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The Science of Awe



Kanab, Utah, United States (Photo by Christopher Ruel)

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The Science of Awe

EXECUTIVE SUMMARY



Taj Mahal, Agra, India (Photo by Julian Yu)

If you’ve hiked among giant sequoias, stood in front of the Taj Mahal, or observed a particularly virtuosic musical performance, you may have experienced the mysterious and complex emotion known as “awe.”

Awe experiences are self-transcendent. They shift our attention away from ourselves, make us feel like we are part of something greater than ourselves, and make us more generous toward others.

But what is awe? What types of experiences are most likely to elicit feelings of awe? Are some people more prone to experiencing awe? And what are the effects of awe?

While philosophers and religious scholars have explored awe for centuries, it was largely ignored by psychologists until the early 2000s. Since then, there has been growing interest in exploring awe empirically. This has led to a number of fascinating discoveries about the nature of awe, while also raising many questions still to be explored.

What is awe?

Awe is a complex emotion that can be difficult to define. Feelings of awe can be positive or negative—unlike most other emotions—and can arise from a wide range of stimuli. In a landmark 2003 paper, psychologists Dacher Keltner and Jonathan Haidt presented a “conceptual approach

to awe.” In this paper, Keltner and Haidt suggested that awe experiences can be characterized by two phenomena: “perceived vastness” and a “need for accommodation.”

“Perceived vastness” can come from observing something literally physically large—the Grand Canyon, for example—or from a more

theoretical perceptual sense of vastness—such as being in the presence of someone with immense prestige or being presented with a complex idea like the theory of relativity.

An experience evokes a “need for accommodation” when it violates our normal understanding of the world. When a stimulus exceeds our expectations in some way, it can provoke an attempt to change the mental structures that we use to understand the world. This need for cognitive realignment is an essential part of the awe experience as conceptualized by Keltner and Haidt.

Since Keltner and Haidt’s 2003 paper, studies have shown that awe is often accompanied by feelings of self-diminishment and increased connectedness with other people. Experiencing awe often puts people in a self-transcendent state where they focus less on themselves and feel more like a part of a larger whole. In this way, awe can be considered an altered state of consciousness, akin to a flow state, in addition to an emotional state.

Why might awe have evolved?

While no one knows for sure why awe evolved, there are some interesting theories. Haidt and Keltner, for instance, suggest that awe evolved because it prompted reverence and devotion to powerful leaders and promoted social cohesion. Alternatively, psychologists Alice Chirico and David Yaden suggest that awe may have evolved because it helped people identify safe places to seek shelter, such as environments with large vistas that would have allowed our hunter-gatherer relatives to see approaching predators or attackers.

Awe’s ability to elicit cognitive accommodation may also explain why humans evolved to experience this unique emotion. Experiencing awe may be adaptive because it encourages us to

take in new information and adjust our mental structures around this information, helping us navigate our world and increasing our odds of survival. Finally, awe’s ability to make us feel more connected with others and to be more helpful and generous may have also helped ensure our ancestors’ survival and reproductive success.

What types of experiences elicit awe?

A number of empirical studies have explored the types of situations that can elicit awe. For example, studies have found that natural scenes are frequent awe elicitors, that stimuli do not need to be physically large to elicit awe, and that recalling spiritual and religious experiences can evoke feelings of awe.

There are likely cultural variations in the awe experience. For example, one study found cultural differences in the situations that elicit awe: personal accomplishments were more frequent awe elicitors among people in the United States (a more individualistic culture) than among people from China (a more collectivist culture), whereas feeling in awe of another person was more commonly reported by people from China than by people from the United States.

Who experiences more awe?

A few studies have explored various factors that may make some people more prone to experiencing awe than others. For example, more extraverted people may have a greater tendency to experience awe, as may people who are more open to new experiences. People who are less comfortable with ambiguity, on the other hand, appear to be less likely to experience awe.

Other studies suggest that wiser people may also experience more awe, and one’s tendency to

experience awe is correlated with a number of other positive character traits, such as appreciation of beauty, creativity, and gratitude.

There are likely social factors that influence whether a person has a greater disposition for awe. For example, one study found evidence that people from lower social classes report experiencing awe more frequently than people from higher classes. And another study comparing awe experiences among people from the United States, Malaysia, Iran, and Poland found that people from the United States had the highest dispositional awe, whereas people from Iran had the lowest.

Effects of awe

Awe experiences may bring with them a host of physiological, psychological, and social effects. For example, studies have found that feelings of awe can be accompanied by heart rate changes, “goosebumps,” and the sensation of chills, and there is some evidence that awe may even decrease markers of chronic inflammation.

When it comes to psychological effects, studies have found that awe can create a diminished sense of self (an effect known as “the small self”), give people the sense that they have more available time, increase feelings of connectedness, increase critical thinking and skepticism, increase positive mood, and decrease materialism.

Multiple studies have found evidence that experiencing awe makes people more kind and generous. For example, people who wrote about a time when they experienced awe reported a

greater willingness to volunteer their time to help a charity than did people who recalled a happy experience. Another study found that people with more dispositional awe were more generous in laboratory tasks—such as in how they distributed raffle tickets between themselves and an unknown participant—and that people who stood among awe-inspiring eucalyptus trees picked up more pens for an experimenter who had “accidentally” dropped them than did people who stared up at a not-so-inspiring large building.

Future directions

The science of awe is barely 15 years old, and there are many more questions left to be explored than those that have been answered. Particularly interesting areas for future study include: How do children experience awe? How do our different senses contribute to the awe experience? How do natural awe experiences vary from those in the lab? And can people be taught to experience awe more frequently?



Thórsörk, Iceland (Photo by Jonatan Pie)



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Introduction

Have you ever had an experience that left you overcome with wonder? Perhaps you were marveling at Mount Rushmore, moved to tears by a work of art, or staring with amazement at an electrical storm. In these moments—if the conditions were right—you may have experienced awe, an emotion that had evaded scientific inquiry until just recently.

Awe can be scary, or it can be a delight. Sometimes it's both. It can even change your life—leading to an epiphany or spiritual transformation.

But how do we define an awe experience? What experiences are mostly likely to elicit awe? What does awe feel like in our bodies? Why do some people feel more awe than others? And how does awe change our sense of ourselves and our behavior toward others? These are some of the questions that psychologists have started to explore through the science of awe.

Indeed, while religious leaders and philosophers have long pondered the nature of awe and its ability to change how we feel about ourselves and our world, psychologists began studying the emotion in earnest only 15 years ago. In fact, only a single peer reviewed paper published in the year 2002 listed “awe” as a major subject or keyword, according to the PsycINFO database; in 2017, that figure had jumped to 12. This paper presents an overview of research produced over those 15 years.

In this white paper, the number of citations for a particular study or review paper (as of March 2018) is indicated in brackets [] next to that citation; highly cited studies (>50 citations) are indicated in **bold**.

It is important to note that, because this area of study is so new, many of the findings presented in this paper stem from only a few studies (often a single study) and thus should be considered preliminary until they are validated by future studies.

The paper is divided into seven sections, including this introductory section. The second section briefly defines awe, its features, and what distinguishes it from other emotions. The third discusses theories for why humans may have evolved to feel awe. The fourth delves into what is known about the general types of situations that elicit awe. The fifth explores the personality, social, and cultural factors that may influence who experiences awe. The sixth discusses the physical, psychological, and social effects of awe. The final section outlines limitations to this research and discusses promising future directions in the science of awe.



Monrovia, Liberia (Photo by Bethany Laird)

What is Awe?

Defining Awe

A majestic waterfall, the Taj Mahal, towering redwoods, the Grand Canyon, a tornado, Beethoven's Symphony Number 9, Monet's Water Lilies, a fractal, a spiritual experience, a performance by Prince, a child being born, a speech by Martin Luther King, Jr., the view of Earth from space. What do all these things have in common? They're likely to induce one of the most mysterious and mystifying of emotions: awe.



Aracaju, Brazil (Photo by Patricia Prudente)

It's likely that you've experienced awe at one time or another. But how would you describe it? Was it pleasurable? Fearful? Wondrous? Awe is difficult to define, which may help explain why psychologists—until recently—have kept their distance from this particular emotion.

While religious scholars, philosophers, and sociologists have considered awe's role in religious transformations, aesthetics, and political change, psychologists historically had only a fleeting interest in the emotion (Shiota, Keltner, & Mossman, 2007) [265]. But in 2003, psychologists Dacher Keltner and Jonathan Haidt presented a "conceptual approach to awe" in their paper "Approach-

ing awe, a moral spiritual, and aesthetic emotion" (Keltner & Haidt, 2003) [755]. This paper presents a theoretical proposal for how to define, conceptualize, and study awe, laying the foundation for a new and rigorous line of research. But what exactly is awe?

In their paper, Keltner and Haidt note that the word "awe" is derived from words in Old English and Old Norse that expressed "fear and dread, particularly toward a divine being." The English meaning evolved into "dread mingled with veneration, reverential or respectful fear; and the attitude of a mind subdued to profound reverence in the presence of supreme authority, moral greatness or sublimity, or mysterious sacredness." And the meaning has further evolved since then. Ask someone in the United States about their latest awe experience and you're likely to hear about a positive experience in nature.

How best to characterize a state or emotion that can be elicited by such various experiences? Keltner and Haidt propose that all awe experiences have two essential central features in common: perceived vastness and a need for accommodation.

Perceived vastness

While many stimuli that elicit awe are physically vast, Keltner and Haidt's idea of "vastness" goes beyond literal size and includes stimuli that are perceptually or conceptually vast (such as a complex scientific theory).

"Vastness refers to anything that is experienced as being much larger than the self, or the self's ordinary level of experience," they write. So while we can perceive a sense of vastness in the face of an open plain or giant redwood tree, it can also be induced by "social size"—like prestige, authority, or fame—or by something intricate or complex—like a fractal or an impressive work of art or music. Essentially, any stimulus that exceeds a person's normal range of experience in one attribute or another could lead to the perception of vastness, as can stimuli that lead people to feel as if they are part of something larger than themselves.

Need for accommodation

Accommodation, according to Keltner and Haidt, refers to psychologist Jean Piaget's "process of adjusting mental structures that cannot assimilate a new experience." In other words, your conception of the world needs to shift or expand in order to make sense of this new experience.

Importantly, Keltner and Haidt emphasize that awe involves a need for accommodation, which may or may not be met. "The success of one's attempts at accommodation may partially explain why awe can be both terrifying (when one fails to understand) and enlightening (when one succeeds)," they write. The "need for accommodation" feature of awe explains why we find these experiences so mind-blowing: Awe experiences actually prompt us to question and try to revise our understanding of the world.

In order to elicit awe, an experience must involve both perceived vastness and a need for accommodation, at least as conceptualized by Keltner and Haidt. For example, an experience that involves a need for accommodation but not vastness would elicit surprise but not awe. Imagine walking into your house and being greeted with a surprise party. You might experience cognitive accommodation—in this case, that might involve realizing that your spouse didn't really have a work function that night and finally deducing why there had been bags of ice in the freezer than morning. Yet you likely wouldn't have the perception of vastness (unless your party was at Niagara Falls or Beyoncé was invited). So you'd be surprised, but not awed.

"Flavors" of awe

In their 2003 paper, Keltner and Haidt propose the prototypical awe experience as involving "a challenge to or negation of mental structures when they fail to make sense of an experience of something vast"—a prime example being the feeling one has in the presence of a powerful leader. However, they also propose five peripheral or features that can "flavor" awe experiences, producing a diverse range of awe-related states. Their proposed flavors of awe are: threat, beauty, ability, virtue, and supernatural causality (Keltner & Haidt, 2003) [755].

Keltner and Haidt propose the following explanations of these awe flavors:

Threat-based awe is likely accompanied by fear; stimuli that may elicit threat-based awe include a charismatic leader like Hitler or an extreme weather event like an electrical storm.

Beauty-based awe is flavored with "aesthetic pleasure" and may be elicited by a person, a natural

scene (e.g., the Grand Canyon), or a work of art (e.g., Monet's Water Lilies).

Ability-based awe is thought to co-occur with admiration of a person's "exceptional ability, talent, and skill." Examples include seeing an especially talented musician or stellar athlete.

Virtue-based awe—the awe one feels when in the presence of someone displaying virtue and strength of character—would likely be accompanied by feelings of elevation. An example of virtue-based awe might be reading about the lives of saints.

Supernatural causality-based awe—as one might experience if they saw an angel, a ghost, or a floating object—will be tinted with an "element of the uncanny," which can be terrifying or glorious depending on the source.

It is important to note that these "flavorings" are theoretical variations of awe experiences rather than experimentally validated categories. Write researchers Alice Chirico and David B. Yaden in a recent chapter about awe, "It is unclear how consistent this part of Keltner and Haidt's theory is with mainstream emotion theory, though these themes provide interesting avenues for further empirical research" (Chirico & Yaden, 2018) [1].

Awe as a self-transcendent experience

Since Keltner and Haidt's 2003 article, multiple studies have shown that awe experiences are often accompanied by a diminished sense of self (often termed "the small self"), feelings of connectedness with others, and a sense of being in the presence of something greater than oneself. These findings have led David Yaden and others to suggest that awe can be classified not just as an emotion but also as a type of altered state of consciousness called a "self-transcendent experience (STE)"—(Yaden, Haidt, Hood, Vago, & Newberg, 2017) [8]. Other STEs include states like "mindfulness"

and "flow." The self-transcendent qualities of the awe experience will be covered in greater depth in the "Effects of Awe" section of this paper.

How Awe Relates to Other Emotions

In the eyes of emotion researchers, awe maintains a complicated, sometimes fuzzy, relationship to other positive emotions—it can sometimes be challenging to differentiate it from other emotional states, a challenge not uncommon among positive emotions [26] (Keltner & Cordaro, 2017) [17] (Cordaro, Fridlund, Keltner, & Russell, 2015) [0].

One recent paper, which proposes a taxonomy of positive emotions, theorizes that emotions can be differentiated in part based on the "adaptive problem they address" and argues that awe is a discrete emotion that addresses the need to take in novel, complex information (Shiota et al., 2017) [9]. This conception of awe means that we may experience awe because it induces us to process (or try to process) new information about our environment.

Importantly, the researchers also note that emotions can also be differentiated from one another by attributes such as the neural mechanisms, nonverbal expressions, peripheral physiology, cognitive aspects, motivations/behaviors, and subjective experiences associated with each of them. Most of these attributes are largely unknown when it comes to awe. Awe may very well be its own basic emotion, then, but other emotional states might overlap with it.

Wonder, in particular, is often thought to be related to awe. For example, in a 2011 paper, Paul Ekman and Daniel Cordaro wrote that wonder is "the response to something incomprehensible, incredible but not frightening, a rarely felt emotion" (Ekman & Cordaro, 2011) [434], and that "[w]hen

it combines with fear, then the correct term is ‘awe.’” However, most of the studies discussed in this white paper would collapse all of these responses into the concept of “awe.”

Other studies have used people’s descriptions of experiences to try to elucidate differences between awe and wonder. One such study found that awe “was related to observing the world, reflected in greater use of perception words” (such as “heard” or “saw”) whereas wonder “was related to trying to understand the world, reflected in greater use of cognitive complexity and tentative words” (such as “think,” “because,” or “perhaps”) (Darbor, Lench, Davis, & Hicks, 2016) [7]. This is somewhat similar to an analysis of astronauts’ accounts of their experiences in space, which determined that awe is “a direct and initial experience or feeling when faced with something incomprehensible or sublime” whereas wonder is “a reflective experience motivated when one is unable to put things into a familiar conceptual framework—leading to open questions rather than conclusions” (Gallagher, Reinerman-Jones, Sollins, & Janz, 2014) [11]. Thus there may be ways to differentiate wonder and awe, but the two states are likely to overlap, at least in terms of how most people think about these emotions.

Another emotion sometimes conflated with awe is “elevation,” the warm, uplifting feeling one has when witnessing a moral act. According to Keltner and Haidt, elevation is in the awe family—along with inspiration and admiration—but can be distinguished from awe because it does not include a perception of vastness (Keltner & Haidt, 2003) [755].

While both awe and elevation involve an element of self-transcendence, spurring us to turn our attention outside ourselves, awe leads people to feel small and connected to others,

while elevation leaves people feeling uplifted and inspired to be similarly altruistic (although as we will see later, awe can also inspire generous acts) (Shiota, Thrash, Danvers, & Dombrowski, 2014) [10]. Researchers will likely continue to explore and clarify the differences between awe, elevation, and related emotions.

Expressions of Awe

As mentioned above, research suggests that emotions are often characterized by particular verbal and nonverbal expressions that may help differentiate those emotions from other, similar emotions. Some research has attempted to zero in on these expressions when it comes to awe, though questions remain as to the universality of these expressions.

In one study, multiple people attempted to convey several different emotions, including awe, with their voice, using short vocalizations that the researchers called “vocal bursts” (Simon-Thomas, Keltner, Sauter, Sinicropi-Yao, & Abramson, 2009) [114]. When other participants listened to the vocal bursts and were asked to determine which emotion the person was trying to convey, they were able to successfully identify a significant number of the awe vocalizations, suggesting that there is a stereotypical verbal expression that people associate with awe (although there was more variability in the identifications of the awe expressions than in many of the other emotions). Another study of people from 10 globalized cultures and a remote village in Bhutan found moderate evidence that a vocal burst, similar to “wow,” could be universally recognized as being related to an experience of awe (Cordaro, Keltner, Tshering, Wangchuk, & Flynn, 2016) [29].

Whether or not there are clear nonverbal expressions of awe is still a matter of some debate.

In one study, undergraduate participants recalled times when they had experienced different emotions and showed how they would express those emotions nonverbally (Shiota, Campos, & Keltner, 2003) [113]. When it came to awe, the majority of participants displayed some combination of an open, slightly drop-jawed mouth, widened eyes, and raised inner eyebrows, and more than a quarter slightly jutted their head out or inhaled.

The researchers speculate that the forward head jutting and widened eyes may help people take in and process new information—part of the process of cognitive accommodation—whereas inhalation and a dropped jaw may reduce physiological arousal, which can interfere with complex cognitive processing.

A later study found very similar results (Campos, Shiota, Keltner, Gonzaga, & Goetz, 2013) [92], and another study found that the majority of both American and Indian college students were able to correctly identify three different displays of an emotion akin to wonder (Hejmadi, Davidson, & Rozin, 2000) [84], again suggesting that nonverbal expressions of awe may be at least somewhat universal (if potentially conflated with wonder).

However, while partially universal, a person's nonverbal expression of awe is likely modified by culture. A recent study that asked participants from China, India, Japan, Korea, and the United States to produce nonverbal expressions for 22 emotions found that there was indeed a core nonverbal expression of awe that was highly conserved across all five cultures, but expressions also contained cultural “accents” (Cordaro et al., 2018) [1]. For example, Indian participants made open-mouthed lip puckers in response to awe. This study found that about a quarter of an

“individual's expression of a specific emotion resembled the emotion-specific cultural dialect of that individual's locale.”

Besides varying by culture, it is possible that nonverbal expressions may vary in response to the subtype of awe experienced (e.g., an expression of awe in response to threatening stimuli may look different from an expression of awe in response to a particularly beautiful site)(Keltner & Cordaro, 2017) [17]. Thus further research will be required to determine if there are consistent and/or universal nonverbal expressions specific to different experiences of awe.

Methods for Studying Awe

Researchers have developed a number of methods for studying awe. These methods include asking participants to recall a time when they experienced awe and talk or write about the experience in detail (Shiota et al., 2007) [265] (Piff, Dietze, Feinberg, Stancato, & Keltner, 2015) [133] (Schurtz et al., 2012) [34]; showing participants slideshows or videos of stimuli that are likely to induce awe, such as grand vistas or childbirth (Saroglou, Buxant, & Tilquin, 2008) [152] (Silvia, Fayn, Nusbaum, & Beaty, 2015) [70] (Shiota, Neufeld, Yeung, Moser, & Perea, 2011) [97] (Piff et al., 2015) [133] (Prade & Saroglou, 2016) [16] (Van Cappellen & Saroglou, 2012) [88]; taking participants to an awe-inspiring environment, such as a grove of towering trees (Piff et al., 2015) [133]; having participants read short stories about known elicitors of awe (Piff et al., 2015) [133]; and asking participants to keep a daily diary about their awe experiences (Bai et al., 2017) [2].

When measuring the extent to which a person is disposed to experience awe in their day-to-day lives—what researchers refer to as “dispositional awe”—researchers often use the awe subscale

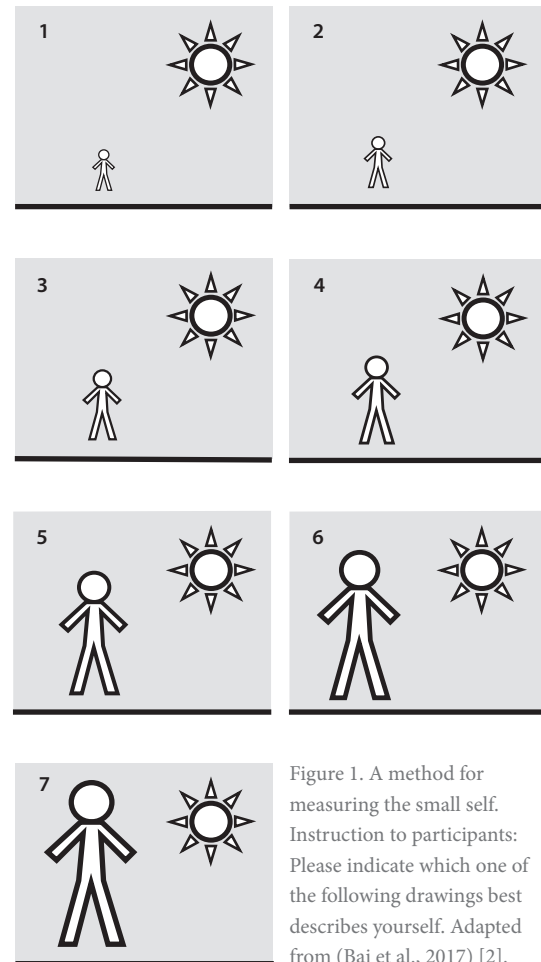
of the Dispositional Positive Emotion Scales, a commonly used psychological tool (Shiota, Keltner, & John, 2006) [379]. The awe subscale is a self-reported survey that asks participants to indicate their level of agreement with each of the following items on a 1 to 7 scale:

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

To measure specific elements of awe, including perceived vastness and need for accommodation, researchers generally ask participants questions designed to tease apart the awe experience. For example, to measure perceived vastness, a researcher might ask to what extent participants agree that their awe experience was accompanied by “qualities that were beyond measure” (Schurtz et al., 2012) [34]; to gauge someone’s need for accommodation, they may ask to what extent they “felt confused and bewildered” (Chirico et al., 2017) [5] by the experience. For the latter element, some studies have also used the Need for Cognitive Closure scale. This scale includes statements with which participants must rate their level of agreement, such as “I think that having clear rules and order at work is essential for success” and “When considering most conflict situations, I can usually see how both sides could be right” (Shiota et al., 2007) [265].

There has also been considerable interest in developing methods for measuring the perception of a diminished self that often accommodates an awe experience. These methods include survey items such as “I felt small or insignificant”

(Shiota et al., 2007) [265], as well as more visual means. For example, researchers have measured the size of self-portraits drawn by participants or they have presented participants with a series of different sized circles, drawings of different sized people (see Figure 1), and/or a set of different sized “Me” signatures and asked them which version reflects how big or small the participants feel (Bai et al., 2017) [2].

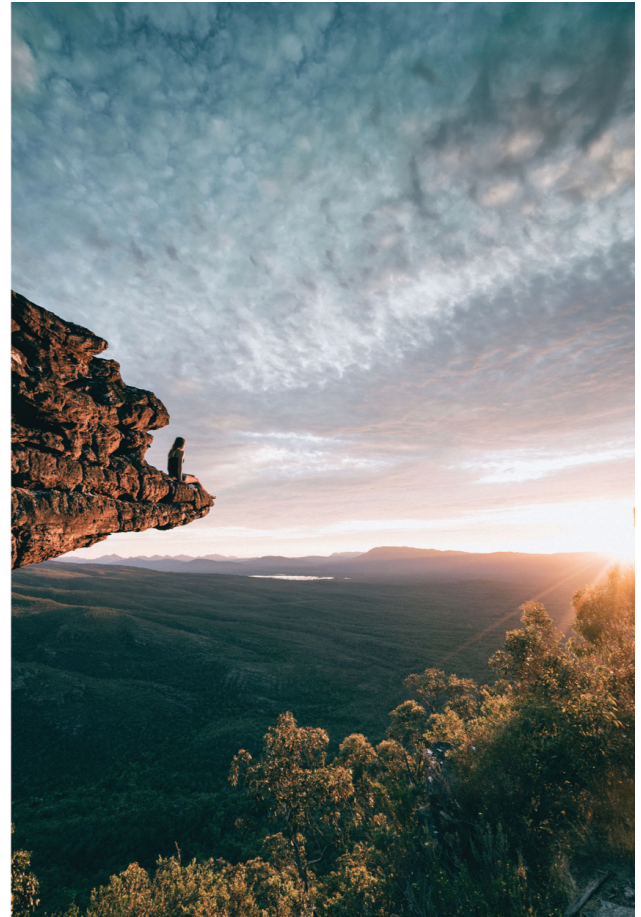


The discipline of “neurophenomenology” also provides a new approach for studying awe (Gallagher, Reinerman-Jones, Janz, Bockelman, & Trempler, 2015) [18]. Neurophenomenological methods combine traditional objective methods from neuroscience (such as EEG) with more subjective firsthand accounts of experiences. Such methods have been used in experiments attempting to

simulate the experience of space travel: First, researchers gleaned information from the testimonials of astronauts; then these testimonials were used to create a realistic space vehicle simulation; researchers then used the simulation to collect brain activity and other physiological data from participants in real-time in order to probe questions about how awe experiences relate to perceptual and physiological phenomena, such as do people's hearts beat differently when they are and are not experiencing awe? (They do.) (Bockelman, Reinerman-Jones, & Gallagher, 2013) [27](Gallagher et al., 2014) [11].

Virtual Reality (VR) also presents a promising method for inducing and studying awe because it can present complex and vast stimuli that “overcome our sense of physics and challenge our assumptions about the world” (Chirico, Yaden, Riva, & Gaggioli, 2016) [14]. In addition, VR provides the potential to simultaneously measure psychophysical measurements in real-time, such as skin conductance, respiration, heart rate, facial movements, and posture. One study found that immersive videos, a highly realistic form of VR, that displayed “vast and panoramic scenes of natural beauty from a 360 degree perspective” resulted in more intense awe experiences than watching normal 2D videos (Chirico et al., 2017)

[5]. And a very recent study used VR to explore how four different immersive virtual environments influenced perceptions of vastness, need for accommodation, and awe (Chirico, Ferrise, Cordella, & Gaggioli, 2018) [0]. Taken together, these studies highlight VR's potential for studying awe in new and comprehensive ways.



Grampians National Park, Australia (Photo by Manuel Meurisse)

Why Did Awe Evolve?

In his 1872 treatise *The Expression of the Emotions in Man and Animals*, Charles Darwin posited that emotions and emotional expressions have evolutionary origins; in short, natural selection selected for emotions because they offered some sort of fitness advantage and either helped our ancestors survive and/or reproduce (Darwin, 1872) [17984]. So why might an emotion like awe have evolved?

Keltner and Haidt propose that primordial awe—the awe one feels when in the presence of a powerful individual—may play a role in maintaining social hierarchies (Keltner & Haidt, 2003) [755]. “This feeling is likely to involve reverence, devotion, and the inclination to subordinate one’s own interests and goals in deference to those of the powerful leader,” they write. In other words, awe promotes social cohesion by supporting current group dynamics.

However, as we’ll see later in this paper, when asked to recount an awe experience modern people—particularly those in the United States—are much more likely to think of a majestic mountain vista than an encounter with a powerful leader. According to Keltner and Haidt, these are examples of “elaborated awe,” defined as “culture-specific norms, meanings, and practices that cultures build up around primordial emotions.” Thus awe may have started off as a mechanism for ensuring the stability of social hierarchies, but human cultures co-opted and expanded on it to encompass many other types of experiences.

Yet as researchers Alice Chirico and David Yaden argue in a recent book chapter, perhaps the fact that natural scenes are such common awe

elicitors points to another reason that awe may have evolved, what they term the “nature-first” view (Chirico & Yaden, 2018) [1]. This theory suggests that awe first evolved not to maintain social hierarchies but instead as a signal that hunter-gatherers had found a safe environment for shelter. The idea is that the safest kind of shelter is one where one side is protected and people can easily view approaching predators



Prehistoric granaries along the Colorado River, Grand Canyon National Park, United States (Photo by Mark Lellouch)

or enemies. “These conditions are most often fulfilled by elevated locations with a sweeping view of the surrounding area—and this sweeping view of natural scenery happens to be the stereotypical and most prevalent elicitor of awe in contemporary settings (e.g. the Grand Canyon),” write Chirico and Yaden.

They note that further evidence supporting this “nature-first” theory over the “social-first” proposal (put forth by Keltner and Haidt) includes: 1) a study that found that children have a preference for elevated positions with sweeping scenery (Fischer & Shrout, 2006) [35], 2) the idea that prosocial behavior (a common effect of awe, as discussed later in the “Effects of Awe” section) may be adaptive in safe environments but could put people in danger in less safe environments, 3) the observation that “social” awe is usually triggered by unknown people, but hunter-gatherers lived in small tribes where they presumably knew their fellow tribespeople well. Chirico and Yaden do offer the caveat that this theory does not account for awe’s effects on cognitive accommodation.

There is yet another evolutionary theory concerning awe’s fitness-enhancing function, this one focusing on awe’s ability to induce cognitive accommodation in information-rich environments—the way that it induces people to update their mental schemas and to use their analytical abilities rather than to rely on mental shortcuts when they are confronted by stimuli that violate their current understanding of the world. By this theory, awe’s ability to initiate this type of cognitive agility and prioritize assessment of incoming information could be adaptive in all

sorts of scenarios—for instance, it could help people adapt to new environments and experiences by allowing them to process novel, complex information more critically. Corroborating this theory, one study found that inspiring awe made people more skeptical of weak arguments (Griskevicius, Shiota, & Neufeld, 2010) [170]. Such skepticism could hypothetically have helped our ancestors navigate complex social interactions.

Ultimately, awe’s self-transcendent functions—including its ability to reduce self-focus and increase feelings of connectedness with others—are likely fundamental to its evolution. “Evolutionary claims about the functions of awe are predicated on the assumption that individuals attain goals (e.g., hunting large mammals) and fend off threats (e.g., warfare) more successfully in groups than alone,” write Jennifer Stellar, Keltner, and colleagues in a recent review (Stellar, Gordon, Piff, et al., 2017) [8]. “Individuals reap the most benefits from group membership when those social groups are cohesive and stable, which requires reducing the self-interested motivations of each individual group member.” Thus, awe may have helped our ancestors to be less selfish and tend to the needs of their group, aiding in the survival of the group (and also themselves).



General Elicitors of Awe

What situations are most likely to evoke awe? In the past 15 years, a few studies have attempted to identify the general features of stimuli—events, people, objects, experiences—that are more likely to elicit feelings of awe in people.

Empirical Evidence of Awe Elicitors

Several studies have empirically explored the various experiences that elicit awe and have identified that certain types of stimuli and events appear to be more common awe elicitors than others.

For example, a 2007 study examined factors that elicited awe (versus happiness) in undergraduate students' personal narratives (Shiota et al., 2007) [265]. This study found that students asked to write about awe-eliciting events were more likely to report being in nature or an experience with art or music than students who wrote about a situation that made them feel happy; by contrast, when writing about happiness, participants were more likely to report social events. The two groups were equally likely to describe their own accomplishments.

These results suggest that information-rich stimuli—such as nature, music, and art—are frequent elicitors of awe. This aligns with Keltner and Haidt's theorized essential conceptualization of the central features of awe: Complex stimuli can be understood as being “perceptually vast,” and taking in rich information often elicits a need for cognitive accommodation. The results also showcase the “relatively asocial nature of awe” relative to happiness. And, interestingly, all of the awe elicitors in this study were positive, suggest-

ing that people—or at least this subset of U.S. college students—think of awe as a fundamentally positive emotion.

But as is discussed above, positive stimuli aren't the only ones that elicit awe. The rest of this section will go into more depth on the role of nature as an awe elicitor, cover some of the other common stimuli—threatening events and spiritual experiences—that cause people to experience awe, and discuss what might be considered the ultimate awe elicitor: the view of Earth from space.

Nature

Perhaps due to its inherent vastness, nature is a particularly prominent elicitor of awe. In a study where undergraduate participants were asked to recall a time when they had encountered a “really beautiful” natural scene and then rate the extent to which different emotions described their experience on a 1 to 7 scale, the average rating for “awe” was 6.07 (Shiota et al., 2007) [265]. In another study, in which undergraduate students recalled a time when they had experienced a “profound sense of beauty,” the majority (55 percent) of the beauty experiences involved nature, and students reported feeling a high level of awe (an average of 4.5 on a 1 to 5 scale) during the beauty experiences (Cohen, Gruber, & Keltner,

2010) [38]. A recent VR study found that interacting with a scene showing high snowy mountains elicited more awe than a forest scene or viewing Earth from space, although all three produced significantly more awe than a neutral green clearing scene (Chirico et al., 2018) [0]. The mountains and Earth views created greater perceptions of vastness than the forest, while there was no difference in any of the conditions for perceived need for accommodation. And one study found that gazing up at a towering grove of Tasmanian eucalyptus trees can elicit awe, whereas gazing up at a tall building does not. This suggests that vastness—as conceptualized by physical size—is not sufficient to elicit awe (Piff et al., 2015) [133].

Interestingly, this study also found that a slow motion video that highlighted “minute and intricate patterns in liquid . . . that are invisible to the naked eye” in drops of colored water falling into a bowl of milk elicited awe and a sense of vastness (as assessed with questions like “I feel the presence of something greater than myself” and “I feel like I am in the presence of something grand”), suggesting that physical vastness is not a necessary component of awe either; it is the perception of vastness that matters.

Threat-based awe

Some research has found evidence of Keltner and Haidt’s proposed threat-based flavor of awe. One study found that people who watched video montages of threatening natural phenomena, like volcanoes and tornadoes, experienced more awe than people who watched a neutral video about the construction of a countertop (Piff et al., 2015) [133]. A later study found that when participants were asked to describe “an experience in which they felt intense awe,” roughly 21 percent of the experiences involved threat-based awe (Gordon

et al., 2017) [41]. These included memories of the September 11th attacks and the Challenger Space Shuttle explosion, as well as personal experiences such as “crawling out to the edge of a ledge at the peak of a mountain with a large lake 2,000 feet below.” Overall, the categories of stimuli (e.g. nature, religion, social events) that elicited threat-based awe were similar to those that elicited positive awe.

Spiritual and religious experiences

Spiritual and religious experiences can also elicit awe, although surprisingly few psychological studies have explored the link between spirituality or religion and awe.

In a 2011 paper, Edward Bonner and Harris Friedman analyzed the major themes evoked by the interviews within Kirk Schneider’s 2009 book, *Awakening to Awe: Personal Stories of Profound Transformation* (Bonner & Friedman, 2011) [70].

Among the 10 themes that Bonner and Friedman extracted from the personal stories in the book was the concept of the “numinous.” They define the numinous as “a nonrational aspect of religious experience that arises upon sensing the presence of something seen as holy, such as a divinity.” Multiple people in Schneider’s book recounted this type of awe experience. Here is one example: “One day something stirred me enough [while in church] ... where I couldn’t go back without becoming an altar boy, without becoming part of the ceremony.”

In this paper, Bonner and Friedman also discuss the various relationships between religion, spirituality, and awe. They explain: “For many, religion is their sole source of spirituality; for others, spiritual experiences arise from both religious and secular activities, and there are those who have no religious affiliation yet experience spirituality through a variety of

means. For all who acknowledge a spiritual life, the numinous is that aspect of spiritual experience wherein the individual senses and reveres a transcendent presence of some sort. This presence may be conceived of as a deity, a spirit, a universal consciousness, or some other construct, depending on the belief system of the individual.” They note that these varied notions of the numinous were often connected with awe in their study.

Only a few experimental studies have explored the relationship between spirituality/religion and awe. In one such study, undergraduate students were asked to describe a memory that involved a spiritual transformation. They were told that this transformation “may be of the religious variety, it may have to do with what you consider to be sacred, it may be in response to something in nature, it may result from relationship with other people, or art, or many other things.”

These students reported experiencing a high level of awe associated with their spiritual transformations (an average of 3.9 on a 1-5 scale)(Cohen et al., 2010)[38]. More than a third of the students recounted spiritual experiences that involved a religious event, suggesting that religious experiences in particular may be frequent awe elicitors. Transformative spiritual experiences also appeared to produce lasting changes in the students: More than half reported having a changed understanding of themselves, almost 30 percent described a changed understanding of the world, more than a quarter of the experiences had a feature of “religious strengthening,” and more than one in five reported that the experience changed their sense of connection with God.

Another set of studies found that recalling spiritual experiences elicited awe in both religious and non-religious people (Preston & Shin, 2017)

[3]. Perhaps unsurprisingly, this study also found that religious and non-religious people recalled different types of spiritual experiences. Religious people were more likely to report traditional religious experiences—as well as life or death experiences. Indeed, the authors highlight in their discussion how elements of religious rituals frequently evoke a sense of smallness (towering cathedrals, kneeling in prayer, etc). On the other hand, non-religious people were more likely to report different types of spiritual experiences (e.g. yoga, nature, science). This may suggest that people—particularly non-religious people—have a rather diffuse understanding of spirituality. In fact, the authors write that “the experience of awe and small self may be one of the essential points of overlap that could help us to understand the meaning of spirituality without religion.”

The “overview effect”: The ultimate awe experience?



Figure 2. “Earthrise” photo taken by NASA astronaut William Anders from the Apollo 8 spacecraft in 1968. Image Credit: NASA

The ultimate awe elicitor may be one that few of us will be able to experience: the view of Earth from space (Figure 2). This experience is known as the “overview effect”; accounts from multiple astronauts have “attributed deep feelings of awe and even self-transcendence to this experience,”

according to a study by David Yaden and colleagues (Yaden et al., 2016) [19]. That paper quotes several astronauts discussing their experience:

It's hard to explain how amazing and magical this experience is. First of all, there's the astounding beauty and diversity of the planet itself, scrolling across your view at what appears to be a smooth, stately pace. . . I'm happy to report that no amount of prior study or training can fully prepare anybody for the awe and wonder this inspires. (NASA Astronaut Kathryn D.)

You've seen pictures and you've heard people talk about it. But nothing can prepare you for what it actually looks like. The Earth is dramatically beautiful when you see it from orbit, more beautiful than any picture you've ever seen. It's an emotional experience because you're removed from the Earth but at the same time you feel this incredible connection to the Earth like nothing I'd ever felt before. (NASA Astronaut Sam Durrance)

One reason why this view is such a potent elicitor of awe is its vastness. "The wholeness of the Earth makes it a symbol of almost all that is meaningful in human life; it has tremendous, perhaps absolute, conceptual vastness," writes Yaden and colleagues in their study about astronauts' accounts of the overview effect. "Seeing it from a distance, when one is disconnected physically yet connected emotionally, conjures thoughts of home, of the entirety of one's world, and of mankind as a whole." Additionally, because this view is such a radically different perspective from how we normally see Earth, it makes sense that seeing Earth from space would

inspire a profound need for accommodation.

A 2014 multidisciplinary study sought to recreate the overview effect, along with the sensation of being in deep space, in participants on Earth (Gallagher et al., 2014) [11]. This study used textual analysis of the accounts of 51 different astronauts to create a simulated space travel experience. The researchers created a Virtual Space Lab (VSL) that tried to replicate the experience of space travel, complete with launching and landing sequences, auditory effects and vibrations, and a portal that opened with either a view of deep space (stars and gassy formations) or a view of the Blue Marble (Earth from space). College student participants tested the simulation while connected to various physiological sensors and then answered a series of questionnaires about their experience.

Results showed that many of the effects reported by the astronauts, including feelings of awe and wonder, could be replicated by the simulator—although some phenomena, such as elation and a feeling of "unity with the universe," were not. Overall, this study suggests that simulated space flight might be a unique method of eliciting a particular awe experience that once could only be experienced by astronauts.

Cross-Cultural Comparisons of Awe Elicitors

According to one study, there may be cultural differences in the elicitors of awe. This study asked Chinese and U.S. undergraduate students to keep a diary of their awe experiences for two weeks (Bai et al., 2017) [2]. The most common awe elicitors in both cultures were experiences involving another person or nature. However, there were also some significant differences between the two cultures.

While personal accomplishments (such as performing much better on an exam than expect-

ed) were relatively common elicitors of awe for U.S. participants (making up eight percent of experiences), they were virtually nonexistent for the Chinese participants (0.41 percent). Additionally, 63 percent of the awe elicitors mentioned in Chinese participants' diaries involved feeling in awe of another person, whereas this was only the case 49 percent of the time in the U.S. participants' diaries. This finding points to how living in a more individualistic culture (like the U.S.) or collectivistic culture (like China) may influence the particular stimuli that elicit awe for people in each culture. Nonetheless, the researchers note that the frequency with which other people elicited awe in both cultures suggests that "different sources of interpersonal awe—moral beauty, virtuosity, extreme altruism, and perhaps charismatic dominance—merit systematic investigation."



Sequoia & Kings Canyon National Park, United States
(National Park Service)



Factors That Influence Who Experiences Awe

Would you say that you frequently experience awe? More than other people do? Some people are indeed more frequently awestruck than others, and researchers have explored whether certain factors—including one's personality, social class, religion, and culture—might explain these differences, both as a general propensity and in specific situations.

Personality

A few studies have explored whether certain personality factors make some people more prone to experiencing awe. When it comes to the Big Five personality traits—extraversion, conscientiousness, agreeableness, openness to experience, and neuroticism—people who are more open to experience report feeling more awe in general (Shiota et al., 2006) [379] (Silvia et al., 2015) [70] (although this was not seen when personality ratings were made by a friend or partner instead of by self-report) and in response to awe-provoking stimuli like images of space or a moving piece of music (Silvia et al., 2015) [70]. Additionally, one study found that people who were more open to experience were more likely to report an awe-related state (feeling euphoric, amazed, happy or inspired) when they recalled a time they had felt like crying while listening to music; neurotic people were more likely to report a sad state (Cotter, Silvia, & Fayn, 2017) [34].

People who reported being more extraverted also reported a greater tendency to experience awe in general, in one study (Shiota et al., 2006) [379]. (However, this relationship between extraversion

and awe was not found when a close friend or partner, rather than the participants themselves, rated the participants' extraversion.) Another study found that the effect of extraversion on one's likelihood to feel awe in response to particular stimuli was near zero (Silvia et al., 2015) [70]. While further research is needed to confirm these findings, this preliminary work suggests that people who are more open to new experiences may feel more awe; it is less clear whether extraversion or the other personality traits have much of an effect.

Interestingly, other studies have found that openness to experience is a strong predictor of who will experience chills in response to music or other art (McCrae, 2007) [162] (Nusbaum & Silvia, 2011) [69]. These aesthetic chills may stem from the awe experience, as will be discussed later.

Beyond the Big Five, there are other traits that may predispose some people to experience awe more frequently than other people. For example, one study found that people with a strong need for cognitive closure—those who are “uncomfortable with ambiguity, prefer continuity in their surroundings and in what is expected of them,

and dislike situations that do not have a ‘correct’ answer or response”—report less of a tendency to experience awe, suggesting “that awe-prone individuals should be especially comfortable revising their own mental structures, or acknowledging that currently held mental structures are not adequate to the occasion” (Shiota et al., 2007) [265]. Similarly, a recent study found that people with low need for cognitive closure experienced more awe in response to reflective and complex music (Pilgrim, Norris, & Hackathorn, 2017) [1].

Wisdom may also make people more prone to experience awe. A survey of 1,553 middle-aged and older U.S. adults found that those who reported having a high level of “practical wisdom,” as measured with questions like, “Over the years I’ve found that wisdom has a lot to do with learning from my mistakes,” also reported experiencing more awe of God (Krause & Hayward, 2015) [14]. One possible explanation for this finding is that wise people are more tolerant of ambiguity and uncertainty, and thus may be better able to handle the need-for-accommodation component of an awe experience. “[W]hen it comes to issues of awe of God specifically, it seems unlikely that a full understanding can ever be attained,” write the researchers. “So the type of person who is more likely to reach out and embrace feelings of the awe of God when they arise is the individual who understands the limits of his or her own knowledge and has a relatively high level of tolerance for ambiguity.”

Character Traits

Do positive character traits make people more likely to experience awe? A study of 574 German adults found that participants’ dispositional awe was significantly correlated with all 24 character strengths in the Values in Action Inventory

of Strengths (VIA-IS) (Güesewell & Ruch, 2012) [203]. A person’s level of dispositional awe was most strongly correlated with their appreciation of beauty, gratitude, religiousness, creativity, and love of learning. Importantly, while these results suggest that people who have these strengths may be more prone to experiencing awe, they cannot provide us with any information about possible causal relationships between awe and these strengths.

Social Class

Perhaps surprisingly, there is some evidence that social class may influence awe. One study found that while people from higher social classes reported more frequently experiencing self-oriented emotions like pride and contentment than people from lower social classes, people from lower social classes reported more frequently experiencing other-oriented emotions such as compassion and love—as well as awe—than people from higher social classes. A potential explanation for this finding put forth by the researchers is that higher class people are more prone to experiencing narcissism, which may “rein in propensities toward awe and its self-diminishing effects” (Piff & Moskowitz, 2017) [0].

Religion

While multiple studies have measured the extent to which awe experiences influence spiritual and religious feelings, there is little known about whether being religious or spiritual makes people more or less likely to experience awe. One study found that both religious and non-religious people reported feeling awe and experiencing the small self when recounting a spiritual experience (Preston & Shin, 2017) [3]. This result occurred despite differences in the types of spiritual experiences that religious and non-religious

people recounted: Religious people were more likely to mention explicitly religious or life-or-death events, while non-religious people were more likely to mention experiences in nature or with yoga and meditation.

Another small study found that people who did not experience awe during a simulated experience of viewing Earth from space were more religious and spiritual, on average, than those who did (Reinerman-Jones, Sollins, Gallagher, & Janz, 2013) [14]. This suggests that religiosity is a factor in the experience of awe, at least in this scenario. However, this study did not explore whether religious adherents are more or less likely to experience awe in other contexts. It would be interesting to know whether religion decreases, increases, or simply shifts the experience of awe to different situations, but this question has not yet been thoroughly explored.

Culture

While the vast majority of studies on awe have been conducted with participants from just a few Western countries, there is some evidence that culture may be a factor in who experiences awe. For example, a 2016 study of adults from the U.S., Iran, Malaysia, and Poland found that there were country-level differences for dispositional awe, amusement, and pride, and the largest difference was seen with awe (Razavi, Zhang, Hekiart, Yoo, & Howell, 2016) [1]. Participants from the U.S. reported the highest dispositional awe while people in Iran reported the lowest, and the difference between these countries was quite large. The researchers note that this maps with previously reported country-wide levels of extraversion—the U.S. having the highest mean extraversion and Iran

the lowest—perhaps providing more evidence that dispositional awe may relate to extraversion.

Importantly, the scale used to test dispositional awe in this study included an item—“I seek out experiences that challenge my understanding of the world”—related to valuing awe, and scores on this item were not significantly different between Iranian, Malaysian, and American participants, suggesting that these participants valued awe similarly but differed in the frequency with which they had awe experiences. Further research will need to probe possible mechanisms behind these country-level differences.

Another recent study found cultural differences in the precise nature of the awe experience itself—the effects that the experience had on people—particularly in regards to the “small self;” these findings will be discussed in the next section (Bai et al., 2017) [2].



Temple Expiatori del Sagrat Cor, Barcelona, Spain (Photo by Biel Morro)



Effects of Awe

Evidence from studies to date suggests that feeling awe can lead to a host of physiological, psychological, and social effects. These range from goose bumps to an expanded perception of time to increased generosity.

Physiological Effects

We often experience emotions not just in our minds but in our bodies as well—in fact, these bodily sensations may be an essential component of an emotional experience (James, 1884) [5239]. Awe is no exception. The experience of awe is associated with a number of physiological effects, including changes in nervous system activity, goosebumps, chills, and possibly reduced inflammation.

While past research has shown that different negative emotions are associated with different responses by the autonomic nervous system (ANS), researchers paid much less attention to how positive emotions relate to ANS responses until a 2011 study by Michelle Shiota and colleagues (Shiota et al., 2011) [97]. The autonomic nervous system contains both the sympathetic branch, which controls the bodily functions needed for a “fight or flight” response, and the parasympathetic branch, which controls the “resting and digesting” functions characteristic of less stressful scenarios.

The researchers hypothesized that when people viewed awe-inspiring images, parasympathetic activity would increase and sympathetic activity would decrease because awe requires focusing on an outside stimulus, being relatively immobile, and exerting intense cognitive effort. The results of this study largely supported this hypothesis, with the exception being that awe tends to increase respiration rate (a sympathetic nervous system function).

However, a more recent study suggests that ANS responses to awe may depend on the type of awe experienced (Gordon et al., 2017) [41]. This study found that experiencing threat-based awe—as provoked by watching a video that “depicted the earth, space, and other stars in the solar system set to ominous music”—led to increased sympathetic nervous system activity (such as increased heart rate). These results suggest that threat-based awe, and perhaps other types of awe, may have different physiological effects than more positive experiences of awe.

The autonomic nervous system controls another physiological response that has been tied to awe: goose bumps (known scientifically as “piloerection”). In fact, a study that asked people to keep a journal of the times they had experienced goose bumps found that awe was second only to feeling cold in eliciting goose bumps (Schurtz et al., 2012) [34]. A second part of this study asked participants to remember a time when they had felt goose bumps in response to another person—specifically, that person’s “superior power, or superior abilities or talents, or extraordinary actions, or greater advantage over you”; the study also measured the participants’ emotional reaction to the situation they recalled—specifically, the extent to which people felt awe, envy, or fear in relation to that person. This experiment found that the intensity of goose

bumps was positively associated with awe but negatively correlated with envy. Finally, a third part of the study found that people who recalled a time when they had felt intense awe of another person were more likely to report having goose bumps than people who wrote about feeling envious, and the extent to which they reported awe was associated with the degree of goose bumps (there was no correlation between envy and goose bumps).

Another study measured goose bumps directly while participants listened to clips of various pieces of music or film; it found that there was a significant association between goose bumps and the feeling of “being moved” (Benedek & Kaernbach, 2011) [113]. The state of being moved or touched is likely related to awe, although some have argued that one can be moved without experiencing awe (Konečni, 2005) [187].

Some scientists have advanced an interesting potential explanation for why awe may cause goose bumps: Experiencing awe or being moved may invoke feelings of vulnerability. When threatened, some animals extend their body hair, possibly to make them look larger. Thus, human goose bumps could be “an evolutionary relic corresponding to a response to the threatening aspect of being moved or touched” (Benedek & Kaernbach, 2011) [113]. In contrast, Keltner has suggested that, since humans often experience goose bumps “when we ourselves feel expanded beyond the boundaries of our skin, and feel connected to other group members . . . [p]iloerection shifted from an association with adversarial defense to connection to the collective” (Keltner, 2009) [336].

Intriguingly, results from another study may reconcile these opposing views of the function of goose bumps in humans (Maruskin, Thrash, & Elliot, 2012) [51]. This study examined what we

colloquially call “the chills”—bodily responses that accompany strong emotions. It found that “the chills” can actually be broken down into two categories: “goosetingles” (goosebumps and a tingling sensation) and “coldshivers” (coldness and shivers), which have likely been conflated in previous studies.

Furthermore, multiple experiments in this study revealed that goosetingles were associated with positive emotional states while coldshivers were related to negative states. In these experiments, goosetingles were associated with high levels of awe, but coldshivers were not (this study asked about awe in general; it remains to be determined whether threat-based awe is associated with goosetingles or coldshivers). Additionally, one experiment found that experiencing goosetingles led people to report feeling more connected to an attachment figure (their mother) while experiencing coldshivers had the opposite effect. These findings around goosetingles are consistent with other evidence suggesting that experiencing awe leads people to feel more connected to others and prosocial, a relationship that will be discussed in more depth in the following section.

While the studies discussed in this section thus far have focused on the immediate physiological effects of awe, results from one study suggest that frequently experiencing awe over time could potentially have positive long-term health effects (Stellar et al., 2015) [78]. This study probed a possible link between people’s tendency to experience different positive emotions and chronic inflammation, which can increase one’s risk of developing various chronic diseases.

The first part of the study found that, out of seven positive emotions studied, dispositional awe was the only emotion that was significantly negatively associated with levels of interleukin-6

(IL-6), a “proinflammatory cytokine” and marker of inflammation. High levels of proinflammatory cytokines have been linked to a number of chronic diseases, such as cardiovascular disease, diabetes, and depression. A second part of the study found that participants who reported feeling more “awe, wonder, and amazement that day” had lower levels of IL-6; this association remained even after controlling for dispositional awe and openness to experience, suggesting that it isn’t just people who are prone to experiencing awe frequently who may have decreased inflammation following a particularly awe-filled day.

Why might frequently experiencing awe predict lower levels of markers of chronic inflammation? Before delving into the possibilities, it’s important to note that this study cannot tell us anything about causality—i.e. whether awe reduces IL-6 or whether higher IL-6 reduces awe. There exists the possibility that having more proinflammatory cytokines in one’s body might actually reduce one’s likelihood of experiencing awe. Indeed, previous studies have found evidence that proinflammatory cytokines may decrease positive affect (Janicki-Deverts, Cohen, Doyle, Turner, & Treanor, 2007) [50] and encourage social withdrawal and exploration, possibly as a mechanism for encouraging sick or injured people to rest and recover (Maier & Watkins, 1998) [1234]. As a result, that social withdrawal and reduced exploration could lead to fewer opportunities to experience awe.

However, an alternative possibility is that awe’s ability to increase feelings of interconnectedness may help foster supportive relationships, which have been associated with decreased cytokine levels (Kiecolt-Glaser, Gouin, & Hantsoo, 2010) [276]. Further work will be needed to tease apart these possibilities and shed more light on the connection between awe and chronic inflamma-

tion—including to determine whether there is indeed a connection in the first place.

Psychological Effects

Though new findings on the physiological effects of awe continue to emerge, there is an even more robust body of research attesting to awe’s psychological effects. These effects include both cognitive (e.g., one’s perception of time) and emotional (e.g., positive mood) outcomes.

The small self

Research suggests that awe diminishes a person’s sense of self, shifting their focus away from their own concerns. Accordingly, perhaps the most studied psychological effect associated with awe is the “small self”—the feeling of being small relative to one’s surroundings. In one study, participants who were asked to describe a time when they had observed a beautiful natural scene reported feeling more awe and more strongly reported feeling “small or insignificant” than those who described a time when they had felt pride about a personal accomplishment (Shiota et al., 2007) [265]. In another study, participants who wrote about an awe experience more strongly reported “feeling small relative to environment/others” than participants who wrote about other emotional experiences (Campos et al., 2013) [92]. And a study in which participants viewed a slide show of spectacular natural scenes, mundane natural scenes, or neutral scenes found that participants who viewed the spectacular scenes reported feeling more awe and smallness than participants in the other two groups (Joye & Bolderdijk, 2015) [23].

Yet another study found that increased feelings of the small self could be evoked by asking people to recall a time when they had felt awe (versus pride or completing a neutral writing

activity) and when watching awe-provoking nature videos (versus amusing or neutral nature videos) (Piff et al., 2015) [133]. Importantly, this study also found that watching videos of threatening natural phenomena and a non-nature-based awe-inducing stimulus (a water droplet falling in slow motion) could induce feelings of the small self as well. And another experiment found that staring up at towering eucalyptus trees elicited more awe and feelings of the small self than staring up at a tall building, suggesting that physically large stimuli do not universally evoke the small self. These findings suggest that stimuli do not need to invoke only positive feelings of awe, be physically vast, or be natural scenes to create a perception of a diminished self.

A study that explored similarities and differences in the awe experience among people from more individualistic cultures (e.g., the United States) vs. people from more collectivistic cultures (e.g., China) found some cultural differences in the small self phenomenon (Bai et al., 2017) [2]. The researchers had two opposing hypotheses for how culture might influence this phenomenon. Previous research had found that people from more interdependent/collectivistic cultures have a smaller perceived self-size compared to people from more independent/individualistic cultures even without exposure to awe-inspiring stimuli (Kitayama, Park, Sevincer, Karasawa, & Uskul, 2009) [384]. The researchers therefore hypothesized either that awe may magnify this difference (people from collectivist cultures would have extra-diminished selves while those from individualist cultures would not experience the effect as much)—or, conversely, that awe may have a greater effect on the diminished self in people from individualistic cultures since there is greater room to move in that direction.

To test these hypotheses, Chinese and U.S. university students kept a diary about times they had experienced awe and joy and reported their perceived self-size by indicating which of seven differently sized circles they felt best represented their size (see Figure 3). On days when students had reported feeling awe, they reported feeling smaller than on days when they had reported feeling joy, and this difference was greater for the Chinese students, supporting the idea that awe magnifies the existing difference in perceived self size between collectivistic and individualistic cultures. Additionally, the reported size of the stimuli that evoked awe was not significantly associated with the small-self effect—again suggesting that actual physical vastness of the awe-provoking stimuli is not necessary for this cognitive phenomenon.

Think about one of the circles below as representing yourself.
Please choose the circle that best describes how big or small you feel about yourself.

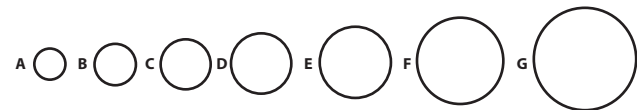


Figure 3. A method for measuring “the small self” (Bai et al., 2017) [2].

Another experiment in this study asked tourists at Yosemite National Park and Fisherman’s Wharf, a tourist area in San Francisco, about their feelings of awe and other emotions, as well as their sense of self. Tourists of all cultural backgrounds at Yosemite reported experiencing significantly more awe, chose smaller circles to represent their current self, drew self-images that were nearly 33 percent smaller, and produced a smaller “Me” written next to their self-image than tourists at Fisherman’s Wharf (see Figure 4). However, these differences were greater for tourists from North America and Europe than for tourists from East Asia. The researchers write that “the experience of awe in the presence of natural wonder had a greater effect on rendering the self small for individuals

from individualistic cultures as opposed to collectivist, East Asian cultures.” However, another experiment in the same study found that Chinese and U.S. college students reported similar decreases in self size between before and after watching an awe-inspiring video from the Planet Earth series. Overall, this study suggests that there may be cultural differences in the small-self effect, but further work is needed to elucidate what causes these differences across specific awe-inducing scenarios.

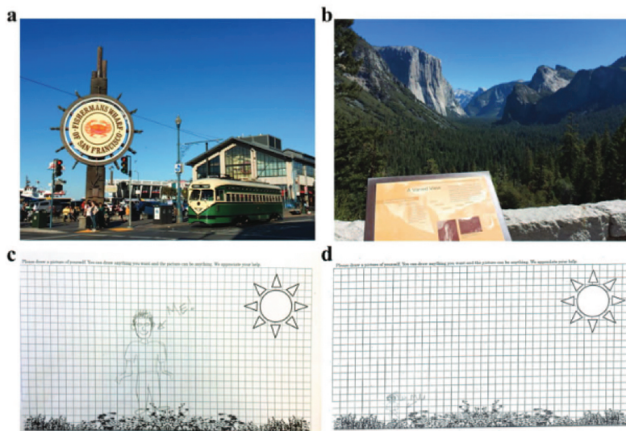


Figure 4. Participants drew larger self-portraits (c) at Fisherman's Wharf (a) and smaller self-portraits (d) at Yosemite National Park (b). Figure is from (Bai et al., 2017) [2].

Spiritual experiences may be particularly good at evoking the small-self effect. The daily diary study mentioned above found that people from both groups reported feeling smaller on days when they felt awe from a spiritual experience than on days when they mentioned other awe-eliciting experiences (Bai et al., 2017) [2], and another study found that recalling spiritual experiences led both religious and non-religious people to report more of the small-self effect than recalling a humorous experience; moreover, the extent to which people felt small could predict their level of awe (Preston & Shin, 2017) [3].

Together these studies suggest that feeling a diminished sense of self is a common effect of experiencing awe, a result that may help explain

some of awe's other psychological effects, such as inducing humility and a sense of connection with others, discussed below.

Humility

Besides causing people to perceive themselves as smaller, awe may also make people more humble, at least according to one recent study (Stellar, Gordon, Anderson, et al., 2017) [2]. This study found that people who are more dispositionally prone to experiencing awe were rated as more humble by their friends; people who reported feeling more awe over the course of two weeks also reported feeling more humble; and experimentally inducing awe in participants led them to “present a more balanced view of their strengths and weaknesses to others and acknowledge, to a greater degree, the contribution of outside forces in their own personal accomplishments.”

Furthermore, participants who experienced an awe-inducing vista in person reported more self-diminishment and feeling more humble than participants who viewed a neutral scene. Analysis of the latter findings supported the claim that “awe led to self-diminishment, which in turn gave rise to humility.”

Another study found that people who recalled a spiritual experience reported feeling more awe than people who recalled a humorous memory, and recalling spiritual experiences was also associated with greater reported spiritual humility (“a deference or submissive stance before God, related to a feeling of sacred small self”) for religious participants; for non-religious participants, it was associated with greater feelings of “intellectual humility,” which the researchers define as “a willingness to change beliefs when confronted with conflicting information, related to the need for cognitive accommodation” (Preston & Shin, 2017) [3].

Why might a relationship exist between awe and humility? Both feelings are key to people's understanding of their place in the world. "Humility, central to having a realistic and secure sense of the self alongside an appreciation of the value and contributions of others, represents a vital virtue at the foundation of morality and [is a] key to living in social groups," write researcher Jennifer Stellar and her colleagues. "Awe, which arises as one confronts the vastness and complexity of the world, helps individuals gain perspective on their importance and place within it."

This could help explain why religious and non-religious people may have different responses to spiritual experiences. Both groups experience humility in the face of awe, but they experience it differently because they are coming at the situation from different vantage points. Religious people may not need to cognitively accommodate a particular spiritual experience because it's already ingrained into their perception of reality, whereas non-religious people may need to cognitively accommodate a spiritual, awe-inducing moment.

Cognitive accommodation

As discussed earlier, the need for cognitive accommodation has been proposed as a core element of the awe experience (Keltner & Haidt, 2003) [755]. A few other studies have sought to determine whether, consistent with Keltner and Haidt's theory about accommodation, experiencing awe does indeed lead people to change the way they view the world.

As mentioned previously, research has found that people who report high dispositional awe also report a lower need for cognitive closure, an indicator that they are open to modifying their worldview; however, it is unknown whether this lower need for cognitive closure is an effect of frequently experiencing awe or whether there

is some other explanation for the relationship (Shiota et al., 2007) [265]. In another study, participants tasked with writing about a time when they had experienced specific emotions were asked to what extent they "felt the situation challenged their worldview (e.g., seeing something not thought possible)." People who wrote about awe experiences reported having felt the most challenged in their worldview, although the rating was still relatively low (1.97 on a 5 point scale) and was not significantly higher than people who wrote about experiences of gratitude, interest, joy, or love (Campos et al., 2013) [92].

However, other studies have found evidence supporting the idea that awe promotes cognitive accommodation by encouraging people to think more critically. "Because the theorized function of awe is to increase systematic, accommodative processing, we hypothesized that awe should lead to more careful scrutiny of persuasive messages," write Vladas Griskevicius and colleagues in one study. In particular, this study found that when people were induced to feel awe, they were less persuaded by weak arguments than were people who did a control activity (imagining doing their laundry). This was in contrast to the effect of some other positive emotions; people induced to feel anticipatory enthusiasm or amusement, for example, were more persuaded by weak arguments (Griskevicius et al., 2010) [170].

Another study found that experiencing awe made people less likely to rely on internalized scripts. People who watched awe-inducing videos were less likely to falsely recall details of a story they heard about a traditional romantic dinner—they were less likely to rate false details as "true" simply because they seemed plausible—than were people who watched general positive or neutral videos before hearing the story (Danvers

& Shiota, 2017) [3]. This study may exemplify one way that awe expands people's worldview, encouraging them to see things how they are and not as they expect them to be.

Perception of time

Awe may also expand our perception of time. One study found that people induced to feel awe agreed more strongly with statements suggesting that time is plentiful and expansive than did people induced to feel happiness (Rudd, Vohs, & Aaker, 2012) [229]. Other experiments in this study found that if people who felt awe experienced this expanded perception of time, they were then more willing than other people to volunteer their time to help others, to prefer experiential purchases over material ones, and to report greater satisfaction with their lives. The researchers speculate that by causing people to be immersed in the moment, awe may allow people to savor the here and now: "[A]we-eliciting experiences might offer one effective way of alleviating the feeling of time starvation that plagues so many people in modern life," they write.

Connectedness

Research suggests that awe helps people feel more connected to other people, and to humanity as a whole. A study of 1,535 middle-aged and older adults found that those who reported more awe of God also reported feeling more connected to others (Krause & Hayward, 2015) [14]. Another study found that people with high dispositional awe who were asked to write 20 responses to the question "Who am I?" wrote more responses that emphasized "membership in a universal group" (such as "a person" or "an inhabitant of the Earth") than did people who reported experiencing awe less frequently. This study also found that

experimentally eliciting awe by exposing participants to a *Tyrannosaurus rex* skeleton led those participants to use more self-descriptors related to these "universal categories" than did people who had spent time in a regular hallway, suggesting that awe increases people's sense that they are part of a greater whole (Shiota et al., 2007) [265].

In another study, researchers measured the extent of people's feeling that they were part of a collective. They showed participants six pairs of circles labeled "self" and "community" that overlapped to different degrees—i.e., the first pair didn't overlap at all, the sixth pair almost entirely overlapped—and asked them to select which pair best represented their view of their self in relation to others (see Figure 5). People who reflected on an awe experience chose circles that overlapped more than people who reflected on a neutral or shameful moment, indicating that awe led people to feel more collective engagement (Bai et al., 2017) [2].

Circle the picture that best describes your relationship with the community at large. (S=Self; C= Community at large)



Figure 5. The Inclusion of Community in the Self (ICS) Scale (Mashek, Cannaday, & Tangney, 2007) [84]

Interestingly, another part of this study found evidence that awe's effect on connectedness may manifest differently in people from more individualistic cultures than in those from more collectivist cultures. An experiment used videos to elicit feelings of awe or amusement among American and Chinese college students and then asked them to draw their social network using circles. The result? Compared to experiencing amusement, experiencing awe led American students to draw a larger number of social ties but led Chinese students to draw circles closer together (indicating less psychological distance).

This finding may suggest that awe leads people from individualistic cultures to feel as if their social network has expanded (they feel closer to more people) while it may lead people from collectivistic cultures to feel closer to those already in their network. According to the researchers, these findings suggest that awe's ability to evoke the small self can be considered "universal"—"while varying in elicitor, magnitude, and content across cultures, it is cognitively available to individuals from different cultures and serve[s] a similar end, in integrating the individual into the collective."

Finally, a recent study suggests that self-esteem may modify the effect of awe on feelings of connection. Specifically, people with lower self-esteem reported less identification with others after being exposed to an awe-inspiring video than a neutral video, but people with higher self-esteem reported more identification with others in the awe condition than in the neutral condition (Hornsey, Faulkner, Crimston, Moreton, & Emerson, 2018) [0]. The researchers suggest that people with lower self-esteem may be more likely to experience awe as threatening, leading to "a defensive reassertion of selfhood through disconnecting from others."

Positive mood and well-being

Awe may improve a person's mood and sense of well-being. In one study, people who watched a slideshow of extraordinary natural scenes reported a better mood than they reported before they watched the slideshow. People who viewed mundane natural scenes also experienced a mood boost, but not as much of one, and people who viewed neutral scenes did not have a change in mood. Increased feelings of awe could explain the heightened mood people experienced after

viewing the extraordinary scenes compared to the mundane natural scenes. If this explanation holds, then awe—and not just natural stimuli—may have an exceptional ability to improve one's mood (Joye & Bolderdijk, 2015) [23]. A recent study with Virtual Reality stimuli found that viewing high, snowy mountains increased people's positive affect (mood), while viewing the Earth from space or a forest did not; the mountain scene also induced the highest level of awe, although the other stimuli also increased awe significantly (Chirico et al., 2018) [0].

Whether or not an awe-inducing experience is threatening (or perceived as threatening) may influence awe's effects on mood and well-being. For example, one study found that people's ratings of daily well-being were higher on days when they had had positive awe experiences than on days when they did not report experiencing awe; however, people did not report improved well-being on days when they experienced threat-based awe (Gordon et al., 2017) [41]. Furthermore, people who watched positive awe-inducing nature videos experienced a greater boost in well-being than did people who watched neutral videos—and, again, those who watched threat-based nature videos did not report improved well-being.

Another study found that, after watching an awe-inducing video, people with higher self-esteem reported greater improvements in positive affect than did people who watched a control video. People with low self-esteem, however, did not experience this increase in positive affect and reported a significant increase in negative affect. As mentioned previously, it's possible that people with low self-esteem interpreted the video as more threatening than people with higher self-esteem (although that wasn't explicitly tested in this study) (Hornsey et al., 2018) [0].

And a very recently published study found evidence that awe plays an important role in nature's ability to decrease stress and increase well-being (Anderson, Monroy, & Keltner, 2018) [0]. The authors of this study took military veterans and youth from underserved communities white water rafting, and also measured their symptoms of stress and their overall well-being. Their results found that the amount of awe that the participants experienced could predict the extent to which their symptoms of stress and indicators of well-being had improved one week later. These researchers also found that undergraduate students reported feeling more awe—as well as greater life satisfaction and well-being—on days when they spent time in nature. This higher level of awe could statistically explain the greater sense of life satisfaction and well-being reported by these students on days when they had been in nature, suggesting that awe may be a crucial ingredient in nature's restorative abilities.

Life satisfaction

There's some evidence to suggest that awe may also increase people's sense of satisfaction with their life. While a study of middle-aged and older adults found that experiencing awe of God did lead to greater life satisfaction in some cases, there was no direct effect—experiencing awe of God did not reliably boost life satisfaction. However, the researchers did identify an indirect effect: When awe of God instilled a greater sense of connectedness in someone, that significantly increased the likelihood that they would feel greater satisfaction with their life, leading the researchers to conclude, “[T]he relationship between awe of God and life satisfaction is fully explained by the greater sense of connectedness that awe of God appears to instill” (Krause & Hayward, 2015) [14].

In another study, participants who read an awe-evoking story about seeing Paris from the top of the Eiffel Tower reported greater momentary life satisfaction than people who read a story about seeing a plain landscape from up high, and this effect could be predicted by greater perceptions of available time for the people who read the Paris story (Rudd et al., 2012) [229]. Though it is just based on a single study, this result suggests that a single short awe experience—elicited by something as simple as a story—could create a short-term boost in life satisfaction.

Decreased materialism

A few studies suggest that experiencing awe may dampen feelings of materialism. The same experiment that elicited awe by having people read the story about visiting the Eiffel Tower found that, when given a hypothetical choice between a material good (such as a \$50 backpack) or an experiential product (such as a \$50 iTunes gift card), people in the awe condition chose the experiential product more often than people in the neutral condition did—and here again, people's post-awe perception that they had more available time predicted their preference for experiences over material goods (Rudd et al., 2012) [229].

In another study, participants who recalled an awe experience placed less value on money than did participants who recalled happy or neutral experiences, and viewing awe-inducing images reduced the effort people were willing to put into getting money (where effort was measured by tolerance for listening to the unpleasant sound of nails scratching). Importantly, this effect was seen with different variants of awe-inducing images, including negative and non-nature images (Jiang, Yin, Mei, Zhu, & Zhou, 2018) [0].

What might explain this inverse relationship between awe and materialism? According to the researchers, the answer may lie in the self-transcendence that can result from awe. “People in awe start to appreciate their sense of selfhood as less separate and more interrelated to the larger existence,” they write. “The experience of awe elevates people from their mundane concerns, which are bounded by daily experiences such as the desire for money.”

Further support for a possible inverse relationship between awe and materialism comes from a recent set of studies that found evidence that awe can function as a buffer that makes people feel less negatively about losing possessions (Koh, Tong, & Yuen, 2017) [0]. More specifically, this study found that: undergraduate students induced to feel awe reported feeling less negative emotion when asked to imagine losing a possession than students assigned to a neutral condition; students induced to experience awe were less upset about losing their eligibility to receive \$20 in an experiment than those assigned to a neutral condition; and students who had recently experienced awe in their daily lives were less troubled about having lost an actual possession recently. According to the researchers, these findings suggest that “to the extent that awe diminishes the perceived importance of the self, it may help buffer against the distress resulting from losing a possession.”

Spiritual feelings

For many people, experiences of awe are deeply intertwined with religiosity and spirituality, and awe is an inherent component of many religious traditions, stories, and rituals. According to psychologist Kirk Schneider, a sense of awe is “foundational to the major religions and may even be at the vanguard of a new spiritual consciousness”—what he calls

“awe-based consciousness” or “enchanted agnosticism” and others term “post-secular humanism” (Schneider, 2018) [0]. Schneider suggests that this “awe-based consciousness” is highly compatible with the spiritual seekers amongst the growing number of “Nones”—people who do not identify with a particular religious group.

And, indeed, research from a few experimental studies suggests that awe may increase spiritual and/or religious feelings. In one study, undergraduate students who watched videos expected to elicit self-transcendent emotions (including awe)—for example, a video of childbirth or a nature video—reported being more religious (as measured by the extent to which they agreed with statements like “Religion is important in my life” and “Without God the world would not have a meaning”) than people who watched a neutral video of a man making beer; however, people who watched a humorous video also reported this increase in religiousness (Saroglou et al., 2008) [152]. A second experiment using the same videos with a new group of participants found that people who watched one of the two awe videos reported being more spiritual than those who watched the neutral or humorous videos.

Those who watched the childbirth and nature videos also reported a stronger agreement with “the idea of God as the creator of the world,” although when the researchers considered those responses together with the participants’ responses to statements about whether they would take actions related to belief in God (e.g. “Would you stand up for this conception if one casts doubt on it?”), there was not a significant difference between people who watched the awe videos and those who watched the neutral video.

“Since religion implies concrete and specific engagement and behavior to a greater extent

than spirituality,” write the researchers, “priming self-transcendent emotions seems to be more efficient for increasing spirituality [than religion].”

That said, another study did find evidence that awe may activate the behavioral intentions of religious and spiritual people. In this study, researchers found that participants’ level of religiosity/spirituality was positively related to their reported willingness to visit Tibet (a spiritual destination), but only after they had recalled a memory involving awe (recalling a neutral event had no effect) (Van Cappellen & Saroglou, 2012) [88]. This study suggests that awe may encourage religious and/or spiritual people to engage in behaviors related to religion or spirituality.

A few studies have found that awe experiences may increase supernatural beliefs, at least in some people. In particular, a set of five experiments found that experiencing awe decreased people’s “tolerance for uncertainty” and increased their supernatural beliefs and intentional perception of patterns. Put another way, experiences of awe confront people with the inexplicable, thereby driving them to search for plausible explanations, even if those explanations rely on supernatural forces. Certain experiences of awe increased participants’ supernatural beliefs, and in another experiment, people who had just experienced awe were more likely to believe that random strings of numbers were deliberately designed by humans (Valdesolo & Graham, 2014) [80]. Awe appears to turn on our “agency detectors” and leads us to attribute ambiguous events to human or supernatural causes.

Scientific thinking and learning

Science is another framework for understanding, so one could reasonably wonder whether awe might lead people to embrace a scientific world-

view in order to make sense of their experiences and perceptions. Indeed, some research has explored that question.

Intriguingly, a recent theoretical paper argues that awe may help facilitate scientific learning and reasoning in children (Valdesolo, Shtulman, & Baron, 2017) [7]. “Awe is elicited in the presence of an event that is perceived as a major violation of one’s current theories about the world and cannot be assimilated into existing mental structures,” write the authors. “The feeling of uncertainty created by this gap between knowledge and experience triggers a need for accommodation (or knowledge restructuring) that promotes explanation and exploration, two crucial antecedents of learning.” For example, when a child sees an anvil and feather drop at the same rate in a vacuum, this experience likely violates the child’s intuitive understanding of how gravity works, creating a need for accommodation (and likely awe), and encourages them to develop a new theory about the relationships between weight, gravity, and motion. “In short, awe will drive the conceptual change in the domain of science, defined by dissatisfaction with existing theories and motivating the replacement of those theories with new, more accurate ones,” suggest the researchers.

In agreement with this theorized role for awe, a recent set of six studies found that people who have a greater disposition to experience awe had a more accurate understanding of the nature of science and were more likely to reject creationism and other scientifically questionable explanations about the world (Gottlieb, Keltner, & Lombrozo, 2018) [0]. Importantly, dispositional awe was not associated with having “faith” in science, just in understanding how science works.

Through a series of experiments, another study found that experiencing awe drove theists toward accepting supernatural explanations and

away from scientific explanations, but did not drive nontheists toward being more accepting of either supernatural or scientific explanations. Awe experiences did, however, drive nontheists to place more stock in an explanation of the theory of evolution that was “framed as explicitly providing order and explanation and eschewing the importance of randomness in the process”—however, this is not necessarily a good thing as randomness is an essential part of the theory of evolution (Valdesolo, Park, & Gottlieb, 2016) [3].

There is much left to be explored about the relationship between awe and scientific learning, reasoning, and thought, and this relationship poses a particularly interesting avenue for further research.

Awe as a transformational experience

Also warranting further research is the transformative ability of some awe experiences. Theory and anecdotal accounts suggest that some intense awe experiences can provoke such profound cognitive accommodation that they create life-lasting changes in how people view themselves and the world.

Clinical psychologist David Elkins discussed such transformative awe experiences in his 2001 essay, “Reflections on Mystery and Awe”(Elkins, 2001) [6]. Elkins notes that theologians and religious scholars such Rudolf Otto and Mircea Eliade have characterized concepts that seem to encompass such experiences.

Elkins notes that prominent psychologists, too, have considered what could be described as transformative awe experiences. William James wrote a book titled *The Varieties of Religious Experience*, which Elkins notes features many “stories of awe-filled encounters with the mystical and the sacred.” And he describes how Abraham Maslow “was almost obsessed with the realm

of being and with those mystical, awe-filled moments in life that he called ‘peak experiences.’”

Perhaps the most moving example of a transformative awe experience included in this essay comes from psychiatrist, neurologist, and Holocaust survivor Viktor Frankl, who recounted an experience he had after being liberated from a concentration camp. His wife and family had been killed and he had been filled with despair.

One day, a few days after the liberation, I walked through the country past flowering meadows, for miles and miles, toward the market town near the camp. Larks rose to the sky and I could hear their joyous song. There was no one to be seen for miles around; there was nothing but the wide earth and sky and the larks’ jubilation and the freedom of space. I stopped, looked around, and up to the sky—and then I went down on my knees. At that moment there was very little I knew of myself or of the world—I had but one sentence in mind—always the same: “I called to the Lord from my narrow prison and He answered me in the freedom of space.”

How long I knelt there and repeated this sentence memory can no longer recall. But I know that on that day, in that hour, my new life started. Step for step I progressed, until again I became a human being. (pp. 141-42)

“Awe is a lightning bolt that marks in memory those moments when the doors of perception are cleansed and we see with startling clarity what is truly important in life,” writes Elkins, who had Frankl as his graduate professor and is a propo-

nent of using awe in psychotherapy. “Moments of awe may be the most important, transformative experiences of life.”

As of yet most of the work related to transformative awe experiences has been qualitative, exploratory, or theoretical in nature. Thus many questions remain about what elements of awe experiences make them more likely to provoke such transformational feelings, as well as whether certain individual characteristics may make people more prone to experience lasting change following moments of extreme awe.

(Pro)Social Effects

Though we may think of awe as being a very personal, internal experience, there is some emerging evidence suggesting it has social effects as well, specifically on our levels of kindness and generosity.

In one study, people who were asked to write about a time when they had experienced awe reported a greater willingness to volunteer their time to “support a worthy cause” and to “help a charity” than did people who had written about a time when they had experienced happiness. The researchers hypothesized that an awe-related prompt induced the expanded perception of available time associated with awe, and as a result of feeling like they had more time to give, the study participants were more willing to spend some of their time helping others (Rudd et al., 2012) [229]. Consistent with this hypothesis, people who wrote about an awe experience reported feeling less time pressure (impatience) than those who wrote about a happy memory. Additionally, there was no difference between the two groups in their willingness to donate money, supporting the idea that awe’s effects on prosocial behavior may stem from its ability to make people feel like they have more available time.

That said, other studies have found associations between awe and other forms of generosity as well. In one study, people who reported a greater tendency to perceive natural beauty also scored higher on measures of agreeableness, perspective taking, and empathy (Zhang, Piff, Iyer, Koleva, & Keltner, 2014) [94]. This study also found that people who were assigned to watch either a video or still pictures of beautiful scenes were more generous and trusting in economic games than were people who viewed less beautiful imagery. While this study did not directly measure participants’ levels of awe, there is reason to believe that awe may be involved in these prosocial behaviors, as natural stimuli are one of the most common elicitors of awe.

A more recent study used multiple methods and tested diverse groups of participants to uncover some of the most extensive and varied evidence to date that awe relates to prosocial behavior (Piff et al., 2015) [133]. In one part of the study, participants were given 10 tickets for a raffle and afforded the opportunity to give some of the tickets to an assigned partner. The people with more dispositional awe gave away significantly more of their raffle tickets raffle than did people with less dispositional awe. Additionally, people who were first asked to recall a time when they experienced awe later reported more ethical answers to a set of hypothetical scenarios involving selfish and/or amoral behavior than people who were asked to remember a time when they had felt pride or to recall a neutral memory (moreover, the extent to which they felt the “small self” predicted the ethicality of their answers).

In a separate part of the study, participants watched either an awe-inspiring nature video, an amusing video, or a neutral video, then played a game in which they were given a certain amount of

money and were free to decide how much to share with other people. The participants who watched the awe videos reported higher small-self ratings and were more generous in the game. What's more, participants in yet another part of the study who watched videos of awe-inspiring stimuli that either were non-nature-based (a colored water droplet falling in slow motion) or depicted natural threats (e.g., tornadoes, volcanoes, etc.) exhibited more prosocial tendencies in a game where they had to allocate points between themselves and an unknown other participant compared to participants who watched a neutral video clip.

Finally, in yet another part of the study, some participants gazed at a grove of towering Tasmanian eucalyptus trees while others stared up at a tall building. Those who looked at the trees reported more awe, fewer feelings of entitlement, and indicated feeling a smaller self. And when the experimenter "accidentally" dropped a bunch of pens in front of each participant, the tree-gazers picked up more of them—a measure of helpfulness. "Our investigation indicates that awe, although often fleeting and hard to describe, serves a vital social function," write the researchers. "By diminishing the emphasis on the individual self, awe may encourage people to forego strict self-interest to improve the welfare of others."

Another study asked some participants to think of a time when they had experienced awe from a "stunning natural landscape," then later had them imagine winning the lottery and asked them how much they would give to friends, family, and charity. These participants said they would give away significantly more of their hypothetical winnings than did participants who were asked to recall an amusing or neutral memory, again suggesting that awe can induce people to think more about others (Prade & Saroglou,

2016) [16]. In a second experiment, participants who watched an awe-inducing video clip reported significantly greater willingness to help others in response to a series of hypothetical scenarios than did people who watched amusing or neutral video clips. Interestingly, this result was specific to people with less agreeable personalities; highly agreeable people were no more prosocial in the awe condition than in the other conditions in this second experiment.

Other research suggests that there are some limits of awe's connection to prosocial behavior. In this study, researchers showed participants a slideshow of beautiful pictures and asked them to report how "awed"—as well as "spiritual," "caring," "connected to others" and "fearful"—they felt while watching the slideshow. The researchers found that people did indeed report feeling more awe while viewing spectacular natural images than while viewing more mundane or neutral images, and they also reported feeling significantly smaller, more emotionally affected, fearful, interested, and surprised; however, they did not report feeling more caring or connected. Another part of this study found that participants who viewed more awe-inspiring images were more altruistic when presented with a hypothetical scenario in which they could be more generous or selfish in how they distributed resources; however, they did not report being more willing to donate food, clothing, money, or blood to victims of a natural disaster (Joye & Bolderdijk, 2015) [23].

Together these studies suggest that awe may prompt people to help others and to be more generous, and that these impulses may be supported by awe's ability to encourage people to focus less on themselves, as well as its ability to expand their perception of available time.



Limitations and Future Directions

While this white paper is intended to present a fairly comprehensive overview of the research on awe to date, this is still a nascent field—there are many scientific avenues that can be further explored and questions left to be answered. Below are a few of the limitations of the current state of awe research, as well as some promising future directions.

Limitations

Perhaps the largest limitation of awe research is its youth. Because there are not many researchers studying awe, and those who are studying it have not been doing so for very long, many of the findings discussed in this paper have yet to be replicated.

Another limitation of awe research is inherent to the very nature of the concept of awe: often awe experiences can be elusive and difficult to define. Thus, because experimenters often use different ways of eliciting awe, it is difficult to know if an awe phenomenon probed in one study is similar to awe explored via different methods in another study. Additionally, it may be difficult to interpret studies that rely on participants to recall a time when they had experienced awe because different people have different conceptions of what “awe” means. Over time, the field will likely become more consistent in its methods for eliciting and measuring awe, which in turn will create more confidence in researchers’ findings.

On the other hand, some psychologists have argued that the field of awe research has veered too far into the quantitative realm. Kirk Schneider argues in a recent article that the nature of awe requires a broader approach. “[I]f there was ever a time where mixed methods were called for,

this is it,” he wrote. “Such quantitative and qualitative methods could considerably enrich our understanding of the long-term and multifaceted implications of awe-inspired lives” (Schneider, 2017) [0]. Studies that take advantage of such mixed methods could help psychologists glean insights into a wider range of awe experiences.

Future directions

The science of awe is ripe for future exploration; what researchers don’t know about awe far eclipses what they do know.

- *Awe and prosocial behavior*

One particularly promising research direction is to better understand the relationship between awe and prosocial behavior. How exactly does awe lead to prosocial behavior (if in fact it even does so to begin with)? Do awe’s effects extend to other forms of prosociality, such as pro-environmental behavior (Piff et al., 2015) [133]? Does awe make us more generous toward everyone universally, or just to other people like us (Prade & Saroglou, 2016) [16]? Furthermore, because religious organizations are “social institutions that elicit, organize, and ritualize awe,” could part of the effect that religion has on prosocial behavior be due to awe (Piff et al., 2015) [133]?

- *The psychological effects of awe*

Many questions also still surround awe's other psychological effects (Piff et al., 2015) [133]. For example, how does the small-self sensation differ from negative feelings of smallness (e.g. how one feels when ashamed)? Does awe make people more curious and/or open to novel experiences? How does awe influence memory? Could awe "interventions" be used to make people more generous, humble, and patient?

- *The relationship between spirituality and awe*

While a few studies have explored the religious and spiritual aspects of awe, including how experiencing awe can elicit spiritual and religious feelings (and it has been a topic for a number of qualitative essays by humanistic psychologists), there is a relative dearth of studies on this topic overall considering the prominence of awe in the literature and in the history of many religious traditions (in their 2003 paper, Keltner and Haidt even present awe as a primary component of conversions and other religious experiences). In particular, not much experimental research has been conducted on how awe relates to specific religious and spiritual beliefs and practices, how religious institutions cultivate and benefit from eliciting awe in believers, and whether religious or spiritual people experience more awe than non-spiritual and religious people.

- *The therapeutic potential of awe*

Along similar lines, another area of research ripe for further exploration is the potential use of awe in therapeutic settings. Some clinical psychologists have already considered this topic. For example, in his article "Enchanted Agnosticism, Awe, and Existential-Integrative Therapy," Kirk Schneider discusses how "awe-based conscious-

ness" is the basis of what he calls "existential-integrative therapy," a version of psychotherapy that can help people develop "an attitude of inner freedom, a capacity to access and express the fuller ranges of one's experience, and thereby a capacity to experience the humility and wonder—sense of adventure—toward living" (Schneider, 2014) [4].

And in 2016, the entire spring issue of *Voices*, the journal of the American Academy of Psychotherapists, was devoted to the topic of awe and psychotherapy. "Despite being underrepresented in the scientific literature, in all likelihood the vast majority of therapists intuitively recognize that experiences of awe often signify momentous occasions in the course of an individual's life," writes psychotherapist Edward Bonner in an article within this issue. "It is equally likely that most also recognize that these experiences have the capacity to initiate profound and long-lasting changes" (Bonner, 2016) [0]. Bonner goes on to describe various recommendations for how therapists can help clients cultivate experiences of awe. These include promoting clients' spiritual development in therapy, taking advantage of interventions that promote openness to experience (such as exposure therapy and dialectic discourse), addressing barriers to awe such as rigid belief systems or a reticence to feel intense emotions, and cultivating the therapists' own personal sense of awe and spirituality.

- *The dark side of awe*

Researchers have just started to scratch the surface of a psychological dark side to awe, specifically related to its tendency to deemphasize the self and emphasize one's association with a group. Researcher Yang Bai and her colleagues suggest that awe "might predict harmful behaviors directed at outgroups—outgroup bias, aggression, and

even genocidal tendencies.” For instance, they suggest that religious awe may inspire people to carry out suicide bombings (Bai et al., 2017) [2].

- *How culture influences awe experiences*

Many of the studies in this paper were performed predominantly on so-called WEIRD (Western, Educated, Industrialized, Rich and Democratic) populations, so it is unclear to what extent these findings will extend to other populations. Elucidating the differences and similarities of the awe experience across cultures is an interesting and important area for further study (Razavi et al., 2016) [1].

- *The neuroscience of awe*

Little is known about the neurological mechanisms that underlie the awe experience. One small study found differences in two types of brain waves—theta and beta—between people who did and did not experience awe while in simulated space flight, suggesting that people who experienced awe were less fatigued or distracted and paid more attention to the awe-inspiring image (viewing Earth from space) (Reinerman-Jones et al., 2013) [14].

Additionally, there were brain-activity differences between when people viewed a more awe-inspiring stimulus (Earth from space) and a less awe-inspiring stimulus (simulated deep space), although this may be due at least in part to differences in the visual complexity of the images. In producing this white paper, we uncovered no evidence that functional magnetic resonance imaging studies have been used to probe the brain areas involved in the experience of awe; this is a research area ripe for future exploration.

- *Open questions*

Many questions remain open concerning the awe experience itself. These include basic questions, such as: When it comes to threatening stimuli, what determines whether an individual experiences awe, rather than experiencing anxiety or simply ignoring the stimulus (Shiota et al., 2007) [265]? And how does the awe experience unfold over time (Piff et al., 2015) [133]?

A host of other basic psychological questions remain to be explored in relation to awe. These include:

- Developmental questions: How do children experience awe during development? What role does culture or parenting play in this development?
- Experiential and daily sampling questions: How often do people tend to experience awe in their day-to-day lives? Are there some experiences that are likely to induce strong awe in most people? Most studies have focused on the visual aspects of awe, but how do other sensory modalities contribute to the experience?
- Basic methodological questions: How do natural awe experiences vary from those in the lab?
- Intervention questions: Can people be taught to experience awe more frequently?

Additionally, advances in Virtual Reality technology will allow experimenters to further tease apart the essential components of awe experiences, determine which stimuli are most effective at eliciting awe, and probe the psychological consequences of eliciting awe.

It’s an exciting time for the science of awe. Much is known but even more remains to be explored. With increasing interest in the topic, the future looks bright—maybe even awesome.

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Tian Tan Buddha, Hong Kong (Photo by Jason Cooper)

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