provide a baseline—before completing emotion ratings (as manipulations checks) and the SAS. Prior to viewing the video, however, they also watched a video providing information designed to vary in its ability to make the triggering event more meaningful: Some participants watched a video describing the creation and legislative history of the Yosemite National Park (as a baseline), whereas others watched a video about the geological and environmental history that described the vastness of the park and its varied landscape and wildlife. Because the latter video provided information directly related to what participants would actually see in the target video, we expected that it would have greater capacity than the other knowledge video to provide meaning.

We were unsure what to expect in Study 5. On the one hand, relevant knowledge might heighten awe, but it is also plausible that if an event is sufficient to trigger awe, then relevant knowledge may not have an impact. Similarly, it is not clear whether an event that is not sufficient to trigger awe on its own can overcome some threshold with the addition of relevant knowledge. Thus, Study 5 was exploratory.

Hypotheses

Hypothesis I. Participants will report more awe on the emotion manipulation check in response to the awe video than the baseline video.

Hypothesis II. We predicted that the SAS will show good convergent validity, correlating positively with the DPES-awe (Shiota et al., 2006).

Hypothesis III. Participants will report more awe on the SAS in response to the awe video than the baseline video.

Hypothesis IV. Participants' dispositional awe will not differ in response to the awe and baseline videos.

Research Questions

Research question I. Will experience-relevant versus -irrelevant knowledge moderate the effect of stimulus (video) type on how much awe is experienced?

Research question II. Will this vary as a function of SAS subscale?

Method

Participants and design. The study took approximately 15 minutes to complete and used a 2 (Video: awe, baseline) × 2 (Knowledge Type: experience-relevant versus -irrelevant) × 2 (Narrator: female, male) between-subjects design.

To determine the sample size needed, we used G*power statistical software (Faul, Erdfelder, Lang, & Buchner, 2007). To calculate the sample size needed, we conducted the analysis for an analysis of variance with main effects and interactions having the following parameters: two-tailed, Cohen's *f* effect size set at 0.25[8], alpha set to the standard .05, power set to the standard .80, and the condition sample size ratio at 1. Using these parameters suggested a required sample size of 200 participants (50 participants per condition).

Participants were 232 individuals (n = 111 for interim analysis; see Results below) recruited from Amazon.com's MTurk service and paid $2 for their participation. Thirty participants (11 from the interim analysis) were excluded for failing to meet one of our criteria for inclusion: completing the study in less than 7 minutes (impossible if they watched the embedded videos in their entirety), failing the manipulation check, or failing the attention check. Our final sample for analysis included 202 participants (75 female; 127 male; M_{age} = 35.43 years, SD = 9.95). The racial breakdown was 153 White, 13 Hispanic/LatinX, 12 Black/African American and multi-racial, 7 East Asian, and 5 South/South East Asian.

[8] 0.25 was selected because of it being a medium effect.

In accordance with IRB requirements, all participants received information on the experimental procedure prior to participating. Following the completion of all tasks, participants were debriefed and compensated accordingly.

Procedure. Participants completed a study on *Psychology of National Parks*. The study was hosted on Qualtrics (http://www.qualtrics.com), enabling each participant to complete the study at their own convenience and in their preferred location.

The survey began with instructions explaining to participants that they would be provided with background information, in the form of a video, about a national part that would be depicted in a second video; participants were additionally informed that their memory for the background information would be tested at the end of the study (to increase their engagement). Participants were assigned randomly to one of two passages, one that provided a geological description of Yosemite National Park or one that described the legislative history of Yosemite National Park. Next, they were assigned randomly to view a video designed to elicit awe or provide a baseline. Importantly, to ensure participant engagement (because it was an online study), participants were instructed (falsely) that for some participants, a visual cue in the form of a color/shape combination would be embedded into the video, and that their task was to remember what the cue looked like for a later test. After viewing the video, participants rated their emotions, completed the SAS and the DPES-awe, completed manipulation and attention checks, and provided demographic information.

Stimuli.

Knowledge manipulation. Participants were presented with one of two passages, each approximately 300–350 words in length and coming from the same source (https://en.wikipedia.org/wiki/Yosemite_National_Park). The content scrolled upwards in time with the voice of a narrator reading the passage. There were two versions of each passage, one with a female narrator and one with a male narrator; this was strictly to provide generality. Participants in the relevant-knowledge condition were presented with a passage describing the geological and environmental history and characteristics of the landscape of the Yosemite National Park (e.g., its size in area and elevation, the number of landscape types, examples of wildlife). Participants in the irrelevant-knowledge condition were presented with a passage describing the creation and legislative history of Yosemite National Park. The passages can be found in Appendix F.

Video stimuli. The awe video was the same Yosemite National Park video used in Studies 3a and 3b. The baseline video presented a first-person perspective walk on a trail in Sequoia National Park, with attractive but non-awe-evoking scenery (i.e., no wide, expansive views) and non-awe-evoking music. The decision was pragmatic: We were unable to find a non-awe depiction of Yosemite National Park. The landscape depicted in the Sequoia National Park video, however, was consistent with some of the landscape found in Yosemite National Park and described in the knowledge-relevant passage. We thus felt the background information would be as applicable to both videos, because the closer-up perspective in the Sequoia video would make it relatively unlikely that

participants would recognize that it was not Yosemite; that is, the background information would seem plausible.

We conducted a pilot analysis to identify a non-awe inducing but pleasant video. We tested three separate first-person perspective videos of individuals walking along a trail in the Sequoia National Park, with the positive awe Yosemite National Park video from Study 3 as our comparison video. Participants were presented with one of four videos, and then rated the extent to which they felt each of 10 emotions (*awe*, *amazement*, *wonder*, *contentment*, *happiness*, *joy*, *unease*, *disorientation*, *anxiety*, *apathy*, and *boredom*; presented in random order) while watching the video. After the emotion ratings, participants responded to a manipulation check question to ensure that they correctly identified the video presented to them.

Participants. One hundred and thirty-eight undergraduate psychology students (99 female, 25 male, 1 other, 13 unreported; M_{age} = 20.01 years, SD = 4.049) completed the study for partial course credit. Thirty-three participants were excluded for failing the manipulation check, leaving a final sample of 105 (81 female, 22 male, 1 other, 1 unspecified; M_{age} = 20.24 years, SD = 4.399). The racial breakdown was 58 White, 15 Hispanic/LatinX, 12 multi-racial, 8 Black/African American, 5 other, 3 Middle Eastern/Near East Asian, 2 South/South East Asian, 1 East Asian, and 1 unspecified.

Results. The emotion items for this study were meant to reflect positive awe (*awe*, *amazement*, *wonder*), positive non-awe (*contentment*, *happiness*, *joy*), negative awe (*unease*, *disorientation*, *anxiety*) and negative non-awe (*apathy*,

boredom). An exploratory factor analysis indicated that all 10 emotion items loaded onto three factors: positive emotion (i.e., *awe*, *amazement*, *wonder*, *contentment*, *happiness*, *joy*, and reverse-coded *boredom*), and two factors reflecting negative emotion (i.e., one including *unease* and *anxiety*, and the other including *disorientation* and *apathy*). Both the positive emotion factor and the first negative emotion factor showed good reliability (α = .904 and .794, respectively), good mean inter-item correlations (.576 and .661, respectively); the positive emotion factor also demonstrated an acceptable range of the inter-item correlations (.394; BrckaLorenz et al., 2013; Clark & Watson, 1995). The second negative emotion factor did not show acceptable reliability (α = .510), therefore we did not include this factor in the analysis. Scores were created for the positive and negative emotion factors by averaging across the relevant items.

We conducted a 2 (Emotion: positive, negative) × 4 (Video: non-awe 1/2/3, awe) multivariate analysis of variance (MANOVA); Bonferroni-corrected *t*-tests were used to probe significant results. There was a statistically significant multivariate difference in emotion ratings based on the video watched, $F(6, 182) = 4.347$, $p < .001$, Wilks' $\Lambda = .765$, $\eta_p^2 = .125$. The effect of video was significant for positive emotion, $F(3, 92) = 8.604$, $p < .001$, $\eta_p^2 = .219$. There was no effect for negative emotion, $F(3, 92) = 1.099$, $p = .354$.

Multiple comparisons analysis showed that participants reported higher positive emotion scores in response to the awe video ($M = 4.49$, $SD = 1.20$) than either non-awe video 1 ($M = 2.86$, $SD = 1.49$; $p < .001$) or non-awe video 2 ($M = 3.19$, $SD = 1.31$; $p = .002$), but not non-awe video 3 ($M = 3.79$, $SD = 1.12$; $p =$

.305). Because the difference between awe and non-awe was numerically greater for non-awe video 1 than non-awe video 2, and because non-awe video 1 also included fewer shots of vast landscapes, we chose non-awe video 1 for use in the target study.

Measures.

Emotion manipulation check. Before completing the SAS, participants rated the extent to which they experienced each of 10 emotions (*awe*, *amazement*, *wonder*, *contentment*, *happiness*, *joy*, *unease*, *disorientation*, *anxiety*, *apathy*, *boredom*) while watching the video; these were the same emotions as used in the pilot. Ratings were made along 7-point scales anchored by *not at all* and *very much*.

SAS. Participants completed the SAS as in previous studies.

DPES-awe. Participants completed the DPES-awe as in previous studies.

Exploratory knowledge items. Participants were asked to think back to the passage they read/heard before the video and the video itself. They responded to three questions: “To what extent was the passage informative?”, “To what extent did the passage make the video more impactful?” and “To what extent were you familiar with Yosemite National Park prior to this study?” All ratings were made along 7-point scales anchored by *not at all* and *very much*.

Video manipulation check. As in Study 3, participants responded to a single multiple-choice item to confirm that they could correctly identify the video that they viewed.

Video attention check. Participants responded to a single multiple-choice item to test their attentiveness to the video. The item asked them to choose which of three options represented the memory cue included in their video: (a) 9 red dots arranged in the shape of a circle, (b) 8 yellow dots arranged in the shape of a square, or (c) no memory cue. (No memory cue was provided; thus Option C was always the correct response.)

Results

Due to the substantial number of participants needed to satisfy the parameters set for this study, we conducted sequential analysis on our data based on the guidelines provided by Lakens (2014). This allowed us to examine our data before reaching the target sample size determined by our power analysis, to determine whether we could stop data collection early. Sequential analysis involves adjusting the alpha level needed to reject the null hypothesis, based on the number of times the data are analyzed and the proportion of the total estimated sample that would be analyzed each time; it is designed to protect against false-positive inferences.

We conducted a two-sided symmetric power family function analysis based on the intention to look at our data a maximum of two equally spaced intervals (i.e., after 50% and 100% of the data were collected). For the power family function analysis, we set the Phi to equal to 1. This analysis provided us with two alpha thresholds against which we compared our *p*-values and made decisions whether to reject the null hypothesis: .0125 after 50% of the data were collected and .01679 after 100% of the data were collected. For our interim data

analysis, we also set an upper boundary for continued data collection: If our *p*-value was larger than .400, we intended to stop data collection and accept that we did not have enough evidence to reject the null hypothesis.

Interim analysis. As stated above, our alpha threshold for the interim analysis was set to .0125.

Manipulation check. An EFA indicated that 9 of the 10 emotion items loaded onto two factors: positive emotion (i.e., *awe*, *amazement*, *wonder*, *contentment*, *happiness*, and *joy*) and negative emotion (i.e., *unease*, *disorientation*, *anxiety*, and *apathy*); *boredom* loaded onto both factors and was excluded from the analysis. Both the positive and negative emotion factors showed good reliability (α = .92 and .78, respectively), good mean inter-item correlations (.665 and .501, respectively), and an acceptable range of the inter-item correlations (.393 and .288, respectively; BrckaLorenz et al., 2013; Clark & Watson, 1995). Two scores were created by averaging across the relevant items.

Both factors were analyzed in a 2 (Emotion: positive, negative) × 2 (Video: awe, baseline) × 2 (Knowledge: relevant, irrelevant) × 2 (Narrator: female, male) MANOVA. There were no statistically significant multivariate main effects, all $F(2, 91) < 2.081$, all $p > .131$.

Convergent validity. Prior to conducting the correlation analysis, we checked the reliability of the SAS subscales and the DPES-awe subscale. Across all scales and subscales, we found high reliability (all > .72), good inter-item correlation means (all > .447), and an acceptable range of the inter-item correlations (all < .421; BrckaLorenz et al., 2013; Clark & Watson, 1995).

Correlations between the SAS composite and subscale scores, and the DPES-awe measure, were positive for the SAS composite and the liberation/connection, chills, and small-self/vast-world subscales (all $r(99) > .249$, $p < .012$). The DPES did not correlate significantly with the oppression/isolation subscale, $r(99) = -.050$, $p = .623$.

Knowledge and awe. SAS subscale scores were analyzed in a 4 (Subscale: liberation/connection, oppression/isolation, chills, small-self/vast-word) × 2 (Video: awe, baseline) × 2 (Knowledge: relevant, irrelevant) × 2 (Narrator: female, male) MANOVA.

There was a statistically significant multivariate main effect of video, $F(4, 89) = 3.644$, $p = .009$, Wilks' $\Lambda = .859$, $\eta_p^2 = .141$. At the subscale level, however, none of the effects were significant, all $p > .12$. The multivariate main effect of knowledge was non-significant, $F(4, 89) = 0.648$, $p = .629$, Wilks' $\Lambda = .972$, $\eta_p^2 = .028$, as was the Video × Knowledge interaction, $F(4, 89) = 0.440$, $p = .780$, Wilks' $\Lambda = .981$, $\eta_p^2 = .019$. The remaining multivariate effects were also non-significant, all $p > .288$.

Discriminant validity. DPES-awe scores were analyzed using a 2 (Video: awe, baseline) × 2 (Knowledge: relevant, irrelevant) × 2 (Narrator: female, male) ANOVA. Importantly, there was no effect of video, $F(1, 92) = 1.387$, $p = 242$. The analysis yielded no other significant effects, all $F(1, 92) < 2.065$, all $p > .154$.

Exploratory items. The inter-item reliability for the three items was low ($\alpha = .47$), so the items were analyzed separately in a 2 (Video: awe, baseline) × 2 (Knowledge: relevant, irrelevant) × 2 (Narrator: female, male) MANOVA. There

was no effect of knowledge, $F(3, 90) = 0.904$, $p = .443$, Wilks' $\Lambda = .971$, $\eta_p^2 = .029$, nor was there a Video × Knowledge interaction, $F(3, 90) = 1.527$, $p = .213$, Wilks' $\Lambda = .952$, $\eta_p^2 = .048$. The remaining multivariate effects were also non-significant, all $p > .230$.

In light of the interim findings, we collected the remaining data and conducted the full analysis.

Full analysis. As stated above, our alpha threshold for the full analysis was set to .01679.

Manipulation check. The EFA indicated that 9 of the 10 emotion items loaded onto two factors: positive emotion (i.e., *awe*, *amazement*, *wonder*, *contentment*, *happiness*, and *joy*) and negative emotion (i.e., *unease*, *disorientation*, *anxiety*, and *apathy*); *boredom* loaded onto both factors and was excluded from the analysis. Both the positive and negative emotion factors showed good reliability ($\alpha = .92$ and .75, respectively), good mean inter-item correlations (.624 and .461, respectively), and an acceptable range of the inter-item correlations (.431 and .327, respectively; BrckaLorenz et al., 2013; Clark & Watson, 1995). Two scores were created by averaging across the relevant items.

Both factors were analyzed in a 2 (Emotion: positive, negative) × 2 (Video: awe, baseline) × 2 (Knowledge: relevant, irrelevant) × 2 (Narrator: female, male) MANOVA. There was a statistically significant multivariate main effect of video, $F(2, 193) = 4.819$, $p = .009$, Wilks' $\Lambda = .952$, $\eta_p^2 = .048$. The univariate effect of video was significant for the positive emotion, $F(1, 194) = 9.383$, $p = .003$, $\eta_p^2 = .046$, such that participants who watched the awe video (*M*

= 4.034, *SE* = .141) reported higher positive emotions than those who watched the baseline video (*M* = 3.419, *SE* = .143).

Convergent validity. Prior to conducting the correlation analysis, we checked the reliability of the SAS subscales and the DPES-awe subscale. Across all scales and subscales we found high reliability (all $\alpha > .73$), good inter-item correlation means (all > .475), and a good range of the inter-item correlations (all < .489; BrckaLorenz et al., 2013; Clark & Watson, 1995).

Correlations between the SAS composite and subscale scores and DPES-awe scores were positive for the SAS composite and the liberation/connection, chills, and small-self/vast-world subscales (all $r(201) > .280$, all $p < .003$). The DPES-awe did not correlate significantly with the oppression/isolation subscale, $r(201) = -.079$, $p = .266$.

Knowledge and awe. SAS subscale scores will be analyzed in a 4 (Subscale: liberation/connection, oppression/isolation, chills, small-self/vast-word) × 2 (Video: awe, baseline) × 2 (Knowledge: relevant, irrelevant) × 2 (Narrator: female, male) MANOVA.

There was a statistically significant multivariate main effect of video, $F(4, 191) = 6.729$, $p < .001$, Wilks' $\Lambda = .876$, $\eta_p^2 = .124$. The effect of video was significant for the small-self/vast-world subscale, $F(1, 194) = 10.735$, $p = .001$, $\eta_p^2 = .052$, $BF_{10} = 48.35$, and the chills subscale, $F(1, 194) = 8.414$, $p = .004$, $\eta_p^2 = .042$, $BF_{10} = 114.43$. The awe video (*M* = 0.41, *SE* = 0.15) induced significantly more small-self/vast-world perceptions than the baseline video (*M* = -0.29, *SE* = 0.15; $p = .001$), as well as more chills for the awe video (*M* = -1.04, *SE* = 0.15)

than the baseline video (M = -1.67, SE = 0.15; p = .004). There were no univariate effects of video on liberation/connection, $F(1, 194) = 0.013$, p = .910, η_p^2 = .000, BF_{01} = 5.996, or oppression/isolation scores, $F(1, 194) = 0.004$, p = .949, η_p^2 = .000, BF_{01} = 5.991.

The multivariate main effect of knowledge was non-significant, $F(4, 191) = 0.508$, p = .730, Wilks' Λ = .989, η_p^2 = .011, BF_{01} = 3.017, as was the Video × Knowledge interaction, $F(4, 191) = 0.915$, p = .456, Wilks' Λ = .981, η_p^2 = .019, BF_{01} = 18.493. No other multivariate effects were significant, all $p > .04$ (i.e., above the p-value threshold of .01679).

Discriminant validity. DPES-awe scores were analyzed using a 2 (Video: awe, baseline) × 2 (Knowledge: relevant, irrelevant) × 2 (Narrator: female, male) ANOVA. Importantly, there was no effect of video, $F(1, 194) = 1.819$, p = .179, BF_{01} = 6.232. In fact, there was no evidence that DPES-awe scores varied as a function of any of the factors, all $F(1, 194) < 3.325$, all $p > .070$.

Exploratory items. The inter-item reliability for the three items was low (α = .352), so the items were analyzed separately in a 2 (Video: awe, baseline) × 2 (Knowledge: relevant, irrelevant) × 2 (Narrator: female, male) MANOVA. There was no effect of knowledge, $F(3, 191) = 2.294$, p = .079, Wilks' Λ = .965, η_p^2 = .035, nor was there a Video × Knowledge interaction, $F(3, 191) = 1.785$, p = .151, Wilks' Λ = .973, η_p^2 = .027. The remaining multivariate effects were also non-significant, all $p > .084$.

Discussion

Study 4 provided evidence that awe experienced in response to physical beauty (i.e., in the MSI–Chicago rotunda) was associated with self-reported prior knowledge. In the current study, we set out to further investigate the role of knowledge in experience with awe, exploring whether the type of knowledge would matter. However, our results were inconclusive. While we were able to show that participants who watched an awe-inducing video (compared to baseline) did experience more awe (i.e., chills and small-self/vast-world), we were unable to show that knowledge had any effect on their experience.

The null effect of the knowledge manipulation is difficult to interpret. Quite simply, it could be that gaining knowledge prior to an experience does not affect awe. It is also possible that knowledge only increases awe when that awe experience is related to something of prior interest. In Study 4, the relationship between knowledge and awe was found among a sample of museum guests, who arguably self-selected into a study pertaining to something they already enjoyed: They wouldn't have been in the museum if they were not already interested in what it had to offer. Study 5 participants, in contrast, may have opted into participating in the study for reasons other than preexisting interest in national parks.

It is also possible that the manipulation failed. Perhaps the passages were not strong enough or interesting enough for participants to use them to inform their experience when they were watching the videos. Alternatively, perhaps both knowledge types were equally relevant. Indeed, participants did not differ in their

responses to the question, “To what extent did the passage make the video more impactful?” It is also possible, however, that any form of knowledge can enhance the awe experience (and that participants lacked insight into what affected their experience; Nisbett & Wilson, 1977). A limitation of this study is our lack of a no-knowledge baseline. We presented participants with either relevant or irrelevant knowledge but did not have a condition in which we presented no information. Because of this, we cannot determine whether the knowledge received prior to watching the video had any effect. It is possible that neither type of knowledge had any impact on our participants’ awe experience, or that they had equal impact.

The results of Study 5 do have positive implications. Study 5 once again provided evidence for the construct validity of the SAS. Providing evidence for convergent validity, SAS composite and subscale scores (with the exception of oppression/isolation) correlated positively with DPES-awe scores. Providing evidence for predictive and discriminant validity, scores on two subscales (chills, small-self/vast-world) differed in response to awe-evoking versus non-awe-evoking stimuli, whereas DPES-awe scores did not. That we replicated these patterns in an online study also underscores the value of the SAS by showing its utility regardless of the experimental location that is used (i.e., lab, museum, online).

General Discussion

Inspired by a cross-disciplinary review of perspectives on awe, for this dissertation we set out to construct a new measure of awe that would reflect these

psychological, philosophical, and religious perspectives. Across the series of studies reported in this dissertation, we constructed and validated the SAS, providing evidence for awe being characterized by multiple factors: liberation/connection, oppression/isolation, chills, and a sense of a small self in a vast world. Beyond the creation of the SAS, we also explored the role, if any, that knowledge would play on the experience of awe. While our exploration into knowledge's role yielded mixed results, overall, we were successful in the creation of a new measure for awe with good construct validity.

Structural Validity of the New Measure

At the start of this project, we reviewed literature suggesting that awe was made up of four to six different (but somewhat connected) dimensions. We hypothesized that there was likely both positive and negative dimensions, such that awe can be experienced as a feeling of wonder (e.g., at the Grand Canyon) and/or fear (e.g., of a severe thunderstorm). We also hypothesized that awe likely involves overwhelming physical sensations (e.g., heart racing) and perceptions (e.g., time slowing). Based on our studies, our four dimensions (i.e., liberation/connection, oppression/isolation, chills, and small-self/vast-world) were confirmed repeatedly. We also showed that a two-factor awe model (i.e., based on vastness and need for accommodation, the elicitors identified by Keltner & Haidt, 2003) did not adequately cover the full content of the awe construct—neglecting the negative and physiological aspects of awe that philosophy and religion have written about previously (Bleiker & Leet, 2003; Ecklund & Long, 2011; Forsey, 2007; Ivanhoe, 1997; Krause & Hayward, 2015; Yuen, 2007)—nor did it account

for the data as well as our four-factor model. The addition of these factors helped create a more structurally valid measure of awe.

Construct Validity beyond Structural Validity

As part of the process of creating a measure, we needed to ensure not only that our measure had structural validity (with the four-factor solution replicating across samples), but also that we were measuring the construct (i.e., awe) that we were intending to measure. To do this, we assessed several facets of construct validity. First, we assessed the convergent validity of our scale by simultaneously administered the SAS as well as previously existing measures of participants' dispositional awe (DPES-awe; Shiota et al., 2006) and small-self awe (Piff et al., 2015). Analyzing the correlations between participants' SAS composite and subscale scores with their scores on these other measures of awe, we showed consistent positive correlations between our measure and the previously validated measures. These significant positive correlations across multiple studies provided evidence that our SAS accurately and consistently measures awe, at least insofar as it assesses the same underlying construct as other purported measures of awe.

Beyond establishing that the SAS scale had good convergent validity, we aimed to ensure that it had good criterion validity, correlated with measures of constructs that awe should theoretically correlate with. To do this, we assessed a number of indicators of wellbeing concurrently with assessing situational awe: meaning in life (Steger et al., 2006), daily gratitude (McCullough et al., 2002), life satisfaction (Diener et al., 1985), and subjective happiness (Lyubomirsky & Lepper, 1999). Through the initial process of constructing and validating our scale

(i.e., Studies 1 and 2), we showed replicable positive correlations with certain SAS subscales and these well-being measures. We also provided evidence for criterion validity by demonstrated that SAS composite and/or subscale scores responded to different situations, with higher self-reported on in response to awe-inducing versus non-awe-inducing experiences (in the lab: awe versus baseline videos; at the MSI–Chicago: in the rotunda and U-505 exhibit versus the garage). These different aspects of convergent validity provide the additional evidence that we need to ensure that our scale is measuring the intended construct.

The last step we took in validating our measure was assessing instances in which our scale detected differences in awe while other measures of awe did not—that is, the SAS's discriminant validity. To do this, we compared how participants responded to the SAS versus the DPES-awe scale (Shiota et al., 2006). Because the SAS is intended to measure momentary levels of awe and the DPES-awe is intended to measure stable dispositional tendencies to experience awe, we expected to see SAS scores but not DPES-awe scores to show differences in response to awe-inducing versus non-awe inducing experiences. Consistently across all of our studies, we showed exactly that.

Through properly corroborating our measure with structural, convergent, criterion, and discriminant validity, we can say with confidence that the SAS measures awe, correlates with the theoretically relevant constructs, and detects fluctuations in awe where other measures fail to do so.

Knowledge and Awe

We also sought to conduct a preliminary exploration of the role that knowledge plays in experiences with awe. Through the final two studies, we explored the relationship between knowledge and awe, and found mixed results. On the one hand, Study 4 suggested that previous knowledge enhanced awe: A correlational analysis showed that the more knowledge/enjoyment that guests reported about the relevant experience, the more awe they reported. On the other hand, Study 5 suggested that providing knowledge to participants prior to their experience had no effect on their self-reported awe: Neither experience-relevant nor -irrelevant information enhanced participants' relative awe.

Unfortunately, one limitation with this last study was that there was no condition in which participants received knowledge. Without that true control condition, we cannot determine whether knowledge (i.e., relevant or irrelevant) had some effect on an individual's awe; we only know that we found no evidence that knowledge type had an effect. A future study should look to see whether gaining knowledge (compared to gaining nothing) has an effect on awe. This would help answer the question of what role knowledge plays in the experience of awe.

Limitations and Future Directions

There were two main limitations with the research conducted for this dissertation. The first relates to how the initial pool of words and phrases used in the scale construction study were generated. As discussed earlier, the item generation process involved informal focus group-type discussions with research

group members who were not directly involved with the project. While this process was useful in generating the list we used, it was a very informal and not as structured as other methods could have been. Formal focus group methodology, including cognitive interviews to ask respondents to reflect on their understanding of individual items (Krosnick, Lavrakas, & Kim, 2014), may have yielded different items. This might be especially true given that the informal discussion involved a brief introduction to philosophical and psychological conceptualizations of awe, and it is possible that this "expert" perspective may have led to the creation of different items than what would have been created by "naïve" discussion.

The other main limitation was our difficulty in reliably activating oppression/isolation. While this factor emerged in the studies in which we asked participants to generate memories of awe experiences, we were unable to manipulate it in the lab (i.e., via videos). One possible reason is that oppression/isolation is an aspect of awe that is more easily activated during a real experience (or memory thereof) where there is a true danger than in a lab or online setting where the "terrible" aspect of awe-inducing experiences poses no threat to participants simply observing an event. Our weak experimental results notwithstanding, recent research by Gordon et al. (2017) provides evidence for "dark awe" in which threat-based experiences (e.g., tornadoes) lead to experiences of awe that differ from the normal positive awe experience. This evidence for a "dark awe" helps support our findings that awe is indeed made up

of multiple factors, and that one of those factors is threat-based (i.e., oppression/isolation).

Conclusion

Throughout the centuries, many scholars have taken awe to mean a feeling that overwhelms the senses, elicited by the individual's awareness of the vastness of the world and their own smallness in the grand scheme of things. Awe has been defined as an overwhelming feeling of admiration sometimes mixed with wonder and fear and has been demonstrated to relate to wellbeing (e.g., Gordon et al., 2017) and suggested to be a catalyst for learning (Valdesolo et al., 2017). Inspired by a cross-disciplinary review of perspectives on awe, we constructed the SAS, a measure of awe with four factors: liberation/connection, oppression/isolation, chills and small-self/vast-world. Across five studies, we constructed and validated the SAS, and began to explore its relationship with knowledge. The research reported in this dissertation lays the groundwork for fruitful future investigation into the determinants and outcomes of awe.

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Appendix A: All Measures, Study 1

Describing Awe

Defining Awe

Small-Self (State/Situational Awe) (Piff et al., 2015)

DPES-Awe (Trait/Dispositional Awe) (Shiota et al., 2006)

Meaning in Life (Steger, Frazier, Oishi, & Kaler, 2006)

Satisfaction with Life Scale (Diener, Emmons, Larsen, & Griffin, 1985)

Happiness (Lyubomirsky & Lepper, 1999)

Gratitude (McCullough, Emmons, & Tsang, 2002)

Nature Relatedness Scale (Nisbet, Zelenski, & Murphy, 2009)

Liking of Awe

Ideal Affect (adapted from Tsai, Knutson, & Fung, 2006)

Proneness to Awe

Situational Self-Awareness Scale (adapted from Govern & Marsh, 2001)

Need for Closure (Webster & Kruglanski, 1994)

Ten-Item Personality Inventory (TIPI) (Gosling, Rentfrow, & Swann, 2003)

Coping

Appendix B: Materials, Study 1

Describing Awe

Describe, as vividly as possible, a time when you felt awe. What triggered it? What were you doing? Where were you? Who were you with?

Defining Awe

How do you define awe? What are the emotional and physical feelings/sensations that you experience when you feel awe? What thoughts do you have? (Provide at least five (5) words/phrases.)

Now, got back and rate each word/phrase: How central/important is the feeling/sensation/thought to the experience of awe? (*not at all — completely*)

How positive/negative is the feeling/sensation/thought in the context of awe? (*extremely negative — extremely positive*)

Rate each of the following in terms of how central/important they are to the experience of awe. (*not at all — completely*)

(see Table 1 in main text)

Now, rate how positive/negative they are in the context of awe. (*extremely negative —extremely positive*)

Did we miss any important words/phrases to describe awe? If so, write them below, and then rate how well they central they are to the experience of awe and how positive/negative they are in the context of awe.

Small-Self State/Situational Awe (Piff et al., 2015)

Think back to what you wrote about a time you experienced awe. Rate the extent to which you agree with each of the following statements (-3, *disagree strongly* — 0, *neither disagree nor agree* — +3, *agree strongly*)

1. I felt the presence of something greater than myself.
2. I felt part of some greater entity.
3. I felt like I was in the presence of something grand.
4. I felt like I was a part of a greater whole.
5. I felt the existence of things more powerful than myself.
6. I felt small or insignificant.

7. I felt like my own day-to-day concerns were relatively trivial.
8. In the grand scheme of things, my own issues and concerns did not matter as much.
9. I felt insignificant in the grand scheme of things.
10. I felt small relative to something more powerful than myself.

DPES-awe (Trait/Dispositional Awe) (Shiota et al., 2006)
Rate the extent to which you agree with each of the following statements in general (-3, *disagree strongly* — 0, *neither disagree nor agree* — +3, *agree strongly*)

1. I often feel awe.
2. I see beauty all around me.
3. I feel wonder almost every day.
4. I often look for patterns in the objects around me.
5. I have many opportunities to see the beauty of nature.
6. I seek out experiences that challenge my understanding of the world

Meaning in Life (Steger, Frazier, Oishi, & Kaler, 2006)

Rate the extent to which each of the following statements is true (0, *completely untrue* — 6, *completely true*)

1. I understand my life's meaning.
2. I am looking for something that makes my life feel meaningful.
3. I am always looking to find my life's purpose.
4. My life has a clear sense of purpose.
5. I have a good sense of what makes my life meaningful.
6. I have discovered a satisfying life purpose.
7. I am always searching for something that makes my life feel significant.
8. I am seeking a purpose or mission for my life.
9. My life has no clear purpose.
10. I am searching for meaning in my life.

Satisfaction with Life Scale (Diener, Emmons, Larsen, & Griffin, 1985)

Rate the extent to which you agree with each of the following statements. (-3, *disagree completely* — 0, *neither disagree nor agree* — +3, *agree completely*)

1. In most ways my life is close to my ideal.
2. The conditions of my life are excellent.
3. I am satisfied with my life.

4. So far I have gotten the important things I want in life.
5. If I could live my life over, I would change almost nothing.

Happiness (Lyubomirsky & Lepper, 1999)

1. In general I consider myself: *not a very happy person – a very happy person*
2. Compared to most of my peers, I consider myself: *less happy – equally happy – more happy*
3. Some people are generally very happy. They enjoy life regardless of what is going on, getting the most out of everything. To what extent does this characterization describe you? (*not at all — somewhat — very much*)
4. Some people are generally not very happy. Although they are not depressed, they never seem as happy as they might be. To what extent does this characterization describe you? (*not at all — somewhat — very much*)

Gratitude (McCullough, Emmons, & Tsang, 2002)

Rate the extent to which you agree with each of the following statements (-3, *disagree completely* — 0, *neither disagree nor agree* — +3, *agree completely*)

1. I have so much in life to be thankful for.
2. If I had to list everything in life that I felt grateful for, it would be a long list.
3. When I look at the world, I don't see much to be grateful for.
4. I am grateful to a wide variety of people.
5. As I get older, I find myself more able to appreciate the people, events, and situations that have been part of my life history.
6. Long amounts of time can go by before I feel grateful to something or someone.

Nature Relatedness Scale (Nisbet, Zelenski, & Murphy, 2009).

Rate the extent to which you agree with each of the following statements (-3, *disagree strongly* — 0, *neither disagree nor agree* — +3, *agree strongly*)

Self

1. My connection to nature and the environment is a part of my spirituality.
2. My relationship to nature is an important part of who I am.
3. I feel very connected to all living things and the earth.
4. I am not separate from nature, but a part of nature.
5. I always think about how my actions affect the environment.
6. I am very aware of environmental issues.

7. I think a lot about the suffering of animals.
8. Even in the middle of the city, I notice nature around me.
9. My feelings about nature do not affect how I live my life.

Perspective

10. Humans have the right to use natural resources any way we want.
11. Conservation is unnecessary because nature is strong enough to recover from any human impact.
12. Animals, birds and plants have fewer rights than humans.
13. Some species are just meant to die out or become extinct.
14. Nothing I do will change problems in other places on the planet.
15. The state of nonhuman species is an indicator of the future for humans.

Experience

16. The thought of being deep in the woods, away from civilization, is frightening .
17. My ideal vacation spot would be a remote, wilderness area.
18. I enjoy being outdoors, even in unpleasant weather.
19. I don't often go out in nature.
20. I enjoy digging in the earth and getting dirt on my hands.
21. I take notice of wildlife wherever I am.

Liking of Awe

1. How much do you enjoy the experience of awe? (*1 – 7 anchors; not at all – very much)*

Ideal Affect (adapted from Tsai, Knutson, & Fung, 2006)

Rate how frequently you would *ideally like* to feel each of the following. (*never — all of the time*)

Rate how frequently you *typically* feel each of the following. (*never — all of the time*)

1. **High-arousal positive**: excited, elated, euphoric
2. **Positive**: happy, satisfied, content
3. **Low-arousal positive**: calm, peaceful, serene
4. **Low arousal**: quiet, still, passive
5. **Low-arousal negative**: dull, sleepy, sluggish
6. **Negative**: sad, lonely, unhappy
7. **High-arousal negative**: tense, frustrated, anxious
8. **High arousal**: aroused, surprised, astonished
9. **Awe**: awe, wonder, reverence
10. **Nostalgia**: nostalgia, wistfulness, reminiscence
11. **Anticipation**: anticipation, optimism, hope, eagerness

NB. Participants see only the affect items, not the categories

Proneness to Awe

1. How frequently do you experience awe? (*never — very frequently*)
2. How intensely do you experience awe? (*not at all — extremely*)

Situational Self-Awareness Scale (adapted from Govern & Marsh, 2001)

Rate the extent to which you agree with each of the following statements (-3, *disagree completely* — 0, *neither disagree nor agree* — +3, *agree completely*)

1. I am keenly aware of everything in my environment.
2. I am conscious of my inner feelings.
3. I am concerned about the way I present myself.
4. I am self-conscious about the way I look.
5. I am conscious of what is going on around me.
6. I am reflective about my life.
7. I am concerned about what other people think of me.
8. I am aware of my innermost thoughts.
9. I am conscious of all objects around me.

Need for Closure (Webster & Kruglanski, 1994)

Rate the extent to which you agree with each of the following statements (-3, *disagree completely* — 0, *neither disagree nor agree* — +3, *agree completely*)

1. In case of uncertainty, I prefer to make an immediate decision, whatever it may be.
2. When I find myself facing various, potentially valid, alternatives, I decide in favor of one of them quickly and without hesitation.
3. I have never been late for work or for an appointment.
4. I prefer to decide on the first available solution rather than to ponder at length what decision I should make.
5. I get very upset when things around me aren't in their place.
6. Generally, I avoid participating in discussions on ambiguous and controversial problems.
7. When I need to confront a problem, I do not think about it too much and I decide without hesitation.
8. When I need to solve a problem, I generally do not waste time in considering diverse points of view about it.
9. I prefer to be with people who have the same ideas and tastes as myself.

10. Generally, I do not search for alternative solutions to problems for which I already have a solution available.
11. I feel uncomfortable when I do not manage to give a quick response to problems that I face.
12. I have never hurt another person's feelings.
13. Any solution to a problem is better than remaining in a state of uncertainty.
14. I prefer activities where it is always clear what is to be done and how it need to be done.
15. After having found a solution to a problem I believe that it is a useless waste of time to take into account diverse possible solutions.
16. I prefer things to which I am used to those I do not know, and cannot predict.

Ten-Item Personality Inventory (TIPI) (Gosling, Rentfrow, & Swann, 2003)

Rate the extent to which you agree with each of the following statements (-3, *disagree completely* — 0, *neither disagree nor agree* — +3, *agree completely*)

I see myself as:

1. extraverted, enthusiastic.
2. critical, quarrelsome.
3. dependable, self-disciplined.
4. anxious, easily upset.
5. open to new experiences, complex.
6. reserved, quiet.
7. sympathetic, warm.
8. disorganized, careless.
9. calm, emotionally stable.
10. conventional, uncreative.

Coping

Imagine failing at something that is important to you, or feeling inadequate in some way. What types of activities make you feel better? Rank order the following types of activities, with 1 being the *most* effective way to make you feel better, and 10 being the *least* effective way to make you feel better.

1. Reminiscing about people and events that were important in your past.
2. Revisiting familiar/comforting things from the past (e.g., old TV shows, books, games, collections).
3. Connecting with forces bigger than yourself (e.g., nature, religion).

4. Connecting with ideas bigger than yourself (e.g., through philosophy or aesthetic pursuits such as dance, music).
5. Connecting with the larger community (e.g., by volunteering).
6. Spending time reaffirming connections with close others.
7. Immersing yourself in activities that get your mind off the situation (e.g., playing a video game, burying yourself in a book).
8. Distracting yourself by eating, drinking, etc.
9. Imagining yourself and your life in the future.
10. Trying to address the failure/inadequacy.

Are there other types of activities that work better for you? If so, write them below.

Demographic Information

Age (in years): _____

First language: _____

Sex:

- ☐ Female
- ☐ Male

Race/ethnicity:

- ☐ Asian
- ☐ Black
- ☐ Latino/a
- ☐ Pacific Islander
- ☐ White
- ☐ Other (Specify: _____)
- ☐ Mixed (Specify: _____)

Appendix C: Situational Awe Scale, Study 3

Liberation/Connection

I felt free.
I felt liberated.
I felt a closer sense of my identity, who I am.
I felt psychologically connected to everyone/everything around me.
I felt physically connected to everyone/everything around me.
Everything seemed connected.

Oppression/Isolation

I felt confined.
I felt tense.
I felt suffocated
I felt oppressed.
Everything seemed disjointed.

Chills

My heart was racing.
My breath was taken away.
I felt chills.
I felt goosebumps.

Small Self in a Vast World

I felt physically smaller.
I felt like I was trivial, in the grand scheme of things.
The world seemed vast.

Appendix D: All Measures, Study 4

Emotion Ratings

Situational Awe Scale (SAS)

Prior Knowledge and Interest

Professional Skepticism Scale (PSS)

Critical Thinking Measure

Appendix E: Target Measures, Study 4

Emotion Ratings

Rate the extent in which you feel each of the following emotions (0, *not at all* – 3, *moderately* – 6, *very much*)

- Awe
- Confusion
- Amazement
- Disorientation
- Wonder
- Fascination
- Astonishment
- Curiosity
- Bewilderment

Situational Awe Scale (SAS)

Rate each of the following in terms of how central/important they are to the experience of awe. (*not at all — completely*)

- **Liberation/connection:** Free, liberated, closer sense of my identity, psychologically connected, physically connected, everything seemed connected
- **Oppression/isolation**: Confined, tense, suffocated, everything seems disjointed
- **Chills**: Heart racing, breath taken away, chills, goosebumps
- **Small-self/vast-world:** Physically smaller, world as vast, feel like I am trivial in the grand scheme of things

Knowledge Questions

Rate the extent to which you feel each of the following (0, *not at all* – 3, *moderately* – 6, *very much*)

- To what extent do you enjoy learning about (military history/art)?
- To what extent do you enjoy learning about (military technology/architecture)?
- To what extent do you consider yourself knowledgeable about (military history/art)?

- To what extent do you consider yourself knowledgeable about (military technology/ architecture)?

Appendix F: Knowledge Manipulation, Study 5

Relevant-Knowledge Passage

Yosemite (meaning "killer" in Miwok) is one of the largest and least fragmented habitat blocks in the Sierra Nevada, and on average, about 4 million people visit the park each year. The 1,189 square mile park is roughly the size of the U.S. state of Rhode Island and contains thousands of lakes and ponds, 1,600 miles of streams, 800 miles of hiking trails, and 350 miles of roads. The park has an elevation range from 2,127 to 13,114 feet and contains five major vegetation zones.

Yosemite Valley represents only one percent of the park area, but this is where most visitors arrive and stay. The Tunnel View is the first view of the Valley for many visitors and is extensively photographed. El Capitan, a prominent granite cliff that looms over Yosemite Valley, is one of the most popular rock climbing destinations in the world. Granite domes such as Sentinel Dome and Half Dome rise 3,000 and 4,800 feet, respectively, above the valley floor. There is suitable habitat for more than 160 rare plants in the park, with rare local geologic formations and unique soils characterizing the restricted ranges many of these plants occupy. Of California's 7,000 plant species, about 50% occur in the Sierra Nevada and more than 20% within Yosemite.

The high country of Yosemite contains beautiful areas such as Tuolumne Meadows, the Cathedral Range, and the Kuna Crest. Along much of Yosemite's western boundary, habitats are dominated by mixed coniferous forests of ponderosa pine, Douglas fir, and a few stands of giant sequoia. A relatively high diversity of wildlife species is supported by these habitats, because of relatively mild, lower-elevation climate and the mixture of habitat types and plant species. Wildlife species typically found in these habitats include black bear, coyote, white-headed woodpecker, bobcat, river otter, gray fox, cougar, spotted owl, and a wide variety of bat species.

Irrelevant-Knowledge Passage

Yosemite National Park is a United States national park lying in the western Sierra Nevada of California. The park, which is managed by the U.S. National Park Service, and designated a World Heritage Site in 1984, Yosemite is internationally recognized for its granite cliffs, waterfalls, clear streams, sequoia groves, lakes, mountains, meadows, glaciers, and biological diversity.

Yosemite was central to the development of the national park idea. First, Galen Clark and others lobbied to protect Yosemite Valley from development, ultimately leading to President Abraham Lincoln's signing the Yosemite Grant in 1864. Later, John Muir led a successful movement to establish a larger national park encompassing not just the valley, but surrounding mountains and forests as well—paving the way for the U.S. National Park system.

Automobiles started to enter the park in ever-increasing numbers following the construction of all-weather highways to the park. The Yosemite Museum was founded in 1926 through the efforts of Ansel Franklin Hall. In the 1920s, the museum featured Native Americans practicing traditional crafts, and many of the Sierra Miwok continued to live in Yosemite Valley until they were evicted from Yosemite in the 1960s.

In 1903, a dam in the northern portion of the park was proposed. Located in the Hetch Hetchy Valley, its purpose was to provide water and hydroelectric power to San Francisco. In 1937, conservationist Rosalie Edge, head of the Emergency Conservation Committee (ECC), successfully lobbied Congress to purchase old-growth sugar pines on the perimeter of Yosemite National Park that were to be logged.

In 2016, The Trust for Public Land purchased Ackerson Meadow in order to preserve habitat and protect the area from development. Ackerson Meadow was originally included in the proposed 1890 park boundary but never acquired by the federal government. On September 7, 2016, the National Park Service accepted the donation of the land.

Yosemite Valley is open year-round.