

# Journal of Personality and Social Psychology

## **The Dark Side of the Sublime: Distinguishing a Threat-Based Variant of Awe**

Amie M. Gordon, Jennifer E. Stellar, Craig L. Anderson, Galen D. McNeil, Daniel Loew, and Dacher Keltner

Online First Publication, December 8, 2016. <http://dx.doi.org/10.1037/pspp0000120>

### CITATION

Gordon, A. M., Stellar, J. E., Anderson, C. L., McNeil, G. D., Loew, D., & Keltner, D. (2016, December 8). The Dark Side of the Sublime: Distinguishing a Threat-Based Variant of Awe. *Journal of Personality and Social Psychology*. Advance online publication. <http://dx.doi.org/10.1037/pspp0000120>

# The Dark Side of the Sublime: Distinguishing a Threat-Based Variant of Awe

Amie M. Gordon  
University of California, Berkeley

Jennifer E. Stellar  
University of Toronto

Craig L. Anderson and Galen D. McNeil  
University of California, Berkeley

Daniel Loew  
Abt SRBI, New York, New York

Dacher Keltner  
University of California, Berkeley

Theoretical conceptualizations of awe suggest this emotion can be more positive or negative depending on specific appraisal processes. However, the emergent scientific study of awe rarely emphasizes its negative side, classifying it instead as a positive emotion. In the present research we tested whether there is a more negative variant of awe that arises in response to vast, complex stimuli that are threatening (e.g., tornadoes, terrorist attack, wrathful god). We discovered people do experience this type of awe with regularity (Studies 1 & 4) and that it differs from other variants of awe in terms of its underlying appraisals, subjective experience, physiological correlates, and consequences for well-being. Specifically, threat-based awe experiences were appraised as lower in self-control and certainty and higher in situational control than other awe experiences, and were characterized by greater feelings of fear (Studies 2a & 2b). Threat-based awe was associated with physiological indicators of increased sympathetic autonomic arousal, whereas positive awe was associated with indicators of increased parasympathetic arousal (Study 3). Positive awe experiences in daily life (Study 4) and in the lab (Study 5) led to greater momentary well-being (compared with no awe experience), whereas threat-based awe experiences did not. This effect was partially mediated by increased feelings of powerlessness during threat-based awe experiences. Together, these findings highlight a darker side of awe.

*Keywords:* appraisals, awe, fear, threat, well-being

Awe is a complex emotion, one that can be intensely pleasurable or imbued with dread depending on the context and how it is appraised (Keltner & Haidt, 2003, p. 297; Lazarus, 1991; Smith, Tong, & Ellsworth, 2014). Paradoxically, awe exists in the “upper reaches of pleasure and on the boundary of fear” (Keltner & Haidt, 2003). These scholarly accounts of awe dovetail with intuition and observation—we feel awe in response to the beauty of nature (e.g.,

sunsets), the virtue of a leader (e.g., Nelson Mandela), or the perceived compassion and love of a benevolent God; but we also feel it in response to nature’s capacity for destruction (e.g., thunderstorms), a leader’s coercive charisma (e.g., Adolf Hitler), or an angry and punitive God.

As the above examples suggest, awe can be purely positive in valence or tinged with elements of fear and threat. The emergent scientific study of awe, however, has rarely examined how negative experiences give rise to awe, instead largely portraying the emotion as a discrete positive state (e.g., Campos, Shiota, Keltner, Gonzaga, & Goetz, 2013; Rudd et al., 2012; Shiota, Keltner, & John, 2006; Shiota, Keltner, & Mossman, 2007; Smith et al., 2014; Stellar et al., 2015; Van Cappellen, & Saroglou, 2012; Valdesolo & Graham, 2014; for a recent exception, see Piff, Dietze, Feinberg, Stancato, & Keltner, 2015). Empirical studies of momentary state-like experiences of awe contrast it empirically with other positive emotional states (Piff et al., 2015; Rudd, Vohs, & Aaker, 2012; Stellar et al., 2015; Valdesolo & Graham, 2014). At the trait level, awe is assessed via a subscale of the Discrete Positive Emotion Scale, which contains no negatively valenced items (Shiota et al., 2006). This empirical bias extends to studies of the consequences of awe, which demonstrate that when triggered by recall tasks, experiences in nature, or viewing awe-inspiring videos, awe promotes greater life satisfaction (Rudd et al., 2012), prosocial ten-

---

Amie M. Gordon, Department of Psychology, University of California, Berkeley; Jennifer E. Stellar, Department of Psychology, University of Toronto; Craig L. Anderson, and Galen D. McNeil, Department of Psychology, University of California, Berkeley; Daniel Loew, Abt SRBI, New York, New York; Dacher Keltner, Department of Psychology, University of California, Berkeley.

Galen D. McNeil is now at the Department of Psychology, University of California, Los Angeles.

Amie M. Gordon and Jennifer E. Stellar contributed equally to this work. This research was supported in part by grants from the John Templeton Foundation (95524, 88210).

Correspondence concerning this article should be addressed to Amie M. Gordon, who is now at Center for Health and Community, University of California, San Francisco, San Francisco, CA 94143. E-mail: amie.gordon@ucsf.edu

dencies (Piff et al., 2015), and humility (Stellar et al., 2015), and curiosity (Anderson et al., 2016). This positive representation of awe may reflect current lay conceptions of this emotion (Shiota, Keltner, & Mossman, 2007; Stellar et al., 2015), but it is also possible that researchers' positive conceptualizations of awe are infiltrating lay knowledge and reinforcing the notion that awe is an exclusively positive emotion.

As the science of awe advances, we believe it is critical to characterize a variant of this emotion that is tinged with fear and stems from appraisals of threat. The reasons for this are numerous. This type of awe constitutes a notable, and to date uncharted, realm of awe experiences. It is also likely that this threatening type of awe will be even more prevalent in non-Western cultures, which place less emphasis on positive affect and in which mixed emotional states are more common (Bagozzi, Wong, & Yi, 1999; Shiota et al., 2011). Threat-based awe is also very likely to figure in certain social contexts long thought to be potent elicitors of awe—for example in relation to powerful, charismatic leaders (e.g., Weber, 1968) or in the context of religious experience in relation to a punitive, powerful God (Shariff & Norenzayan, 2011). As an extension of this latter possibility, threat-based awe and positive forms of awe should have divergent outcomes, which could prove fruitful to several lines of inquiry, such as understanding the paradoxical effects of religion on mental and physical health (for a review, see Shreve-Neiger & Edelstein, 2004; Seybold & Hill, 2001). These kinds of conceptual interests motivated the present investigation, a multimethod study of the correlates and consequences of threat-based awe, and how they differ from more positive forms of awe.

### Threat-Based Awe: A Theoretical Analysis

In their attempt to systematize the varieties of awe, Keltner and Haidt (2003) define experiences of awe as resulting from two core appraisals: (a) perceived vastness, which refers to the sense that the stimulus is beyond the scale of ordinary human perception, and (b) the need for accommodation, which refers to the sense that the stimulus cannot be assimilated into current mental structures, thus necessitating changes to basic beliefs, categories, and schemas. These two core appraisals give rise to experiences of awe across a variety of domains, such as in response to social stimuli, nature, political events, religious processes, novel ideas, and artistic or cultural artifacts.

Guided by prototype analyses of emotion (e.g., Ekman, 1992; Fehr & Russell, 1984; Shaver, Schwartz, Kirson, & O'Connor, 1987), Keltner and Haidt further posited that beyond the two core appraisals of vastness and need for accommodation, additional characteristics of the elicitor should lead to distinct "flavors" or variants of awe. For example, objects that are well-proportioned, balanced, and symmetrical might imbue the experience of awe with a positive feeling of beauty. Awe toward individuals who display exceptional ability might be flavored with a positive feeling of admiration. Within this prototype analysis of awe, most variants were largely positive in valence, but one was more negative, stemming from appraisals of threat. As with awe more generally, this more threatening variant of awe can arise from a variety of stimuli, such as social (e.g., a dominant, powerful individual), natural (e.g., lightning), or even more metaphysical (e.g., contemplating one's place in a vast universe) experiences.

In their theoretical account, Keltner and Haidt (2003) proposed that awe evolved as an emotional reaction to high-ranking individuals, motivating patterns of cognition and action that help lower-ranked individuals subordinate their self-interest and fold into the social hierarchies of the groups to which they belong (see also Weber, 1968). This more threatening, status-based variant of awe was referred to as *primordial awe*, from which other variants emerged. Over time, awe then extended to objects with similar qualities to high-ranking dominant individuals (e.g., a large and powerful waterfall) and its threatening elements faded. These positive types of awe now seem to have become more common in Western industrialized societies despite their hypothesized origins in a more negative, fearful form of this emotion (Keltner & Haidt, 2003).

Despite its relative absence from empirical investigations of awe, several types of evidence and analysis point to a more threat-based variant of awe in need of systematic examination. First, the etymology of the word awe in the Middle English words *aghe* or *ege*, meaning fear, dread, or terror, suggests that in the cultural evolution of awe, a threatening variant may have been much more common in the past (for an elaboration of this argument, see Keltner, 2009). Even today, fear and dread appear in definitions of the emotion. For example, the Merriam-Webster dictionary defines awe as "an emotion variously combining dread, veneration, and wonder that is inspired by authority or by the sacred or sublime." Modern English language even includes two similar words to describe an awe-inspiring experience with nearly opposite meanings: awesome and awful. This inclusion of fear in definitions of awe is not limited to Western cultures. For example, the Chinese term for awe, 敬畏, is a combination of respect and fear. Thus, the linguistic representation of awe has long denoted a threat-based variant across historical periods and cultures that blends awe with feelings of fear.

Second, philosophical treatments of a related construct, the sublime, posit that threat and fear are critical to the experience. For example, Edmund Burke (1757/1990) notes that, "Whatever is qualified to cause terror is a foundation capable of the sublime." This treatment of awe is also common to many religious traditions (e.g., Pargament & Mahoney, 2005; Sundararajan, 2002). Within different religions, God is often depicted as both wondrous and terrifying—a powerful, all-knowing Entity. For instance, the Bible often refers to awe in passages depicting feelings of powerlessness in response to God, such as "My flesh trembles in fear of you; I stand in awe of your laws," when referencing God (Psalm 119:120; New International Version).

Finally, recent empirical work hints at a threat-based variant of awe. In one set of studies, participants reported higher fear in response to awe-eliciting videos than videos eliciting a positive or neutral state (Valdesolo & Graham, 2014). In another study, threatening natural stimuli (e.g., tornadoes, volcanoes) elicited similar levels of awe as nonthreatening stimuli but much higher levels of fear (Piff et al., 2015). Both the threatening and nonthreatening awe videos elicited a significantly smaller sense of self and greater prosociality (relative to a neutral video). The study by Piff and colleagues provides the most direct empirical evidence for a threat-based variant of awe, but it focused on outcomes (i.e., small self and prosociality) that were expected to be common across all variants of awe and did not explore the distinctions between these variants. Guided by our theoretical analysis and building upon

these observations and incidental findings, in the present investigation we chart the different elements of threat-based awe.

### Appraisals of Threat: Implications for Experience, Physiology, and Well-Being

Our investigation of threat-based awe is guided by the core principle that crucial to human experience is the ability to detect threat and quickly mobilize the mind and body to respond appropriately to perceived danger (Frijda, 1986; Lazarus, 1991; Rolls, 1999). The capacity to appraise threat in the environment is vital to human survival, and evident in what might be called an automatic threat-detection system that involves regions of the brain such as the amygdala (for reviews, see Bishop, 2008; Rodrigues, LeDoux, & Sapolsky, 2009), and activation in sympathetic branches of the autonomic nervous system (Dimberg & Öhman, 1996; Levenson, 2003; Öhman, 1986). This detection system develops at an early age (e.g., Boyer & Bergstrom, 2011) and responds to a variety of threats from predation and contamination to status-loss and social rejection (Boyer & Bergstrom, 2011; Dickerson & Kemeny, 2004; Eisenberger, Jarcho, Lieberman, & Naliboff, 2006).

Given the foundational role that appraisals of threat play not just in our evolution but also in our modern day experience, it is no surprise that the detection of threat, whether from a predator or a powerful leader, is characterized by a reliable cascade of cognitive, affective, and physiological responses that have been the subject of extensive psychological inquiry (e.g., Öhman, Flykt, & Esteves, 2001). Cognitively, threat detection is triggered by construals of the situation as uncontrollable and uncertain (e.g., Fiske, Morling, & Stevens, 1996; Kraus, Piff, Mendoza-Denton, Rheinschmidt, & Keltner, 2012; Lazarus & Folkman, 1984; Magee & Galinsky, 2008). For example, perceptions of reduced control and certainty are particularly potent during stressful contexts (Geer, Davison, & Gatchel, 1970; Monat, Averill, & Lazarus, 1972) and social-evaluative threat (Dickerson & Kemeny, 2004), and are defining features of low status within a hierarchy (Kraus et al., 2012). Moreover, these two construals appear to be additive, such that particularly threatening contexts are characterized by both low control and low certainty (Suls & Mullen, 1981).

The emotional responses to threat, whether from physical or social dangers, include enhanced fear and anxiety (Cheng, Tracy, Foulsham, Kingstone, & Henrich, 2013; Ellsworth & Smith, 1988; Smith & Ellsworth, 1985, 1987). In conjunction with these affective responses, threatening situations elicit fight-or-flight physiological responses, evident in increased activation of the sympathetic autonomic nervous system (Ax, 1953; Dawson, Schell, & Filion, 2000; Stemmler, Heldmann, Pauls, & Scherer, 2001)—and in more extreme cases, activation of the Hypothalamic-Pituitary Axis—which prepares the individual for specific actions in response to the threat (e.g., Blascovich & Mendes, 2010; Blascovich & Tomaka, 1996; Dickerson & Kemeny, 2004; Kagan, 1994; Tomaka, Blascovich, Kibler, & Ernst, 1997). In contrast, social connection and calm states (Ditto, Eclache, & Goldman, 2006; Keltner, Kogan, Piff, & Saturn, 2014; Kok et al., 2013; Krygier et al., 2013; Porges, 2007; Stellar, Cohen, Oveis, & Keltner, 2015) as well as positive affect (Oveis et al., 2009) have been associated with parasympathetic activation. These empirical literatures yield specific predictions about the qualities of threat-based awe, and

how it will be distinct from more positive forms of awe. Based on the findings just reviewed, we expected that threat-based awe would be characterized by (a) reduced construals of control and certainty, (b) increased feelings of fear and anxiety, and (c) elevated sympathetic autonomic nervous system arousal, compared with more positive variants of awe, which we predicted would be associated with different physiological responses.

Threat-related states and the negative emotions they engender, such as fear and anxiety, are considered antithetical to subjective well-being (Diener, Suh, Lucas, & Smith, 1999). By contrast, positive emotions are thought to increase health and life satisfaction in the moment and even decades later (e.g., Harker & Keltner, 2001; Lyubomirsky, King, & Diener, 2005; for review, see Fredrickson, 2001). In keeping with this literature on positive emotion and well-being, recent research shows that awe at both the state and trait level predicts better health and well-being. In one study, people who were induced to feel awe by imagining that they were looking at Paris from atop the Eiffel Tower reported greater life satisfaction relative to those in a control condition (Rudd et al., 2012). At the trait level, the disposition to experience awe is positively linked to extraversion (Shiota et al., 2006) and negatively associated with markers of inflammation that are harmful to physical health (Stellar et al., 2015). Yet threat-based awe, we argue, generates reduced appraisals of control and certainty, feelings of fear, and sympathetic physiological arousal, a profile that is not likely to be beneficial for well-being. Thus, we expected that threat-based awe would not hold the same beneficial effects for well-being as more positive forms of awe.

Why this prediction? One mechanism we examine is feelings of powerlessness. Threat is characterized by reduced feelings of control and certainty that ultimately lead individuals to feel that they have little power over their situation, a perception that is detrimental for well-being (e.g., Keltner, Gruenfeld, & Anderson, 2003; Lachman & Weaver, 1998; Ryff, 1989; Schulz, 1976). Threat-based forms of awe may be particularly effective at eliciting perceptions of powerlessness as awe more generally is known to elicit a feeling that one's self is small. In a positive context this perception can be pleasant and is associated with self-construals that are important for well-being such as humility (Stellar et al., 2016), but in a threatening context this perception is likely to be more negative and fear-based, eliciting feelings of powerlessness. Thus, we predicted that threat-based awe experiences would not enhance well-being relative to positive awe experiences, and this would be due in part to the fact that threat-based awe induces feelings of powerlessness.

### An Empirical Approach and Hypotheses Concerning the Variants of Awe

The present investigation is grounded in two key assumptions from the science of emotion. The first is that within an emotion category such as love, awe, or anger, there are variations of the specific emotion (e.g., Ekman, 1992; Shaver et al., 1987). These variants, it is further reasoned, have different response profiles. For example, past work has distinguished between variants of embarrassment (Tangney et al., 1995), love (e.g., Fehr, Sprecher, & Underwood, 2009), and disgust (Rozin, Haidt, & Fincher, 2009). Most germane to the present investigation is the recent empirical work on the variants of pride (Tracy & Robins, 2004, 2007).

Narrative and experimental work have characterized two distinct variants of pride—authentic and hubristic. Both variants arise from perceptions of having achieved something valued by others—pride’s central appraisal. However, these variants differ in their appraisals, subjective experience, and personality correlates. Authentic pride stems from the perception that one has achieved something through *effort* and is associated with healthier consequences, such as higher self-esteem, mental health, and relationship functioning (Tracy, Cheng, Robins, & Trzesniewski, 2009; Tracy & Robins, 2007). In contrast, hubristic pride stems from the perception that one has achieved something as a result of innate *ability* and is associated with more maladaptive consequences, such as narcissism, aggressive behavior, and poor relationship functioning (Tracy et al., 2009; Tracy & Robins, 2007). Though these variants of pride share core appraisals of achievement, they yield different patterns of expression, cognition, and behavior due to different perceptions about the source of the achievement. In a similar vein, we expected that experiences of awe would differ dramatically depending on the presence or absence of threat appraisals.

The second assumption guiding our investigation of threat-based awe is that emotions are multicomponent processes (e.g., Ekman, 1992; Keltner & Lerner, 2010; Levenson & Ruef, 1992; Smith et al., 2014). Emotions involve distinct appraisal processes, subjective experiences, and physiological responses, which give rise to the markedly different outcomes that emotions produce. Informed by this broad assumption, we tested specific hypotheses about threat-based awe, focusing on differences, as well as similarities, in the appraisal structure, accompanying emotions, autonomic responses, and psychological consequences of threat-based awe compared with more positive awe.

Guided by these two assumptions, we assessed the prevalence of threat-based awe in Study 1. In Studies 2a (cross-sectional) and 2b (experimental), we examined whether this variant of awe was associated with different appraisals and subjective experiences than positive awe. In Study 3, we explored whether stronger feelings of fear and anxiety during exposure to an awe stimulus were associated with greater sympathetic autonomic physiological activity. In Study 4, we used daily experience methodology to test the associations between positive and threat-based variants of awe and well-being in daily life in a subsample from Study 3. Finally, in Study 5, we experimentally manipulated awe experiences to be more or less threatening and tested the differential effects of threat-based awe and more positive awe on well-being. In Studies 4 and 5 we also tested whether feelings of powerlessness explained any differences in well-being between threat-based awe and more positive awe. Across studies, we tested the following specific hypotheses:

*Hypothesis 1:* Threat-based awe will be characterized by reduced appraisals of control and certainty more so than positive awe.

*Hypothesis 2:* Threat-based awe will generate significantly more fear and anxiety and less positive affect than positive awe.

*Hypothesis 3:* Threat-based awe will be associated with indicators of greater sympathetic autonomic nervous system activation,

whereas positive awe will be associated with indicators of greater parasympathetic nervous system activation.

*Hypothesis 4:* Threat-based awe will not produce the same benefits for well-being as more positive awe.

*Hypothesis 5:* Differences in well-being between threat-based and positive variants of awe will be explained in part by feelings of powerlessness.

## Study 1: The Prevalence of Threat-Based Awe

Given the empirical focus on awe as a positive emotion, in our first study we explored the prevalence of awe experiences characterized by appraisals of threat in both college-student and adult samples. We assessed how frequently this type of awe experience occurred and whether it varied as a function of the reported elicitor (e.g., nature, social, political).

## Method

**Participants.** Two hundred two participants from three different samples described a memorable awe experience. Sample A included 122 undergraduates (gender unknown) from a large Midwestern university; Sample B included 35 (12 males, 21 female) undergraduates at a large university in the Western United States; Sample C included 45 adults (22 male, 23 female) recruited through Mechanical Turk (MTurk; see Buhrmester, Kwang, & Gosling, 2011). Samples A and B participated in return for course credit and Sample C participated in return for monetary compensation. Twenty-two participants from Sample A, seven from Sample B, and eight from Sample C were excluded from analyses because their narratives did not fit the definition of awe or were not about a specific awe experience (i.e., they described what experiences of awe are generally like or wrote that they did not know what awe was), leaving a sample of 165 participants.

**Procedure.** Participants across all three samples were asked to take a couple of minutes to remember “an experience in which they felt intense awe.” They were then asked to describe the experience in detail as if they were telling a completely nonemotional person who has never experienced awe before. They wrote down the experience of awe and answered follow-up questions regarding their experience as well as their emotions and appraisals of the experience (in Sample A, see Study 2a for more details about these variables). Participants in Sample A completed their narratives on paper as part of a larger study assessing the appraisals of awe and related emotions, along with their antecedent events and social context. Participants in Samples B and C completed the same online questionnaire. In addition to describing an experience of awe, they also completed background measures assessing their demographics and personality.

The situational features of the awe narratives were coded by rotating teams of two coders for the presence of an element of threat by indicating yes or no to the question, “Was [the awe experience] in response to something threatening or dangerous? (e.g., a bombing, a lightning storm, a frightening piece of art).” We used the prevalence-adjusted and bias-adjusted Kappa (PABAK; Byrt, Bishop, & Carlin, 1993) to calculate agreement between each team of coders on their overlapping narratives given the disproportionate prevalence of threat-based awe and positive awe experiences.



riences. Agreement between teams of coders ranged from .63 to 1 ( $M = .85$ ).<sup>1</sup> Any disagreements between coders were settled by a third coder. Coders also identified whether the awe experience was elicited by: nature, another person, a religious experience, something supernatural, art, music, or architecture using a nonmutually exclusive coding scheme. All codes were dichotomous (presence or absence of feature). These elicitors were based on prior research and theory (e.g., Keltner & Haidt, 2003; Shiota et al., 2007).

## Results and Discussion

Across all three samples, 35 participants (21.2%) described an experience of awe that involved threat appraisals (Sample A: 24%, Sample B: 18.5%, Sample C: 15.8%). For example, one participant described feeling “completely awestruck by the September 11th incident . . . the horrified, shocked, and dumbfounded sort of awe.” Another recalled being in class and watching the Challenger Space Shuttle explode, writing that, “I was in complete and utter awe. In awe at life and its many joys and sorrows.” Personal danger also played a role, with one participant describing crawling out to the edge of a ledge at the peak of a mountain with a large lake 2,000 feet below.

We next examined whether threat-based experiences of awe were elicited in similar proportions as positive awe experiences across the different categories of awe elicitors (i.e., nature, another person, a religious experience, something supernatural, art, music, or architecture). In line with prior research (Shiota et al., 2007), another person (46%) and nature (32%) were the most frequent elicitors of awe. Music, art, and architecture elicited threat-based awe disproportionately less frequently than positive awe ( $\chi^2$ s = 3.07–5.11,  $ps = .03$ –.07;  $\phi = .14$ –.18). Nature marginally significantly elicited threat-based awe disproportionately *more* frequently than positive awe ( $\chi^2 = 2.93$ ,  $p < .09$ ;  $\phi = .13$ ). For the rest of the elicitors, threat-based and positive awe did not differ significantly ( $\chi^2$ s < 2.20,  $ps > .13$ ;  $\phi$ s = .03–.12). However, given the relatively small number of threat-based awe experiences, some cells had a very small number of observations (<5) weakening our ability to draw conclusions from these analyses.

In sum, the results from Study 1 reveal that in our samples more than 20% of awe experiences, or one of every five, were characterized by perceptions of threat and danger. These threat-based awe experiences occurred across most domains of awe, including nature, social events, and religion.

## Studies 2a and 2b: Appraisal Patterns of Threat-Based and Positive Awe

In our next two studies, we drew upon the appraisal literature to test hypotheses about expected differences in construals of control and certainty associated with threat-based and positively valenced awe (Lerner & Keltner, 2001; Smith & Ellsworth, 1985, 1987). Guided by methods outlined in the appraisal literature (e.g., Fontaine, Scherer, Roesch, & Ellsworth, 2007; Smith & Ellsworth, 1985), in Study 2a, participants described a memorable awe experience and then reported on their appraisals and emotions associated with the experience. To complement this method, in Study 2b we employed an experimental design, randomly assigning participants to describe either a threat-based awe experience or a positive awe experience, after which they reported on their appraisals and emotions.

To test our hypotheses about construals of control and certainty, we focused on four classic appraisal dimensions set forth by Smith and Ellsworth (1985, 1987), which have been previously linked to threat and fear: (a) self-responsibility/control (the extent to which individuals feels they are responsible for, and have control over, the situation), (b) other-responsibility/control (the extent to which individuals feel that a person other than themselves is responsible for, and has control over, the situation), (c) situational control (the extent to which the situation is beyond anyone’s control), and (d) certainty about the outcome of the situation. In keeping with our first hypothesis, we predicted that threat-based awe experiences would be defined by lower appraisals of personal control/responsibility and certainty as well as greater situational control than positive awe experiences. We were less clear as to whether threat-based awe would be appraised as higher on other-responsibility/control because in many cases awe is not attributed to a specific person (e.g., nature, supernatural, etc.).

With respect to differences in subjective experience, in line with our second hypothesis, we predicted fear and anxiety would be more intense during threat-based awe experiences compared with more positive experiences of awe, which would be defined by more intense experiences of positive emotions.

## Study 2a

### Method

**Participants and procedure.** Participants came from two samples: Sample 1 was 228 adults from the United States who participated online using MTurk in exchange for monetary compensation. Of these participants, two participants were removed for failing two or more of the attention checks embedded within the survey, 1 participant did not rate whether their experience was threatening, and 26 participants were removed because they did not write about an awe experience, said they could not think of anything, or their experience did not fit our conceptualization of awe. The final sample was 199 (102 male, 97 female) participants. Mean age for these participants was 36.39 ( $SD = 11.98$ , range = 19–76). Seventy-eight percent were European/European American, 6.5% were Latino/Latino American, 6.5% were Asian/Asian American, 6% were African/African American, and 3% were of other ethnicities. Sample 2 was the 100 participants in Sample A from Study 1 who described a valid awe experience. The results of this study did not differ by sample so we combined them into a single sample ( $N = 299$ ) for data analysis.

After describing their awe experience, participants in both samples reported on appraisals that they made during the experience (Smith & Ellsworth, 1985) as well as their emotions during the experience. Participants in Sample 1 rated the experiences themselves for whether it was threatening or not using the same definition provided to coders in Sample 2 (see Study 1 for more details).

**Measures.** All appraisal items were measured on 7-point scales in the first sample and 10-point scales in the second sample. Emotions were measured on 7-point scales in the first sample and

<sup>1</sup> The PABAKs for each rotating team were: .63, .66, .86, .92, 1, 1. Overall agreement was 92%.

9-point scales in the second sample. For the purposes of combining these samples all responses were converted to a 7-point scale.<sup>2</sup>

**Appraisal dimensions.** All appraisals were measured from *Not at all* to *Completely* and taken directly from Smith and Ellsworth's (1985) study of emotion-related appraisal. In Smith and Ellsworth's research, control and responsibility loaded onto one factor; therefore the item that assessed each was combined. We followed this convention in our study. The wording for each appraisal was as follows.

**Personal responsibility/control.** When you were feeling awe, how responsible did you feel for having brought about the events that were making you feel awe in this situation? When you were feeling awe, to what extent did you feel that you had the ability to influence what was happening in this situation? ( $M = 3.39$ ;  $SD = 1.73$ ;  $\alpha = .56$ ).

**Other responsibility/control.** When you were feeling awe, how responsible did you think someone or something other than yourself was for having brought about the events that were making you feel awe in this situation? When you were feeling awe, to what extent did you feel that someone other than yourself was controlling what was happening in this situation? ( $M = 4.62$ ;  $SD = 1.71$ ;  $\alpha = .52$ ).<sup>3</sup>

**Situational control.** When you were feeling awe, to what extent did you feel that circumstances beyond anyone's control were controlling what was happening in this situation? ( $M = 4.39$ ;  $SD = 2.09$ ).

**Certainty.** When you were feeling awe, how uncertain were you about what was happening in this situation (reverse scored)? When you were feeling awe, how well did you understand what was happening around you in this situation? ( $M = 5.30$ ;  $SD = 1.45$ ;  $\alpha = .61$ ).<sup>4</sup>

**Emotions.** Participants reported on their feelings of awe ( $M = 6.49$ ;  $SD = 1.02$ ) and fear ( $M = 2.21$ ;  $SD = 1.73$ ), as well as variety of other emotions ranging from *No emotion* to *Most in life*. We created composites for negative affect (anger, contempt, disgust, embarrassment, sadness, and shame;  $M = 1.47$ ;  $SD = .88$ ;  $\alpha = .83$ ) and positive affect (happiness, amusement;  $M = 4.73$ ;  $SD = 1.62$ ;  $\alpha = .53$ ).

**Elicitors.** Participants in Sample 1 reported on characteristics of the elicitor of their awe, selecting from a nonmutually exclusive list including: nature, natural disaster, another person, a religious or spiritual experience, myself (something I did), an idea or way of thinking, art, music or architecture, and other.

## Results

First, there were no differences in the kinds of elicitors that evoked threat-based or positive awe in Sample 1 ( $\chi^2_s \leq 2.52$ ,  $ps \geq .11$   $\phi_s \leq .15$ ).

None of the analyses testing our hypotheses concerning appraisals and feelings of fear differed by sample ( $F_s \leq 1.67$ ,  $ps \geq .20$ ), thus in the following analyses we treat them as one sample. In total, there were 40 threat-based awe experiences and 259 positive awe experiences (13.3% threat-based awe experiences). All analyses compare these two groups using independent-samples  $t$  tests. Results are shown in Table 1.

In line with our hypotheses about appraisals (Hypothesis 1), participants who described threat-based awe experiences felt less personal responsibility/control, greater situational control, and less

certainty compared with those who described positive awe experiences. There were no differences in how much they believed another person was responsible for or in control of the situation.

In terms of subjective experience (Hypothesis 2), regardless of whether they were coded as writing about a threat-based experience of awe (i.e., in response to something threatening or dangerous) or a positive experience of awe, participants reported feeling awe more so than any other emotion. Moreover, those whose awe experiences were coded as threat-based reported equivalent levels of awe to those who described positive awe experiences (see Table 1 for all emotions). In line with our second hypothesis, participants who wrote about a threat-based awe experience reported feeling significantly more fear, even when controlling for other negative emotions,  $F(1, 296) = 36.40$ ,  $p < .001$ ,  $\eta^2 = .11$ , and significantly less positive affect than those who wrote about positive awe experiences.

## Study 2b

To replicate the findings from Study 2a using an experimental paradigm, which allowed for more equal cell sizes, in Study 2b we gave participants a definition of awe that was threat-based or entirely positive before asking them to describe an experience. After describing their awe experience, participants rated the same appraisal dimensions from Study 2a as well as two appraisals specific to awe—vastness and need for accommodation—and reported on their accompanying emotions. We again examined the elicitors of the awe experiences to further test whether variants of awe differed meaningfully in the elicitors that gave rise to them. In addition, we improved our measurement of awe and fear by assessing these states using multiple items rather than a single item (e.g., Shiota et al., 2006; Stellar et al., 2016).

## Method

**Participants.** Four hundred eight adults (226 female, 181 male, 1 declined to state) from the United States participated online via MTurk in exchange for monetary compensation. Twenty-four participants were excluded from final analyses: seven for failing to correctly complete two or more of the three attention checks, and 17 for failing to complete the manipulation correctly (i.e., wrote something unrelated to experiencing awe). Mean age was 35.25 ( $SD = 11.66$ , range = 18–83). Seventy-nine percent

<sup>2</sup>To convert the 10- and 9-point scales to be 7 points, we used the following formulas, which preserve the minimum and maximum points: for converting 10-point scale: new value = (6/9) \* original value + (3/9); for converting 9-point scale: new value = (6/8) \* original value + (2/8). We also conducted all analyses using z-scored values and found the same pattern of results as when we convert our 9- and 10-point scales to 7-point scales.

<sup>3</sup>Given the low reliabilities of these items, we also conducted our analyses treating each item as an individual outcome rather than as a composite. We found in both Studies 2a and 2b that our pattern of results was the same as using the composites.

<sup>4</sup>We also measured the appraisal dimensions of anticipated effort, attention deployment, and valence in Studies 2a and 2b, but chose not to include them in the results of this article for the sake of space. The findings were largely consistent across the two studies, with threat-based awe experiences being characterized as less pleasant, less likely to be attended to, and requiring slightly more effort.

Table 1  
Mean Differences in Appraisal Patterns and Emotions as a Function of Type of Recalled Awe Experience in Studies 2a and 2b

Variable	Study 2a, <i>M</i>		<i>t</i>	<i>d</i>	Study 2b, <i>M</i>		<i>t</i>	<i>d</i>
	Threat-based awe ( <i>N</i> = 41)	Positive awe ( <i>N</i> = 258)			Threat-based awe ( <i>N</i> = 188)	Positive awe ( <i>N</i> = 196)		
<b>Appraisals</b>								
Personal control	2.23 (1.43)	3.57 (1.70)	4.72***	.55	2.51 (1.70)	3.24 (1.76)	4.19***	.42
Other control	4.86 (1.59)	4.58 (1.73)	.96	.11	3.80 (1.92)	4.07 (1.83)	1.40	.14
Situational control	5.20 (2.16)	4.26 (2.05)	2.68**	.31	5.29 (1.97)	4.49 (2.06)	3.87***	.40
Certainty	4.42 (1.74)	5.44 (1.36)	3.55***	.41	4.80 (1.50)	5.27 (1.47)	3.10*	.32
<b>Emotions</b>								
Awe	6.41 (.88)	6.50 (1.05)	.51	.06	5.93 (1.22)	6.31 (.91)	3.46***	.35
Fear	4.23 (2.08)	1.90 (1.45)	6.82***	.79	3.61 (2.13)	2.05 (1.48)	8.32***	.85
Positive affect	3.03 (1.75)	4.99 (1.44)	6.73***	.78	4.12 (1.85)	5.43 (1.28)	8.05***	.82
Negative affect	2.32 (1.48)	1.34 (.68)	4.11***	.48	2.18 (1.70)	1.40 (.89)	5.60***	.57

\*  $p \leq .05$ . \*\*  $p \leq .01$ . \*\*\*  $p \leq .001$ .

were European/European American, 7.3% were Latino/Latino American, 7.3% were Asian/Asian American, 4.9% were African/African American, and 1% was of other ethnicities.<sup>5</sup>

**Procedure.** Participants were asked to recall and describe an experience of awe. They were presented with one of two possible definitions, both of which were adapted from the Merriam-Webster dictionary definition of awe as “a strong feeling of fear or reverence, and also wonder.” Threat-based awe was defined as “a strong feeling of fear and also wonder.” Positive awe was defined as “a strong feeling of reverence and also wonder.” Participants were then given examples of awe generated from our findings in Study 1. Participants in the threat-based awe condition ( $n = 188$ ) were given the following instructions:

Often we feel awe in response to natural disasters such as earthquakes, hurricanes, or volcanic eruptions. We can also feel awe in response to people who cause large-scale devastation, such as Hitler and the vast horrors of the Second World War. Other times, we might feel awe towards an idea that is amazing and scary at the same time—such as the mysteries of space.

Participants in the positive awe condition ( $n = 196$ ) were given the following instructions:

Often we feel awe in response to vast, beautiful landscapes and natural wonders such as tall mountains, expansive vistas, or large waterfalls. We can also feel awe in response to people who cause large-scale change such as Nelson Mandela and his role in ending apartheid in South Africa. Other times, we might feel awe towards an idea that is amazing and wondrous—such as the mysteries of space.

To visually amplify feelings of threat-based or positive awe, these definitions and examples were accompanied by a photo of a similar landscape that included either a supercell (threat-based awe condition) or the Aurora Borealis (positive awe condition; see Figure 1 for photos). All participants were then asked to “please take a moment to recall a time when you felt intense awe like the examples described above or depicted in the photo below.” They then reported on their emotions during the experience, appraisals of the situation, and some follow-up questions about the experience. The relevant measures are reported below.

#### Measures.

**Appraisals.** Participants completed the same appraisals described in Study 2a: personal responsibility/control ( $M = 2.88$ ;

$SD = 1.76$ ), other responsibility/control ( $M = 3.93$ ;  $SD = 1.88$ ), situational control ( $M = 4.89$ ;  $SD = 2.05$ ), and certainty ( $M = 5.04$ ;  $SD = 1.50$ ) using 7-point Likert scales (1 = *Not at all* to 7 = *Completely*). In this study,  $\alpha$ s ranged from .53 to .70. Participants also reported on their appraisals of *vastness* (“I felt a sense of vastness”;  $M = 5.74$ ;  $SD = 1.43$ ) and *need for accommodation* (“My view of the world was challenged”;  $M = 5.01$ ;  $SD = 1.81$ ).

**Emotions.** Participants reported on their feelings of awe, wonder, amazement, fear, anxiety, nervousness, and reverence as well as amusement, anger, appreciation, contentment, gratitude, happiness, joy, interest, sadness, and warmth/tenderness on 7-point Likert scales (1 = *Not at all* to 7 = *Completely*). Awe, wonder, and amazement were averaged together to create a composite ( $M = 6.13$ ;  $SD = 1.09$ ;  $\alpha = .76$ ), as were fear, anxiety, and nervousness ( $M = 2.81$ ;  $SD = 1.99$ ;  $\alpha = .94$ ). In addition, we computed a positive affect composite (amusement, appreciation, contentment, gratitude, happiness, joy, warmth/tenderness;  $M = 4.79$ ;  $SD = 1.72$ ;  $\alpha = .93$ ) and a negative affect composite (anger and sadness;  $M = 1.78$ ;  $SD = 1.40$ ;  $\alpha = .82$ ).

**Elicitors.** At the end of the study, participants reported on characteristics of the elicitor of their awe, selecting from a non-mutually exclusive list including: nature, natural disaster, another person, a religious or spiritual experience, myself (something I did), an idea or way of thinking, art, music or architecture, and other. They also reported whom they were with during the experience (stranger, family or friend, alone; *mark all that apply*).

**Manipulation check.** To ensure the effectiveness of our manipulation, we had participants answer the question “To what extent was this a threatening experience?” using a 7-point Likert Scale (1 = *Not at all* to 7 = *Completely*;  $M = 2.80$ ;  $SD = 2.21$ ).

## Results

Participants in the threat-based awe condition reported that their experiences were significantly more threatening relative to those in the positive awe condition, ( $M$ s = 3.68 & 1.96),  $t(316.06) = 8.17$ ,  $p < .001$ ,  $d = .84$ , providing evidence for the effectiveness of our

<sup>5</sup> Participants were collected at two separate time points, but there was only one interaction between time point of data collection and threat manipulation (awe:  $F[1, 380] = 3.85$ ,  $p = .05$ ) of our seven primary hypotheses about appraisals or emotions ( $F$ s  $\leq 2.93$ ,  $p$ s  $\geq .09$ ).





Figure 1. Photos of supercell (left panel) and Aurora Borealis (right panel) accompanying threat-based and positive awe definitions in Study 2b. See the online article for the color version of this figure.

manipulation.<sup>6</sup> In terms of awe's two central appraisals, threat-based awe experiences were appraised as being less vast relative to positive awe experiences ( $M_s = 5.90$  &  $5.57$ ),  $t(365.46) = 2.26$ ,  $p = .02$ ,  $d = .23$ , but did not differ significantly in the extent to which the experiences required a need for accommodation (threat-based awe  $M = 4.98$  & positive awe  $M = 5.03$ ),  $t(378) = .28$ ,  $p = .78$ ,  $d = .03$ .

In line with our first hypothesis concerning appraisal dimensions, participants in the threat-based awe condition reported less personal control/responsibility, greater situational control, and less certainty than participants in the positive awe condition (see Table 1), replicating findings from Study 2a. Again, there were no significant differences in appraisals of other control/responsibility.

Consistent with our second hypothesis and Study 2a, and shown in Table 1, participants who were given a more threat-based definition of awe reported experiencing significantly more fear, anxiety, and nervousness than those given the positive definition, even when controlling for general negative affect,  $F(1, 381) = 38.04$ ,  $p < .001$ ,  $\eta^2 = .09$ . They also experienced significantly less positive affect. In contrast to Study 2a, participants in the threat-based awe condition felt significantly less awe relative to those in the positive awe condition. However, the relatively high means suggest that both conditions were able to elicit strong feelings of awe. In addition, as in Study 2a, awe was the most intensely felt emotion in both conditions.

In terms of elicitors, nature and another person were again the most frequent elicitors of awe. Consistent with our findings in Study 2a, threat-based and positive awe were equally likely to arise in response to nature (nature and natural disaster were combined into one category), another person, the self, art, music or architecture, a religious experience, or an idea ( $\chi^2_s \leq .54$ ,  $ps \geq .46$ ,  $\phi_s \leq .04$ ). They also did not differ in terms of whether participants were alone, with strangers, or with friends and family during the experience ( $\chi^2_s \leq 2.04$ ,  $ps \geq .16$ ,  $\phi_s \leq .08$ ), suggesting it is not just that awe experiences are more threatening when people experience them alone.

## Discussion

In the past, researchers have suggested that awe does not fit classic appraisal structures of emotion (Smith, Tong, & Ellsworth, 2014). Our findings in Studies 2a and 2b, in contrast, reveal that in parsing apart two key variants of awe—awe characterized by perceptions of threat versus more positively valenced awe—one finds systematic and specific appraisal patterns. Threat-based awe experiences were characterized by lower appraisals of personal

responsibility and control over the situation and greater situational control and uncertainty. Feelings of awe were the dominant emotion for threat-based and positive awe, although the former was associated with greater reports of fear and anxiety. Threat-based and positive awe did not differ in their elicitors in two of the three studies assessing elicitors, suggesting that their distinctions cannot be reliably accounted for by differences in eliciting stimuli.

## Study 3: Physiological Correlates of Threat-Based and Positive Awe

Given the strong connections between threat, fear, and sympathetic autonomic nervous system activation (e.g., Ax, 1953; Blascovich & Mendes, 2010; Bosch et al., 2009), in Study 3 we tested whether threat-based and positive awe would be associated with different peripheral physiological responses. In line with our third hypothesis, we predicted that threat-based awe experiences would be characterized by greater sympathetic autonomic nervous system activation. To this end, we tested whether greater threat responses during an awe experience would be associated with increased heart rate (HR) as well as skin conductance (SCL), which represents a pure measure of sympathetic activation. These measures have been associated with negative states such as stress, anxiety, and fear (Ax, 1953; Dawson et al., 2000; Levenson, 2003; Stemmler et al., 2001). In contrast, we predicted that more positively valenced responses during an experience of awe would be associated with greater parasympathetic activation, which has been associated with social connection, calm states, and tonic positive affect (e.g., Kok et al., 2013; Krygier et al., 2013; Oveis et al., 2009). We measured parasympathetic activation using a noninvasive index called Respiratory Sinus Arrhythmia (RSA), which is defined as the variability in time between successive heartbeats as a function of respiration (Berntson, Cacioppo, & Quigley, 1993).

To test our predictions regarding the peripheral physiological correlates of awe, in Study 3 we presented participants with a standardized elicitor of awe that included potentially threatening elements—ominous music and a focus on the insignificant size of the Earth in the vast universe. We chose to present all participants with the same awe-eliciting stimuli to isolate the effect of appraisals and ensure that any observed differences during the awe induction were not due to differences in the awe-eliciting stimuli. Although we expected high levels of awe for all participants, we

<sup>6</sup> Equality of variance assumptions were violated in some cases for both Studies 2a and 2b, when that was the case the degrees of freedom and test statistics do not assume equal variances.

expected threat appraisals to predict different physiological reactions to the same video.

## Method

**Participants.** One hundred seven (33 male, 74 female) first-year undergraduates from a large public university in the western United States participated in this study for payment. The sample ranged from 18 to 22 years old ( $M = 18.41$ ,  $SD = .66$ ) and was 5% African American, 20% European American, 67% Asian American, 14% Latin American, and 1% other ethnicities. This study was part of a larger research project exploring awe during the first year of college.

**Procedure.** Participants came into the lab individually and were seated in front of a computer and a large 44-inch screen TV. The experimenter applied sensors to participants' skin in a Lead II configuration to gather Electrocardiogram (ECG) signals, a belt was placed on the torso to assess respiration frequency, and two additional sensors were placed on the palmar surface of the left hand to measure skin conductance. We used the MP 150 data acquisition and analysis systems (Biopac Systems, Inc.) to collect physiological signals.

Participants were given 15 to 20 min to complete self-report measures of their demographic background, personality, and attitudes using a secure online survey program. This time also allowed participants to habituate to wearing the physiological sensors and reduced any potential effects of their emotional state when they arrived at the lab. Participants then watched a 2-min neutral video depicting an individual building a fence, which is known to elicit minimal emotion (Stellar, Manzo, Kraus, & Keltner, 2012). This video was watched on a computer and served as our control condition, allowing us to account for effects like attentional deployment or an orienting response that would be standardized across videos. After watching the neutral video and reporting on their emotions during that video, participants watched another 2-min video to induce awe. To enhance the experience of awe, participants watched the awe video on the 44-inch TV screen while the lights were dimmed. They wore headphones to minimize ambient noise.

The awe video depicted the earth, space, and other stars in the solar system set to ominous music. Results from a pilot study ( $N = 54$ ) revealed that this video clip elicited similar levels of awe and wonder ( $\alpha = .57$ ;  $M = 5.67$ ;  $SD = 1.37$ ) to those elicited by a video clip depicting sweeping views of the Earth's landscape (e.g., mountains, plains, canyons, waterfalls) from the BBC's *Planet Earth* series ( $M = 5.50$ ;  $SD = 1.12$ ;  $t < 1$ ), which has been used in prior research (see Piff et al., 2015; Valdesolo & Graham, 2014). The solar system clip, however, elicited higher levels of fear and anxiety ( $\alpha = .76$ ;  $M = 2.54$ ;  $SD = 1.57$ ; range = 1–5.5 of 7) than the *Planet Earth* clip ( $M = 1.43$ ;  $SD = .66$ ; range = 1–3 of 7),  $t(34.95) = 3.92$ ,  $p < .01$ .

After watching the ambiguously threatening awe video, participants reported the extent to which they were feeling: awe, wonder, amazement, fear, anxiety, relaxation, amusement, happiness, joy, appreciation, warmth, as well as filler emotions such as disgust, contempt, embarrassment, anger, annoyance, pride, compassion, and sadness measured on a Likert scale from 1 (*not at all*) to 10 (*as much as I have ever felt*). After reporting on their emotions, participants continued on to complete a puzzle activity and watch

two more videos as part of a separate experiment. At the end of the session participants were debriefed and released.

**Physiological measures.** Three people were removed from all analyses for skipping through the videos and an additional six were removed from analyses of physiological measures because the data were not recorded or saved properly, leaving a total sample of 98 participants for our physiological analyses (minus additional cuts described below) and 104 for any analyses that just include self-report measures of emotions.

**Heart rate (HR).** ECG recordings were sampled at 1 kHz and were gathered over the 2 min of the two video presentations. ECG signals were converted to beats per minute to obtain HR and aggregated to form mean HR scores for the entire 2 min (Neutral:  $M = 78.75$ ;  $SD = 9.39$ ; Awe:  $M = 76.60$ ;  $SD = 9.67$ ). Artifacts in the signal (e.g., attributable to coughing, sneezing, or movement) were corrected manually to less than 5% of all data files. We set a threshold for artifacts such that if participants required imputing more than 3 R-spikes during any given video presentation, then they were not included in the analysis. One additional participant had a HR score that was an outlier (more than three standard deviations from the mean) and was not included only for analyses of HR.

**Respiration rate (RR).** Respiration signals were filtered with a low-pass filter of 1 Hz and high-pass filter of .05 Hz. Respiration rate was then assessed by transforming the data through the Biopac data acquisition program to breaths per minute. We aggregated respiration rate to create averages over the 2-min video inductions (Neutral:  $M = 18.24$ ;  $SD = 3.18$ ; Awe:  $M = 17.69$ ;  $SD = 3.46$ ).

**Respiratory sinus arrhythmia (RSA).** RSA was calculated using the analysis package in Biopac, which produces measures of RSA by scanning the ECG channel for the minimum and maximum RR intervals during each respiration cycle. The average data were aggregated to form a mean over two minutes of the video presentation (Neutral:  $M = 84.77$ ;  $SD = 37.13$ ; Awe:  $M = 85.87$ ;  $SD = 41.31$ ). Four additional participants had artifacts in their RSA output, making the values impossibly high and two participants had RSA scores that were outliers (more than three standard deviations from the mean). These six participants were not included in the RSA-related analyses. We log-transformed RSA because the distribution of the data was non-normal, a practice that is commonly employed when analyzing RSA (e.g., Stellar, Cohen, et al., 2015; Watkins, Grossman, Krishnan, & Sherwood, 1998).

**Skin conductance (SCL).** We averaged continuous measures of unfiltered SCL signals over the entire 2 min of each video (Neutral:  $M = 7.87$ ;  $SD = 5.71$ ; Awe:  $M = 8.39$ ;  $SD = 6.32$ ). One participant had a SCL score that was an outlier (more than three standard deviations from the mean) and seven sessions recorded values of zero for SCL. These data are not included only for the analyses of SCL. We log-transformed SCL since the distribution of the data was non-normal.

## Results and Discussion

Our composite of awe, wonder, and amazement ( $\alpha = .93$ ) revealed that the awe video successfully elicited awe ( $M = 6.71$ ,  $SD = 2.18$ ). In addition, our composite measure of fear and anxiety ( $\alpha = .80$ ) demonstrated that there were variations in perceived threat (range = 1 to 9 of 10;  $M = 2.25$ ,  $SD = 1.77$ ), with 58% participants experiencing some fear and anxiety. There were

also variations in positive affect ( $\alpha = .82$ ), measured as an aggregate of relaxed, appreciation, warmth, amused, and happy (range = 1 to 8.80 of 10;  $M = 4.14$ ,  $SD = 1.92$ ). Awe was the dominant emotional response; our composite of fear and anxiety was the primary negative state reported. We also tested for any main effects of our physiological induction. There were no changes in SCL or RSA from the neutral to the awe video ( $F_s \leq .91$ ,  $p_s \geq .34$ ,  $\eta^2_s \leq .01$ ). However, there was a mean level decrease in HR during the awe induction,  $F(1, 96) = 42.58$ ,  $p < .001$ ,  $\eta^2 = .31$ . None of these physiological measures were predicted by our composite of awe ( $\beta_s \leq 1.08$ ,  $t_s \leq 1.56$ ,  $p_s \geq .12$ ,  $f^2_s \leq .03$ ).

**Threat and sympathetic activation.** To test our third hypothesis concerning the physiological correlates of threat-based and positive awe, we conducted three regression analyses predicting each physiological measure during the awe video from participants' reported threat, controlling for the corresponding physiological measure during the neutral video. Reports of threat positively predicted HR ( $\beta = .23$ ),  $t(94) = 2.26$ ,  $p = .03$ ;  $f^2 = .13$ , and SCL ( $\beta = .10$ ),  $t(86) = 2.03$ ,  $p = .05$ ;  $f^2 = .05$ , during the awe clip, controlling for baseline. In our regression with RSA, we also controlled for changes in respiration (see Grossman & Kollai, 1993). Threat did not predict RSA during the awe induction controlling for RSA during the neutral video ( $\beta = -.03$ ),  $t(88) = -.72$ ,  $p = .48$ ,  $f^2 = .005$ .

**Positive affect and parasympathetic activation.** We conducted the same three regression analyses described above, but used the positive emotion composite in place of threat. Positive emotions during the awe induction positively predicted RSA during the same awe induction, controlling for baseline and respiration ( $\beta = .12$ ),  $t(88) = 2.56$ ,  $p = .01$ ;  $f^2 = .08$ . Positive affect during the awe induction did not predict HR nor SCL responses ( $\beta_s \leq -.06$ ,  $t_s \leq 1.07$ ,  $p_s \geq .29$ ;  $f^2_s \leq .01$ ), controlling for baseline.

In sum, participants' reports of threat-related emotion (i.e., fear and anxiety) during an experience of awe predicted greater HR and SCL, though our SCL findings should be interpreted with caution given the small effect size. In contrast, participants' reports of positive emotion (e.g., gratitude, warmth/tenderness) during the awe video predicted greater RSA. These physiological outcomes corroborate our self-report measures of threat from our past studies. Although a great deal of work has demonstrated that increased sympathetic activation is associated with threat (e.g., Blascovich & Mendes, 2010), these findings are among the first to demonstrate variability in threat-related physiology during experiences of a seemingly positive state—awe.

Importantly, this work isolates the effect of appraisals of threat, while keeping all other factors (i.e., the stimuli itself) constant. Past work has found relatively little evidence for consistent physiological changes as a result of feeling awe (Shiota, Neufeld, Yeung, Moser, & Perea, 2011). Different reactions to the same stimuli might help explain this lack of association—the effects of awe may depend on whether or not awe is flavored by appraisals of threat. These data offer preliminary evidence for the influence of threat on physiological changes during awe, and should be complemented by experimental work (i.e., studies that manipulate threat-based vs. positive awe). The present findings not only contribute to the growing literatures on emotion and autonomic

activation, but they also suggest that variants of awe may be associated with different physiological responses.

#### Study 4: Variants of Awe and Well-Being in Daily Life

In Study 4, we turned to our final set of hypotheses. We predicted that threat-based awe would not yield the same benefits for personal well-being as more positive variants of awe, and this would be attributable in part to its accompanying feelings of powerlessness. Although we expected both variants of awe to elicit a smaller sense of self (Piff et al., 2015; Shiota et al., 2007), we predicted that during threat-based awe this small self would feel powerlessness.

We tested our hypotheses in a 14-day daily experience study that focused on daily experiences of awe, self-size, powerlessness, and well-being. Daily experience methods capture more naturalistic occurrences of awe, an important step beyond laboratory inductions of awe, which tend to rely on rare and unusual stimuli. Daily experience methods are less subject to retrospective biases that might plague studies that rely on recollections of awe experiences from the more distant past. Additionally, because we gathered measures of well-being each day we were able to look at how awe is associated with fluctuations in well-being. Finally, this approach allowed us to assess more quotidian experiences of awe that occur in daily life and capture multiple instances of awe across a longer period of time.

We expected that participants would experience greater well-being on days when they experienced positive awe relative to days without awe experiences but that this would not be the case on days in which they experienced threat-based awe. In line with our final hypothesis, we expected that both types of awe experiences would be characterized by feelings of smallness, but that people would feel more powerless during threat-based awe experiences.

#### Method

**Participants and procedure.** The sample for this study was 106 of the 107 freshmen college students from Study 3. As part of a larger multiphase study, participants were given a link to complete an online survey each night for 14 consecutive nights. They received email reminders that included the link to the online survey each night between 8p and 10p. Data from one participant were removed for failing to comply with instructions. The remaining 105 participants completed 1,349 diaries, an average of 12.85 days per person. Seventy percent of the participants completed 14 or more diaries (some participants completed extra diaries, up to 18 possible days). Relevant measures from the diaries are described below.

##### Daily measures.

**Awe narratives.** Each night participants were asked to describe that day's most awe-inducing experience. In doing so, participants described whom they were with, where they were, what they saw, and how they felt. Participants were forced to report on the experience that gave them the most awe, regardless of whether they actually felt awe that day, to maximize compli-



ance.<sup>7</sup> As a result, many events in the awe category did not meet the definition of awe or the participants reported they had not had an awe-inducing experience. To filter out experiences that were not awe-inducing, eight research assistants were trained to identify experiences that fit with theoretical work on the conceptualization of awe (Keltner & Haidt, 2003). Specifically, they were instructed that they should “conceptualize awe as the emotion that people feel in the presence of something vast that they can’t easily wrap their minds around.” To bolster this definition, the coders were given several examples of prototypical awe experiences and several examples of experiences that were not awe (e.g., feeling awful after failing a test). They also completed several practice narratives, comparing their responses to the other coders and the authors who trained them. As part of the training, all coders completed the narratives from the first day of the diary study. Coders then discussed any narratives where there was disagreement and settled on a code. After this, rotating teams of two coded each narrative according to whether or not it was consistent with our operationalization of awe, with disagreements settled by a third coder. Providing validation for this coding, days which were coded as having an awe-inducing event had higher levels of self-reported awe relative to days coded as not having an awe-inducing event ( $M_{awe\ days} = 4.69$ ,  $M_{no\ awe\ days} = 3.98$ ),  $F(1, 1277.34) = 53.70$ ,  $p < .001$ .

Each narrative determined to be a valid experience of awe was then coded for whether the experience involved appraisals of threat using the same criteria from Study 1 (i.e., whether it was elicited by something threatening or dangerous). Coders worked in rotating teams of two and largely had strong agreement (PABAK  $\kappa$  range = .5 to 1,  $M = .88$ ).<sup>8</sup> Disagreements were again settled by a third coder. As part of a larger coding scheme, for valid awe experiences coders also responded to the questions: “Does the person mention feeling small?” and “Does the person mention feeling powerless?”

**Emotions.** Each night participants reported how much they experienced awe, wonder, amazement, fear, and anxiety that day in addition to 10 other emotions (amusement, anger, annoyance, appreciation, compassion, moved, pride, sadness, relaxed, and warmth). They made these ratings on 10-point scales, ranging from 1 (*not at all*) to 10 (*as much as I have ever felt*). Awe, wonder, and amazement were aggregated ( $M_{grand} = 4.23$ ,  $SD = 2.04$ ; average within-day  $\alpha = .89$ ), as were fear and anxiety ( $M_{grand} = 3.98$ ,  $SD = 2.15$ ; average within-day  $\alpha = .89$ ).

**Well-being.** We used two items to measure well-being: daily reports of “happiness” and agreement with the item “Today, I felt that my life was . . . *terrible* to *terrific*” (Gable & Poore, 2008). Both items were measured on 10-point scales (happiness anchors = *Not at all* to *As much as I have ever felt*; life satisfaction anchors = *Terrible* to *Terrific*). The items were highly correlated (average within-day  $\alpha = .75$ ) and yielded converging results so we combined them into a single measure of daily well-being ( $M_{grand} = 6.07$ ,  $SD = 1.82$ ).

## Results and Discussion

**Data analysis strategy.** The data from the daily diaries consisted of up to 18 data points nested within each individual. Participants completed the diary during the same 2 weeks creating potential interdependence within days. Analyses of variance with

day as the between-subjects factor revealed that there was significant between-day variability for our variables of interest ( $F_s > 1.78$ ,  $ps < .03$ ). Thus, we conducted our analyses using a two-level cross-classified model with random effects for individual and day (SPSS Mixed Models, v. 22). Models were first tested with random slopes but none were significant (i.e.,  $p < .10$ ), thus all slopes were fixed. Intercepts were always allowed to vary. The degrees of freedom for our fixed effects were calculated using the Satterthwaite (1946) approximation which yields degrees of freedom for each predictor that are somewhere between the number of units at Level 1 and Level 2. Estimated means and standard errors are reported. Standardized mean differences ( $d$ ) were calculated using recommendations by Lai and Kwok (2014) for cross-classified models. The square root of the total variance (i.e., the sum of within-cluster or residual variance, person-level variance, and day-level variance) was treated as the denominator.

**Main analyses.** Overall, participants were coded as having 410 awe experiences during the diary period, and 51 (12.5%) of these awe experiences were coded as threatening. The elicitors of threat-based awe varied, and ranged from learning about some of the terrible things humans have done to each other in the past, such as learning “about the horrors of the Vietnam war in my history class today,” to art or music pieces that were upsetting yet awe-inspiring, such as “a cathedral made of bullets, human bones and human teeth (with a gold crown).” At the individual level, 36 participants had at least one threat-based awe experience ( $Max = 4$ ; 35 of the 36 also had at least one positive awe experience). Consistent with our prior findings, participants felt similar levels of awe, wonder, and amazement on days when they had threat-based ( $M = 4.71$ ,  $SE = .31$ ) and positive ( $M = 4.70$ ;  $SE = .20$ ) awe experiences ( $F < 1$ ; 95% CI of *mean difference* =  $[-.52, .53]$ ;  $d = .003$ ), but fear and anxiety were marginally significantly greater on threat-based awe days than on positive awe days ( $M_s = 4.22$  &  $3.72$ ,  $SE_s = .30$  &  $.21$ ),  $F(1, 361.2) = 3.72$ ,  $p = .054$  (95% CI of *mean difference* =  $[-.01, 1.00]$ ,  $d = .25$ ).

**Awe and well-being.** To test the hypothesis that threat-based awe would be associated with lower well-being relative to positive awe, we compared days with threat-based awe experiences both to days with positive awe experiences and to days without awe experiences (as determined by coders). These comparisons allowed us to determine whether any differences in well-being between days with threat-based awe and positive awe were due to participants feeling even worse than usual when they experienced threat-based awe, better than usual when they experienced positive awe, or both.

As depicted in Figure 2 (upper panel), there was a significant overall effect of awe type on well-being that day,  $F(2, 1269.6) = 8.55$ ,  $p < .001$ . Post hoc comparisons using Tukey’s least significant difference tests revealed that participants experienced signif-

<sup>7</sup> In prior diary studies, we found that compliance dropped drastically after participants realized they could skip an open-ended question by reporting that they did not have a relevant experience. Thus, although we did not expect people to experience awe every day, we felt requiring them to write their most awe-inducing experience would maximize the number of valid awe experiences reported by participants.

<sup>8</sup> The minimum PABAK (.5) was an outlier, with 30/34 of the teams exhibiting reliability between .78 and 1 (18 of them had perfect agreement) and three teams with .6 reliability. Overall agreement was 95%.



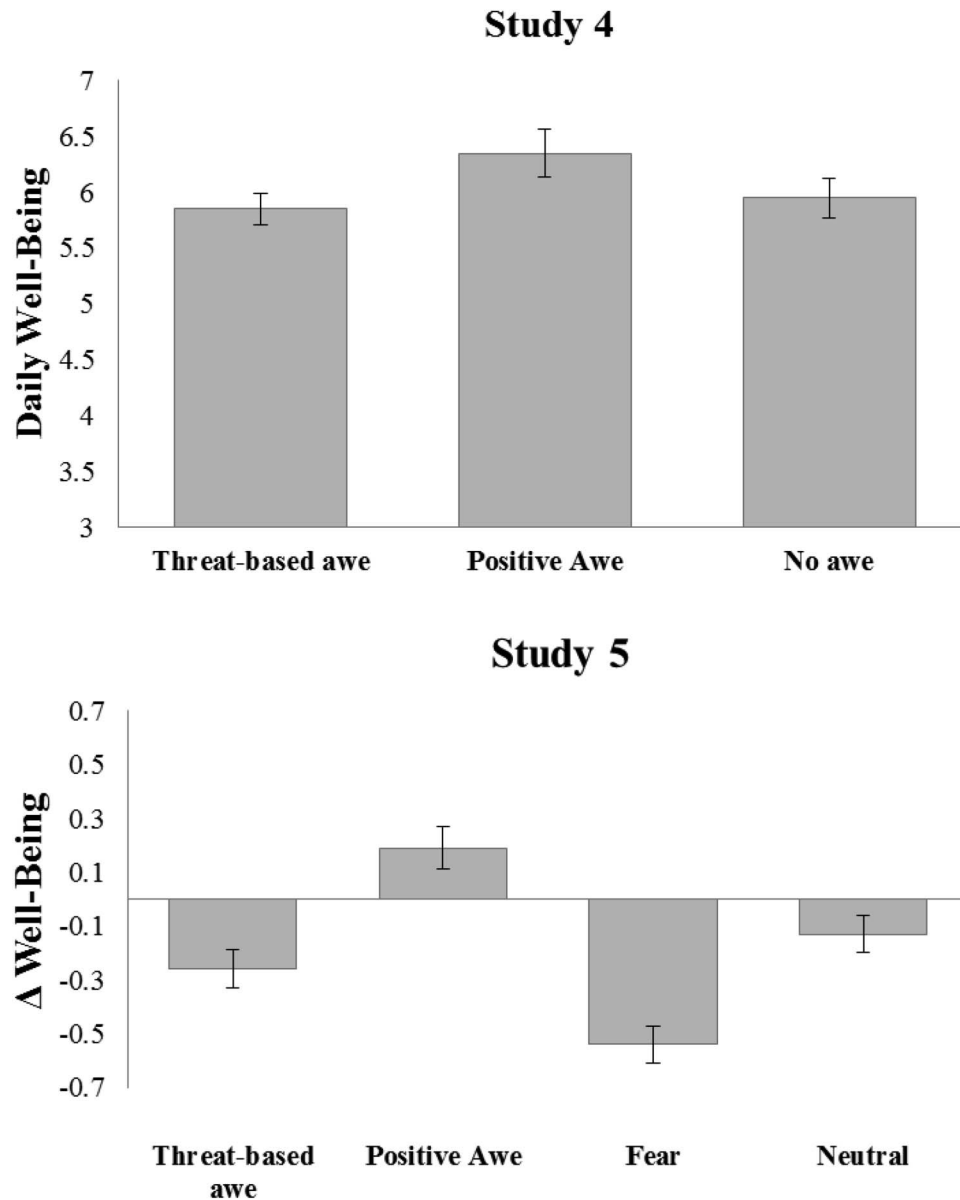


Figure 2. Effects of threat-based and positive awe on well-being in daily life (upper panel) and change in momentary well-being pre- to postexperimental manipulation (lower panel), relative to no-awe or fear. Error bars represent  $\pm 1 SE$ . Positive awe differs from threat-based awe and neutral/no awe. Threat-based awe and neutral/no awe do not differ significantly.

icantly lower well-being on days when they had threat-based awe experiences ( $M = 5.87$ ,  $SE = .25$ ) relative to days with positive awe experiences ( $M = 6.34$ ,  $SE = .16$ ; 95% CI for *mean difference* =  $[-.92, -.04]$ ,  $p = .03$ ;  $d = .26$ ). This difference was primarily driven by increased well-being on days when people experienced positive awe. That is, well-being on positive awe days was significantly higher than well-being on days without awe experiences ( $M = 5.95$ ,  $SE = .15$ ; 95% CI for *mean difference* =  $[-.20, .58]$ ,  $p < .001$ ;  $d = .18$ ), whereas there was no significant difference in well-being when comparing threat-based awe days to no-awe days (95% CI for *mean difference* =  $[-.34, .51]$ ,  $p = .69$ ;  $d = .04$ ).

Given that not all of our participants had a threat-based awe experience during the diary period and those who did may differ in some meaningful way from those who did not, we reran our well-being analyses limiting our sample only to those participants who experienced threat-based awe at least once. We found the same pattern of results using this restricted sample.

**Awe, self-size, and powerlessness.** Self-size and powerlessness were coded dichotomously, therefore we conducted preliminary analyses examining the association between awe type and self-size and powerlessness using generalized linear mixed models (SPSS v. 22) with a binomial probability distribution and a logit link function. Specifically, we tested whether threat-based awe

experiences differed from positive awe experiences in the extent to which participants described feeling small and powerless. The two types of awe experiences did not differ significantly in terms of the proportion of experiences that included a description of feeling small (Threat-based awe: 7.8%, Positive awe: 11.2%;  $F < 1, p = .50$ ). Threat-based awe experiences were, however, significantly more likely to include descriptions of feeling powerless (Threat-based awe: 52.9%, Positive awe: 7.5%),  $F(1, 407) = 56.02, p < .001$ . In addition, both feeling small and powerless during awe experiences were negatively associated with daily well-being: self-size  $F(1, 361) = 7.51, p < .01$ ; powerless  $F(1, 367.8) = 4.25, p < .05$ , such that people experienced lower well-being on days when they felt smaller and more powerless.

In sum, as in our previous studies, participants reported awe experiences that were characterized by perceptions of threat and feelings of fear and anxiety. These threat-based awe experiences elicited comparable levels of awe and wonder as more positive awe experiences, but were not associated with greater daily well-being that day, suggesting a potentially important boundary condition for prior research linking awe to greater well-being (Rudd et al., 2012). In addition, although threat-based and positive awe were equivalent in terms of perceptions of oneself as small, threat-based awe was with feelings of powerlessness more so than positive awe. Our initial analyses examining whether there was significant between-person variability in the link between awe type and emotions, well-being, self-size, and powerlessness revealed that participants did not significantly vary from each other in their associations between awe type and these outcomes. This lack of between-person variability suggests that for most participants there is a similar relationship between threat-based awe and feelings of awe and fear, well-being, self-size, and powerlessness.

Several features of the design of Study 4—small number of threat-based awe experiences, unbalanced cells, dichotomous mediators, and correlational design—limited our ability to draw strong inferences from these findings. Thus, in Study 5, we experimentally manipulated awe to examine its effects on self-size, powerlessness, and well-being, as well as test the mediation model proposed in Hypothesis 5.

### Study 5: An Experimental Test of Awe, Well-Being, and Powerlessness

In our final study we used an experimental paradigm to test the hypothesis that experiences of positive awe enhance well-being, but experiences of threat-based awe do not. In addition, we tested whether these effects were mediated by feelings of powerlessness. We compared both threat-based and positive awe to a nonemotional control state, as well as to fear, the latter offering a critical control in light of the fact that fear appears to be a key feature of threat-based awe. To test these final hypotheses, we had participants watch videos that induced our desired emotions and report on their power, self-size, and well-being after watching the videos.

### Method

**Participants.** Six hundred three adults from the United States completed the experiment in exchange for monetary compensa-

tion. Participants were recruited through MTurk in three waves of data collection spanning nine months. Seventy-eight participants (13%) were removed from analyses: Because of an error with the survey setup, 15 participants did not see a video. Six more participants reported technical issues with watching their videos. We removed an additional 54 participants because a timing measure showed that they had either stayed on their video page for longer than 5 min ( $n = 14$ ) or did not watch their video for its entire length of time ( $n = 40$ ). Finally, four participants failed the manipulation check asking them what type of video they watched (one of which was already excluded for video issues). This left a final sample of 525 participants (296 female and 229 male). On average, participants were 35.5 years old ( $SD = 11.15$ , range = 18–68). Seventy-eight percent were European/European American, 7.4% were Asian/Asian American, 6.1% were African/African American, 6.3% were Latino/Latino American, and 2.3% were of other ethnicities.

**Procedure.** Participants were directed to a secure online website where they first gave consent and then completed basic demographics and a single item assessing current well-being. They were then told they were going to watch a brief video and answer questions about the video and themselves. Participants were randomly assigned to watch one video that elicited either threat-based awe, positive awe, or fear, or elicited no strong emotion (control).

The two awe videos were a little over 2 min and depicted vast, sweeping, natural scenes: the threat-based awe video showed scenes from the Discovery Channel about the birth of tornadoes set to ominous music; the positive awe video showed scenes from the BBC's *Planet Earth* series in which the camera sweeps over the Earth's landscape, including mountains, plains, forests, waterfalls, and canyons, accompanied by uplifting music (Valdesolo & Graham, 2014; Piff et al., 2015). For the fear video, we chose a 1-min video clip from the movie *The Shining*, which has been used frequently to elicit fear (e.g., Gross & Levenson, 1995). The neutral video was the same one from Study 3.

To ensure the videos elicited the desired emotions, we first had 184 participants (after removing 18 participants who had problems with the video or did not watch the video in its entirety) watch one of the four videos and then report on their emotions. Participants were told they were going to watch a brief film clip on the next page. They were told that the footage was of the formation of tornadoes (in the awe-threat condition) or geography of the Earth (in the positive awe condition). As shown in Table 2, the two awe videos elicited similar levels of awe, and both elicited significantly more awe than did the neutral video, but fear and anxiety were significantly greater in response to the threat-based awe video than the positive awe video. Importantly, awe was the dominant emotional response to the threat-based awe video. Fear was the second strongest emotional response to the threat-based awe video, but the intensity of fear was less than in response to the pure fear induction.

Participants in the main study were given the same directions as those in the pilot study. After watching the videos, participants reported on their feelings during the video, including their self-size and powerlessness while watching the video, as well as their well-being after watching the video. They were then asked if there were any problems watching their video, what type of video they

Table 2  
*Emotional Experience, Self-Size, Sense of Power, and Well-Being Across Conditions (Study 5)*

Outcomes	Emotion conditions				Overall <i>F</i>	$\eta_p^2$
	Threat-based awe	Positive awe	Fear	Neutral		
Pilot						
Awe	5.51 <sup>c,d</sup>	5.68 <sup>c,d</sup>	2.42 <sup>a,b</sup>	2.20 <sup>a,b</sup>	89.55 <sup>***</sup>	.60
Fear	3.11 <sup>b,c,d</sup>	1.50 <sup>a,c</sup>	4.19 <sup>a,b,d</sup>	1.34 <sup>a,c</sup>	50.11 <sup>***</sup>	.46
Positive affect	1.95 <sup>b</sup>	4.51 <sup>a,c,d</sup>	1.77 <sup>b</sup>	2.14 <sup>b</sup>	64.30 <sup>***</sup>	.52
Main study						
Small self <sup>^</sup>	3.78 (.10) <sup>b,c,d</sup>	4.20 (.10) <sup>a,c,d</sup>	2.67 (.10) <sup>a,b</sup>	2.45 (.10) <sup>a,b</sup>	68.26 <sup>***</sup>	.28
Powerlessness <sup>^</sup>	3.00 (.09) <sup>b,c</sup>	2.63 (.10) <sup>a,c</sup>	3.32 (.09) <sup>a,b,d</sup>	2.87 (.10) <sup>c</sup>	9.31 <sup>***</sup>	.05
$\Delta$ in well-being	-.26 (.07) <sup>b,c</sup>	.19 (.08) <sup>a,c,d</sup>	-.54 (.07) <sup>b,c,d</sup>	-.13 (.07) <sup>b,c</sup>	16.89 <sup>***</sup>	.09

Note. Standard errors are in parentheses. All omnibus *F* values are significant at  $p < .001$ . For main study, denominator *dfs* = 520.

<sup>a</sup> Mean is different from threat-based awe. <sup>b</sup> Mean is different from positive awe. <sup>c</sup> Mean is different from fear. <sup>d</sup> Mean is different from neutral at  $p < .02$ .

<sup>^</sup> Powerlessness findings control for small self and vice versa.

had watched (selected from a list), and if there was anything else they'd like to tell us. Finally, they were thanked and debriefed.

### Measures.

**Powerlessness.** Powerlessness was measured with the items "How much did you feel the following while watching the video? . . . I felt powerless" and "While watching that video, how much did you feel like you had control over your life?" as well as two items assessing perceived constraint (Lachman & Weaver, 1998): "I felt that what happens in my life is beyond my control," and "I felt like I have little control over the things that happen to me." Control was assessed with a 10-point sliding scale in two of the three waves of data collection (1 = *No control at all* to 10 = *Complete control*) and a 7-point sliding scale (same anchors) in one wave of data collection. The other three items were assessed on 7-point Likert scales (1 = *Not at all* to 7 = *Completely*). To aggregate the four items, the 10-point measure of control was converted to 7 points using the same formula from Study 2a. The control item was reverse-scored and the four items averaged together ( $\alpha = .91$ ; higher scores represent greater feelings of powerlessness,  $M = 2.98$ ,  $SD = 1.56$ ).<sup>9</sup>

**Small self.** Self-size was measured with five items taken from Piff and colleagues (2015). All items stemmed from the prompt "How much did you feel the following while watching the video?" "Small or insignificant," "Like my own day-to-day concerns are relatively trivial," "Small relative to something more powerful than myself," "Insignificant in the grand scheme of things," and "Like I was in the presence of something greater than myself." All items were assessed on 7-point Likert scales (1 = *Not at all* to 7 = *Extremely*). In this sample,  $\alpha = .94$ ,  $M = 3.26$ ,  $SD = 1.79$ .

**Well-being.** Similar to Study 4, well-being was assessed with two items ( $\alpha = .61$ ): "After watching that video, I feel . . . *Terrible* to *Terrific*" and "After watching that video, how satisfied are you with your life as a whole?" (*Not at all satisfied with life* to *Extremely satisfied with life*). Both items were measured on 7-point Likert scales. We also assessed momentary well-being prior to the emotion induction by having participants respond to the item, "Right now, I feel . . . *Terrible* to *Terrific*" on a 7-point scale before they completed demographics. Well-being preinduction was subtracted from well-being postinduction to create a difference score representing change in momentary well-being after watching the videos ( $M_{diff} = -.19$ ,  $SD = 1.0$ ; range =  $-4.5$  to 3).

## Results

**Awe and well-being.** There was a significant effect of emotion condition on change in momentary well-being pre- to postinduction (controlling for preinduction well-being). Specifically, as shown in Table 2 and depicted in Figure 2, post hoc analyses using Tukey's Least Significant Difference revealed that participants in the threat-based awe and positive awe conditions differed significantly such that those who watched the threat-based awe video experienced reductions in well-being postvideo while those who watched the positive awe video experienced increases in well-being (Cohen's  $d = .54$ ). In addition, participants in the positive awe condition experienced boosts in well-being compared with the neutral condition, whereas participants in the threat-based awe condition did not (Cohen's  $ds = .38$  and  $.16$ , respectively). Participants in the fear condition experienced the greatest reduction in well-being, significantly more so than the other three conditions.

**Awe, self-size, and powerlessness.** Self-size and powerlessness were highly correlated ( $r = .69$ ,  $p < .001$ ), and neither was uniquely associated with awe type on its own ( $ps > .1$ ,  $ds < .2$ ). Given the large overlap between the constructs in this study, we conducted further analyses in which we treated each as a covariate when examining the other. As shown in Table 2, participants in both awe conditions reported feeling smaller relative to those in the neutral and fear conditions (threat awe  $ds = 1.21$  &  $1.0$ , positive awe  $ds = 1.59$  &  $1.39$ ). However, whereas participants in the positive awe condition reported significantly smaller perceptions of self-size relative to their threat-based awe counterparts ( $d = .38$ ), those who watched the threat-based awe video felt significantly more powerless than their positive awe counterparts ( $d = .36$ ).

**Powerlessness mediates the relationship between awe type and well-being.** To examine whether differences in feelings of powerlessness helped explain why participants in the threat-based

<sup>9</sup> We had also included two items assessing personal mastery (Lachman & Weaver, 1998), but they were uncorrelated or negatively correlated with the other four items (range of  $rs = -.50$  to  $.14$ ) and only had a moderate correlation with each other, so we did not include them in the final analyses. The items were: "I felt like whether or not I am able to get what I want is in my own hands," and "I felt like what happens to me in the future mostly depends on me" ( $\alpha = .52$  for two items).

awe condition did not experience the same boost in well-being as participants in the positive awe condition, we contrasted the two awe conditions and conducted a mediation analysis using bias corrected and accelerated bootstrapping with 10,000 resamples to obtain a 95% confidence interval for the indirect effect (Preacher & Hayes, 2008). As in the prior analyses, we predicted differences in well-being controlling for preinduction well-being and self-size. As shown in Figure 3, there was a significant indirect effect of awe condition on well-being through perceived powerlessness (point estimate:  $= -.11$ ,  $SE = .04$ ; 95% CI  $[-.21, -.05]$ ) and the effect of awe condition on well-being dropped in significance. That is, participants in the threat-based awe condition did not experience the same boosts in well-being after the awe experience relative to participants who were in the positive awe condition, and this lack of enhanced well-being was due in part to the fact that participants felt more powerless (beyond feelings of self-size) during threat-based awe experiences.

In sum, a threat-based experience of awe did not provide the same momentary boosts in well-being as a more positive awe experience. Moreover, this study showed that differences in well-being between threat-based and positive awe might be explained in part by heightened feelings of powerlessness during threat-based awe experiences. Given that this study used cross-sectional methods and measured the mediator and outcome at the same time, we see these mediational findings as a first step in understanding the mechanisms linking awe and well-being and future work that manipulates powerlessness is needed to further bolster these results (Spencer, Zanna, & Fong, 2005).

### General Discussion

Central to theoretical analyses of awe is that this emotion, complex in its constitution, can be both wonderful and terrifying. The emerging science of awe, however, has largely ignored the more fearful, threatening side of awe, which may hold important clues to its evolutionary and cultural origins, characteristics, and functions. In light of this lacuna in the literature, in the present investigation we examined the extent to which awe experiences are characterized by threat, and how threat-based awe differs from more positive variants of the emotion. Importantly, across methods and samples, threat-based awe made up a notable subset of awe experiences (12%–24%). This threat-based awe comes in many different forms—people reported experiencing threat-based awe in

a variety of settings including social interactions, nature, in the context of political events, and during religious or aesthetic experiences.

Across six studies using cross-sectional, daily experience, physiological, and experimental methods, threat-based awe consistently differed from more positive forms of awe in its appraisals, affective experience, physiological correlates, and consequences for well-being. In our narrative (Study 2a) and experimental (Study 2b) studies, we found that threat-based awe was more strongly associated with reduced appraisals of personal control/responsibility and greater appraisals of situational control and uncertainty than positive awe, in keeping with the theoretical claim that awe may originate in submissive responses (Keltner & Haidt, 2003). Threat-based awe had a more mixed emotional profile with greater fear and anxiety accompanying feelings of awe—the dominant emotion—when compared with more positive awe experiences (Studies 2a, 2b, 4, & 5). Threat-based awe also manifested in a different physiological profile as well as a different effect upon well-being than positive awe. In Study 3, greater fear and anxiety during an awe induction was associated with greater skin conductance and heart rate; positive dimensions to awe, by contrast, were associated with greater RSA, a parasympathetic response that may covary with positive emotion (e.g., Oveis et al., 2009). In Study 4 (a daily experience study) and Study 5 (an experiment), positive awe experiences were associated with a momentary boost in well-being relative to no-awe experiences, but threat-based awe experiences were not. Importantly, we found initial evidence that this divergent effect on well-being may be due, in part, to feelings of powerlessness during threat-based awe experiences.

### Implications for the Science of Awe

Our findings suggest that one of every four to 10 awe experiences can be characterized as tinged with fear and threat. In addition, the medium to large size of our effects on foundational constructs such as well-being suggests that threat-based awe is a meaningful variant of awe that warrants future attention. The findings from the present investigation have several implications for the emerging science of awe. First of all, and most pragmatically, future studies would be well served by carefully attending to threat-based awe. As researchers continue to explore how awe influences perceptions and beliefs (e.g., Valdesolo & Graham, 2014), prosocial tendencies (Piff et al., 2015; Rudd et al., 2012), and other outcomes, such as health (Stellar et al., 2015) and well-being (Rudd et al., 2012), threat-based awe may at times yield different outcomes than the positive variants of awe. Studies that fail to capture and account for this threatening side of awe, common to many awe experiences, may fail to illuminate the causes and consequences of awe and may potentially undersell the benefits of purely positive awe experiences. Future research on awe would be well served by systematic measurement of the threatening dimensions of this complex emotion whether by including these threatening elements of awe in dispositional measures or simply assessing threat or fear during the experience of awe.

Although our studies characterize a more negative, threat-based variant of awe in line with the origin and early uses of the word awe, they also fall in line with the current representations of awe as almost entirely positive in nature—more than 80% of recalled

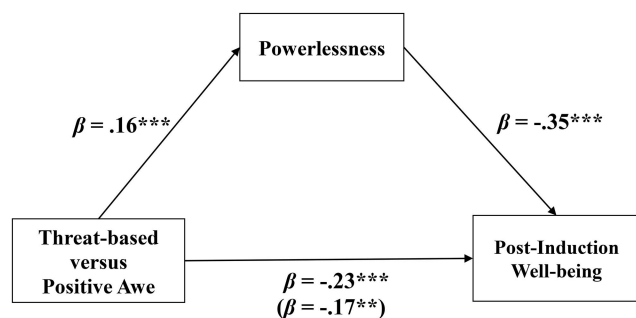


Figure 3. Powerlessness partially mediates link between threat-based awe and reduced well-being in Study 5. Analysis controls for well-being preinduction and self-size; threat-based awe = 1, positive awe = 0;  $N = 260$ .



awe stories and daily experiences of the emotion in our research were positive. It is important to recall that our samples were from the United States, where more positive forms of awe may prevail to a greater degree than threat-based awe compared with other cultures. This pattern of results raises intriguing questions about the determinants of variation in threat-based and positive awe across cultures and historical period. Several candidate explanations are plausible: greater scientific progress, the reduction of personal threats in everyday life, more time to engage in art and music, as well as an overall decline in religiosity in many nations may be responsible shifts in the conceptualization of awe, from what may have been a more threatening experience to the more positive emotion that it is today. This issue could be explored with judicious cross-cultural comparisons (e.g., between more religious vs. less religious cultures), with historical analysis, and with evolutionary research, all of which would shed important light on the origins and evolution of awe's variants.

This discussion begs the question of what triggers threat-appraisals within the experience of awe. Clearly, features of the eliciting stimulus are likely to be relevant as we suggested earlier: natural scenes, people, and cultural artifacts can all represent peril or not. Culture may play a role in whether threat-based appraisals are more or less likely during experiences of awe. In more rigidly hierarchical cultures, which rely on submission to powerful leaders, we posit that threat-based awe will be more common. Individual differences should matter as well. For example, we would expect people who are more neurotic or have a high need for closure to find ambiguously threatening awe stimuli more fear-inducing than people who are less prone to anxiety or more open to cognitive complexity. And as with any threat perceptions, mood or context may also play a role (e.g., positive vs. negative mood or night vs. day).

Finally, this work raises questions about how to define this threat-based variant of awe. Threat-based awe represents a mixed state, combining awe with feelings of fear. The evidence reported here suggests that threat-based awe is more aptly characterized as a variant of awe than a variant of fear because reports of fear were always significantly lower than awe, which was the highest reported emotion. This was true even when we elicited awe through videos in Study 5 and did not bring attention to the fact that we were studying awe. What then distinguishes threat-based awe from pure fear? Several factors are likely contributors, including proximity to the threatening stimulus, level of personal control and agency, as well as the vastness and complexity of the elicitor. As a result, pure fear would likely elicit differential responses, including less of an effect on self-size and a greater effect on risk aversion, than more threatening forms of awe.

### Implications for the Science of Emotion

The present investigation makes two important contributions to the science of emotion. First, it lends important, multimethod credence to appraisal approaches to emotional experience (e.g., Lerner, Li, Valdesolo, & Kassam, 2015; Smith et al., 2014). This conceptual approach has been generative in illuminating the nature of emotional experience (Smith & Ellsworth, 1985; Smith et al., 2014), emotion-specific influences on social cognition, including judgment and decision making (e.g., Lerner et al., 2015), and emotion-related physiological response (e.g., Cacioppo, Petty,

Losch, & Kim, 1986). In the present investigation, threat-related appraisals explicated variation in subjective experience, physiological response, and well-being during the experience of awe.

More generally, the present investigation speaks to the benefits of approaching emotions as families of states with meaningful variations within a category of emotion (e.g., Ekman, 1992). Most typically, the science of emotion moves forward through comparisons of distinct states, treating the emotion as the unit of analysis (Keltner & Lerner, 2010). This science has illuminated how different emotions influence, for example, patterns of social cognition (Lerner et al., 2015) and expressive behavior in the face, voice, and body (Keltner, Tracy, Sauter, Cordaro, & McNeil, in press). It is clear, though, that comparisons between variants within a category of emotion are just as critical to progress in the field. Similar to pride, disgust, and love, awe is composed of variants with different features that appear to have meaningful consequences for psychological outcomes. In the present investigation, the threat-based variant of awe was different from more positive awe on many of the key metrics measured during studies of emotion—appraisals, subjective experiences, physiological correlates, and momentary well-being. Our findings add to a growing body of literature (e.g., Tracy & Robins, 2007) showing that affective science benefits when attention is devoted to the variants of specific emotions as well as how those emotions differ from other states.

### Limitations and Future Directions

Although we used a variety of methodological approaches to fully explore the experience of threat-based awe, a few limitations merit attention. Our inductions of awe typically focused on nature. Although we allowed participants to generate their own experiences of awe (Studies 1, 2, and 4), we did not manipulate interpersonal awe. However, interpersonal experiences represent an important elicitor of awe (Shiota et al., 2007), and were common elicitors in our recall studies as well. Future work is needed to further understand the role of threat-based awe during interpersonal awe experiences (e.g., political rallies, cult ceremonies), especially given that awe is thought to play an important role in social hierarchies (Keltner & Haidt, 2003; Piff et al., 2015).

In addition, we focused on momentary well-being as our primary outcome and found that while positive awe increased well-being, threat-based awe did not. Threat-based awe likely has differential effects on a variety of outcomes and it will be important to uncover those outcomes which are uniquely influenced by threat-based awe. For example, this variant of awe might reduce curiosity, cause individuals to behave more submissively, or question awe-inducing authority figures less. Thus, future work should examine additional outcomes to further outline the manner in which threat-based and positive variants of awe differ or are similar. It will also be important to extend our findings concerning momentary well-being to more stable/long-term measures of well-being. In addition, powerlessness only partially explained why threat-based awe did not have the same positive effect on momentary well-being as positive awe in Study 5. Therefore, caution should be exercised when interpreting our effects and more research is clearly needed to uncover the outcomes of awe and the set of mechanisms underlying these effects, including powerlessness.

## Conclusion

In different veins of scholarship, awe is a cardinal emotion—one vital to our connections to others and to religious entities, our ability to fold into social collectives, and ultimately our health and well-being. The prior work on awe has largely conceptualized it as a positive emotion, one experienced with delight and pleasure. The results of the present investigation paint a more nuanced picture—we provide evidence that there are different variants of awe, including a more negative, threat-based variant that is imbued with fear, anxiety, a sense of powerlessness, the physiology of defense, and appears to have little benefit for personal well-being.

## References

- Anderson, C. L., Gordon, A. M., Stellar, J. E., McNeil, G. D., Monroy, M., & Keltner, D. (2016). *Awe, curiosity, and well-being*. [Manuscript in preparation].
- Ax, A. F. (1953). The physiological differentiation between fear and anger in humans. *Psychosomatic Medicine*, *15*, 433–442. <http://dx.doi.org/10.1097/00006842-195309000-00007>
- Bagozzi, R. P., Wong, N., & Yi, Y. (1999). The role of culture and gender in the relationship between positive and negative affect. *Cognition and Emotion*, *13*, 641–672. <http://dx.doi.org/10.1080/026999399379023>
- Berntson, G. G., Cacioppo, J. T., & Quigley, K. S. (1993). Respiratory sinus arrhythmia: Autonomic origins, physiological mechanisms, and psychophysiological implications. *Psychophysiology*, *30*, 183–196. <http://dx.doi.org/10.1111/j.1469-8986.1993.tb01731.x>
- Bishop, S. J. (2008). Neural mechanisms underlying selective attention to threat. *Annals of the New York Academy of Sciences*, *1129*, 141–152. <http://dx.doi.org/10.1196/annals.1417.016>
- Blascovich, J., & Mendes, W. B. (2010). Social psychophysiology and embodiment. In S. Fiske, D. Gilbert, & G. Lindzey (Eds.), *The handbook of social psychology* (5th ed., pp. 194–227). Hoboken, NJ: Wiley
- Blascovich, J., & Tomaka, J. (1996). The biopsychosocial model of arousal regulation. *Advances in Experimental Social Psychology*, *28*, 1–51. [http://dx.doi.org/10.1016/S0065-2601\(08\)60235-X](http://dx.doi.org/10.1016/S0065-2601(08)60235-X)
- Bosch, J. A., de Geus, E. J., Carroll, D., Goedhart, A. D., Anane, L. A., van Zanten, J. J. V., . . . Edwards, K. M. (2009). A general enhancement of autonomic and cortisol responses during social evaluative threat. *Psychosomatic Medicine*, *71*, 877–885. <http://dx.doi.org/10.1097/PSY.0b013e3181baef05>
- Boyer, P., & Bergstrom, B. (2011). Threat-detection in child development: An evolutionary perspective. *Neuroscience and Biobehavioral Reviews*, *35*, 1034–1041. <http://dx.doi.org/10.1016/j.neubiorev.2010.08.010>
- Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's Mechanical Turk: A new source of inexpensive, yet high-quality, data? *Perspectives on Psychological Science*, *6*, 3–5. <http://dx.doi.org/10.1177/1745691610393980>
- Burke, E. (1990). *A philosophical inquiry into the origins of our ideas of the sublime and beautiful*. Oxford, UK: Oxford University Press. (Original work published 1757)
- Byrt, T., Bishop, J., & Carlin, J. B. (1993). Bias, prevalence and kappa. *Journal of Clinical Epidemiology*, *46*, 423–429. [http://dx.doi.org/10.1016/0895-4356\(93\)90018-V](http://dx.doi.org/10.1016/0895-4356(93)90018-V)
- Cacioppo, J. T., Petty, R. E., Losch, M. E., & Kim, H. S. (1986). Electromyographic activity over facial muscle regions can differentiate the valence and intensity of affective reactions. *Journal of Personality and Social Psychology*, *50*, 260–268. <http://dx.doi.org/10.1037/0022-3514.50.2.260>
- Campos, B., Shiota, M. N., Keltner, D., Gonzaga, G. C., & Goetz, J. L. (2013). What is shared, what is different? Core relational themes and expressive displays of eight positive emotions. *Cognition and Emotion*, *27*, 37–52. <http://dx.doi.org/10.1080/02699931.2012.683852>
- Cheng, J. T., Tracy, J. L., Foulsham, T., Kingstone, A., & Henrich, J. (2013). Two ways to the top: Evidence that dominance and prestige are distinct yet viable avenues to social rank and influence. *Journal of Personality and Social Psychology*, *104*, 103–125. <http://dx.doi.org/10.1037/a0030398>
- Dawson, M. E., Schell, A. M., & Fillion, D. L. (2000). *Handbook of Psychophysiology*. Cambridge, UK: Cambridge University Press.
- Dickerson, S. S., & Kemeny, M. E. (2004). Acute stressors and cortisol responses: A theoretical integration and synthesis of laboratory research. *Psychological Bulletin*, *130*, 355–391. <http://dx.doi.org/10.1037/0033-2909.130.3.355>
- Diener, E., Suh, E. M., Lucas, R. E., & Smith, H. L. (1999). Subjective well-being: Three decades of progress. *Psychological Bulletin*, *125*, 276–302.
- Dimberg, U., & Öhman, A. (1996). Behold the wrath: Psychophysiological responses to facial stimuli. *Motivation and Emotion*, *20*, 149–182. <http://dx.doi.org/10.1007/BF02253869>
- Ditto, B., Eclache, M., & Goldman, N. (2006). Short-term autonomic and cardiovascular effects of mindfulness body scan meditation. *Annals of Behavioral Medicine*, *32*, 227–234. [http://dx.doi.org/10.1207/s15324796abm3203\\_9](http://dx.doi.org/10.1207/s15324796abm3203_9)
- Eisenberger, N. I., Jarcho, J. M., Lieberman, M. D., & Naliboff, B. D. (2006). An experimental study of shared sensitivity to physical pain and social rejection. *Pain*, *126*, 132–138. <http://dx.doi.org/10.1016/j.pain.2006.06.024>
- Ekman, P. (1992). An argument for basic emotions. *Cognition and Emotion*, *6*, 169–200. <http://dx.doi.org/10.1080/02699939208411068>
- Ellsworth, P. C., & Smith, C. A. (1988). From appraisal to emotion: Differences among unpleasant feelings. *Motivation and Emotion*, *12*, 271–302. <http://dx.doi.org/10.1007/BF00993115>
- Fehr, B., & Russell, J. A. (1984). Concept of emotion viewed from a prototype perspective. *Journal of Experimental Psychology: General*, *113*, 464–486.
- Fehr, B., Sprecher, S., & Underwood, L. G. (Eds.). (2009). *The science of compassionate love: Theory, research, and applications*. Hoboken, NJ: Wiley.
- Fiske, S. T., Morling, B., & Stevens, L. E. (1996). Controlling self and others: A theory of anxiety, mental control, and social control. *Personality and Social Psychology Bulletin*, *22*, 115–123.
- Fontaine, J. R., Scherer, K. R., Roesch, E. B., & Ellsworth, P. C. (2007). The world of emotions is not two-dimensional. *Psychological Science*, *18*, 1050–1057. <http://dx.doi.org/10.1111/j.1467-9280.2007.02024.x>
- Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *American Psychologist*, *56*, 218–226. <http://dx.doi.org/10.1037/0003-066X.56.3.218>
- Frijda, N. H. (1986). *The emotions: Studies in emotion and social interaction*. Paris, France: Maison de Sciences de l'Homme.
- Gable, S. L., & Poore, J. (2008). Which thoughts count? Algorithms for evaluating satisfaction in relationships. *Psychological Science*, *19*, 1030–1036.
- Geer, J. H., Davison, G. C., & Gatchel, R. I. (1970). Reduction of stress in humans through nonveridical perceived control of aversive stimulation. *Journal of Personality and Social Psychology*, *16*, 731–738. <http://dx.doi.org/10.1037/h0030014>
- Gross, J. J., & Levenson, R. W. (1995). Emotion elicitation using films. *Cognition and Emotion*, *9*, 87–108. <http://dx.doi.org/10.1080/02699939508408966>
- Grossman, P., & Kollai, M. (1993). Respiratory sinus arrhythmia, cardiac vagal tone, and respiration: Within-and between-individual relations. *Psychophysiology*, *30*, 486–495.
- Harker, L., & Keltner, D. (2001). Expressions of positive emotion in women's college yearbook pictures and their relationship to personality

- and life outcomes across adulthood. *Journal of Personality and Social Psychology*, 80, 112–124. <http://dx.doi.org/10.1037/0022-3514.80.1.112>
- Kagan, J. (1994). *Galen's prophecy: Temperament in human nature*. New York, NY: Basic Books.
- Keltner, D. (2009). *Born to be good: The science of a meaningful life*. New York, NY: W. W. Norton & Company.
- Keltner, D., Gruenfeld, D. H., & Anderson, C. (2003). Power, approach, and inhibition. *Psychological Review*, 110, 265–284.
- Keltner, D., & Haidt, J. (2003). Approaching awe, a moral, spiritual, and aesthetic emotion. *Cognition and Emotion*, 17, 297–314. <http://dx.doi.org/10.1080/02699930302297>
- Keltner, D., Kogan, A., Piff, P. K., & Saturn, S. R. (2014). The sociocultural appraisals, values, and emotions (SAVE) framework of prosociality: Core processes from gene to meme. *Annual Review of Psychology*, 65, 425–460. <http://dx.doi.org/10.1146/annurev-psych-010213-115054>
- Keltner, D., & Lerner, J. S. (2010). Emotion. In S. Fiske & D. Gilbert (Eds.), *The handbook of social psychology* (5th ed.). Hoboken, NJ: Wiley. <http://dx.doi.org/10.1002/9780470561119.socpsy001009>
- Keltner, D., Tracy, J. L., Sauter, D. A., Cordero, D. C., & McNeil, G. D. (in press). Expression of emotion. In L. F. Barrett (Ed.), *The handbook of emotions* (4th ed.). New York, NY: Guilford.
- Kok, B. E., Coffey, K. A., Cohn, M. A., Catalino, L. I., Vacharkulksemsuk, T., Algoe, S. B., . . . Fredrickson, B. L. (2013). How positive emotions build physical health: Perceived positive social connections account for the upward spiral between positive emotions and vagal tone. *Psychological Science*, 24, 1123–1132. <http://dx.doi.org/10.1177/0956797612470827>
- Kraus, M. W., Piff, P. K., Mendoza-Denton, R., Rheinschmidt, M. L., & Keltner, D. (2012). Social class, solipsism, and contextualism: How the rich are different from the poor. *Psychological Review*, 119, 546–572. <http://dx.doi.org/10.1037/a0028756>
- Krygier, J. R., Heathers, J. A., Shahrestani, S., Abbott, M., Gross, J. J., & Kemp, A. H. (2013). Mindfulness meditation, well-being, and heart rate variability: A preliminary investigation into the impact of intensive Vipassana meditation. *International Journal of Psychophysiology*, 89, 305–313. <http://dx.doi.org/10.1016/j.ijpsycho.2013.06.017>
- Lachman, M. E., & Weaver, S. L. (1998). The sense of control as a moderator of social class differences in health and well-being. *Journal of Personality and Social Psychology*, 74, 763–773. <http://dx.doi.org/10.1037/0022-3514.74.3.763>
- Lai, M. H., & Kwok, O. M. (2014). Standardized mean differences in two-level cross-classified random effects models. *Journal of Educational and Behavioral Statistics*, 39, 282–302. <http://dx.doi.org/10.3102/1076998614532950>
- Lazarus, R. S. (1991). Cognition and motivation in emotion. *American Psychologist*, 46, 352–367. <http://dx.doi.org/10.1037/0003-066X.46.4.352>
- Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. New York, NY: Springer.
- Lerner, J. S., & Keltner, D. (2001). Fear, anger, and risk. *Journal of Personality and Social Psychology*, 81, 146–159. <http://dx.doi.org/10.1037/0022-3514.81.1.146>
- Lerner, J. S., Li, Y., Valdesolo, P., & Kassam, K. S. (2015). Emotion and decision making. *Annual Review of Psychology*, 66, 799–823. <http://dx.doi.org/10.1146/annurev-psych-010213-115043>
- Levenson, R. W. (2003). Autonomic specificity and emotion. In R. J. Davidson, K. R. Scherer, & H. H. Goldsmith (Eds.), *Handbook of affective sciences* (pp. 212–224). New York, NY: Oxford University Press.
- Levenson, R. W., & Ruef, A. M. (1992). Empathy: A physiological substrate. *Journal of Personality and Social Psychology*, 63, 234–246. <http://dx.doi.org/10.1037/0022-3514.63.2.234>
- Lyubomirsky, S., King, L., & Diener, E. (2005). The benefits of frequent positive affect: Does happiness lead to success? *Psychological Bulletin*, 131, 803–855. <http://dx.doi.org/10.1037/0033-2909.131.6.803>
- Magee, J. C., & Galinsky, A. D. (2008). Social hierarchy: The self-reinforcing nature of power and status. *The Academy of Management Annals*, 2, 351–398. <http://dx.doi.org/10.1080/19416520802211628>
- Monat, A., Averill, J. R., & Lazarus, R. S. (1972). Anticipatory stress and coping reactions under various conditions of uncertainty. *Journal of Personality and Social Psychology*, 24, 237–253. <http://dx.doi.org/10.1037/h0033297>
- Öhman, A. (1986). Face the beast and fear the face: Animal and social fears as prototypes for evolutionary analyses of emotion. *Psychophysiology*, 23, 123–145. <http://dx.doi.org/10.1111/j.1469-8986.1986.tb00608.x>
- Öhman, A., Flykt, A., & Esteves, F. (2001). Emotion drives attention: Detecting the snake in the grass. *Journal of Experimental Psychology: General*, 130, 466–478. <http://dx.doi.org/10.1037/0096-3445.130.3.466>
- Oveis, C., Cohen, A. B., Gruber, J., Shiota, M. N., Haidt, J., & Keltner, D. (2009). Resting respiratory sinus arrhythmia is associated with tonic positive emotionality. *Emotion*, 9, 265–270. <http://dx.doi.org/10.1037/a0015383>
- Pargament, K. I., & Mahoney, A. (2005). Sacred matters: Sanctification as a vital topic for the psychology of religion. *International Journal for the Psychology of Religion*, 15, 179–198. [http://dx.doi.org/10.1207/s15327582ijpr1503\\_1](http://dx.doi.org/10.1207/s15327582ijpr1503_1)
- Piff, P. K., Dietze, P., Feinberg, M., Stancato, D. M., & Keltner, D. (2015). Awe, the small self, and prosocial behavior. *Journal of Personality and Social Psychology*, 108, 883–899. <http://dx.doi.org/10.1037/pspi0000018>
- Porges, S. W. (2007). The polyvagal perspective. *Biological Psychology*, 74, 116–143. <http://dx.doi.org/10.1016/j.biopsycho.2006.06.009>
- Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, 40, 879–891. <http://dx.doi.org/10.3758/BRM.40.3.879>
- Rodrigues, S. M., LeDoux, J. E., & Sapolsky, R. M. (2009). The influence of stress hormones on fear circuitry. *Annual Review of Neuroscience*, 32, 289–313. <http://dx.doi.org/10.1146/annurev.neuro.051508.135620>
- Rolls, E. T. (1999). *The brain and emotion*. Oxford, UK: Oxford University Press.
- Rozin, P., Haidt, J., & Fincher, K. (2009). Psychology: From oral to moral. *Science*, 323, 1179–1180. <http://dx.doi.org/10.1126/science.1170492>
- Rudd, M., Vohs, K. D., & Aaker, J. (2012). Awe expands people's perception of time, alters decision making, and enhances well-being. *Psychological Science*, 23, 1130–1136. <http://dx.doi.org/10.1177/0956797612438731>
- Ryff, C. D. (1989). Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality and Social Psychology*, 57, 1069–1081. <http://dx.doi.org/10.1037/0022-3514.57.6.1069>
- Satterthwaite, F. E. (1946). An approximate distribution of estimates of variance components. *Biometrics Bulletin*, 2, 110–114.
- Schulz, R. (1976). Effects of control and predictability on the physical and psychological well-being of the institutionalized aged. *Journal of Personality and Social Psychology*, 33, 563–573. <http://dx.doi.org/10.1037/0022-3514.33.5.563>
- Seybold, K. S., & Hill, P. C. (2001). The role of religion and spirituality in mental and physical health. *Current Directions in Psychological Science*, 10, 21–24. <http://dx.doi.org/10.1111/1467-8721.00106>
- Shariff, A. F., & Norenzayan, A. (2011). Mean gods make good people: Different views of God predict cheating behavior. *International Journal for the Psychology of Religion*, 21, 85–96. <http://dx.doi.org/10.1080/10508619.2011.556990>
- Shaver, P., Schwartz, J., Kirson, D., & O'Connor, C. (1987). Emotion knowledge: Further exploration of a prototype approach. *Journal of*



- Personality and Social Psychology*, 52, 1061–1086. <http://dx.doi.org/10.1037/0022-3514.52.6.1061>
- Shiota, M. N., Keltner, D., & John, O. P. (2006). Positive emotion dispositions differentially associated with Big Five personality and attachment style. *The Journal of Positive Psychology*, 1, 61–71. <http://dx.doi.org/10.1080/17439760500510833>
- Shiota, M. N., Keltner, D., & Mossman, A. (2007). The nature of awe: Elicitors, appraisals, and effects on self-concept. *Cognition and Emotion*, 21, 944–963. <http://dx.doi.org/10.1080/02699930600923668>
- Shiota, M. N., Neufeld, S. L., Yeung, W. H., Moser, S. E., & Perea, E. F. (2011). Feeling good: Autonomic nervous system responding in five positive emotions. *Emotion*, 11, 1368–1378. <http://dx.doi.org/10.1037/a0024278>
- Shreve-Neiger, A. K., & Edelstein, B. A. (2004). Religion and anxiety: A critical review of the literature. *Clinical Psychology Review*, 24, 379–397. <http://dx.doi.org/10.1016/j.cpr.2004.02.003>
- Smith, C. A., & Ellsworth, P. C. (1985). Patterns of cognitive appraisal in emotion. *Journal of Personality and Social Psychology*, 48, 813–838. <http://dx.doi.org/10.1037/0022-3514.48.4.813>
- Smith, C. A., & Ellsworth, P. C. (1987). Patterns of appraisal and emotion related to taking an exam. *Journal of Personality and Social Psychology*, 52, 475–488. <http://dx.doi.org/10.1037/0022-3514.52.3.475>
- Smith, C. A., Tong, E. M., & Ellsworth, P. C. (2014). The differentiation of positive emotional experience as viewed through the lens of appraisal theory. In M. M. Tugade, M. N. Shiota, and L. D. Kirby (Eds.), *Handbook of positive emotions* (pp. 11–27). New York, NY: Guilford Press.
- Spencer, S. J., Zanna, M. P., & Fong, G. T. (2005). Establishing a causal chain: Why experiments are often more effective than mediational analyses in examining psychological processes. *Journal of Personality and Social Psychology*, 89, 845–851. <http://dx.doi.org/10.1037/0022-3514.89.6.845>
- Stellar, J. E., Cohen, A., Oveis, C., & Keltner, D. (2015). Affective and physiological responses to the suffering of others: Compassion and vagal activity. *Journal of Personality and Social Psychology*, 108, 572–585.
- Stellar, J. E., Gordon, A. M., Anderson, C. L., Piff, P. K., McNeil, G. D., & Keltner, D. (2016). Awe promotes a more humble self-concept. *Journal of Personality and Social Psychology*. Manuscript submitted for publication.
- Stellar, J. E., John-Henderson, N., Anderson, C. L., Gordon, A. M., McNeil, G. D., & Keltner, D. (2015). Positive affect and markers of inflammation: Discrete positive emotions predict lower levels of inflammatory cytokines. *Emotion*, 15, 129–133. <http://dx.doi.org/10.1037/emo0000033>
- Stellar, J. E., Manzo, V. M., Kraus, M. W., & Keltner, D. (2012). Class and compassion: Socioeconomic factors predict responses to suffering. *Emotion*, 12, 449–459. <http://dx.doi.org/10.1037/a0026508>
- Stemmler, G., Heldmann, M., Pauls, C. A., & Scherer, T. (2001). Constraints for emotion specificity in fear and anger: The context counts. *Psychophysiology*, 38, 275–291. <http://dx.doi.org/10.1111/1469-8986.3820275>
- Suls, J., & Mullen, B. (1981). Life events, perceived control and illness: The role of uncertainty. *Journal of Human Stress*, 7, 30–34.
- Sundararajan, L. (2002). Religious awe: Potential contributions of negative theology to psychology, “positive” or otherwise. *Journal of Theoretical and Philosophical Psychology*, 22, 174–197. <http://dx.doi.org/10.1037/h0091221>
- Tangney, J. P., Burggraf, S. A., & Wagner, P. E. (1995). Shame-proneness, guilt-proneness, and psychological symptoms. In J. P. Tangney and K. W. Fischer (Eds.), *Self-conscious emotions: The psychology of shame, guilt, embarrassment, and pride* (pp. 343–367). New York, NY: Guilford Press.
- Tomaka, J., Blascovich, J., Kibler, J., & Ernst, J. M. (1997). Cognitive and physiological antecedents of threat and challenge appraisal. *Journal of Personality and Social Psychology*, 73, 63–72.
- Tracy, J. L., Cheng, J. T., Robins, R. W., & Trzesniewski, K. H. (2009). Authentic and hubristic pride: The affective core of self-esteem and narcissism. *Self and Identity*, 8(2–3), 196–213. <http://dx.doi.org/10.1080/15298860802505053>
- Tracy, J. L., & Robins, R. W. (2004). Putting the self into self-conscious emotions: A theoretical model. *Psychological Inquiry*, 15, 103–125. [http://dx.doi.org/10.1207/s15327965pli1502\\_01](http://dx.doi.org/10.1207/s15327965pli1502_01)
- Tracy, J. L., & Robins, R. W. (2007). Emerging insights into the nature and function of pride. *Current Directions in Psychological Science*, 16, 147–150. <http://dx.doi.org/10.1111/j.1467-8721.2007.00493.x>
- Valdesolo, P., & Graham, J. (2014). Awe, uncertainty, and agency detection. *Psychological Science*, 25, 170–178. <http://dx.doi.org/10.1177/0956797613501884>
- Van Cappellen, P., & Saroglou, V. (2012). Awe activates religious and spiritual feelings and behavioral intentions. *Psychology of Religion and Spirituality*, 4, 223–236. <http://dx.doi.org/10.1037/a0025986>
- Watkins, L. L., Grossman, P., Krishnan, R., & Sherwood, A. (1998). Anxiety and vagal control of heart rate. *Psychosomatic Medicine*, 60, 498–502. <http://dx.doi.org/10.1097/00006842-199807000-00018>
- Weber, M. (1968). *Economy and society*. New York, NY: Bedminster Press Incorporated.

Received November 4, 2015

Revision received September 6, 2016

Accepted September 16, 2016 ■