

Awe, Uncertainty, and Agency Detection

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Abstract

Across five studies, we found that awe increases both supernatural belief (Studies 1, 2, and 5) and intentional-pattern perception (Studies 3 and 4)—two phenomena that have been linked to *agency detection*, or the tendency to interpret events as the consequence of intentional and purpose-driven agents. Effects were both directly and conceptually replicated, and mediational analyses revealed that these effects were driven by the influence of awe on tolerance for uncertainty. Experiences of awe decreased tolerance for uncertainty, which, in turn, increased the tendency to believe in nonhuman agents and to perceive human agency in random events.

Keywords

emotions, social cognition, awe, supernatural belief, agency

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When I walk the fields, I am oppressed now and then with an innate feeling that everything I see has a meaning, if I could but understand it. And this feeling of being surrounded with truths which I cannot grasp amounts to indescribable awe.

—Charles Kingsley (James, 1902/1987, pp. 346–347)

Theorists have speculated as to the structure (Ekman, 1992; Izard, 1977; Lazarus, 1991) and function (Keltner & Haidt, 2003) of *awe*, but it has largely eluded empirical scrutiny. The existing research has focused on awe's relationship to "perceived vastness." For example, awe distorts time perception, which creates the sensation of more available time (Rudd, Vohs, & Aaker, 2012), and awe increases emphasis on universal categories of self-definition (Shiota, Keltner, & Mossman, 2007). However, awe is also thought to involve accommodation, or "the process of adjusting mental structures that cannot assimilate a new experience" (Keltner & Haidt, 2003, p. 304).

Supporting this latter component of awe, results from Shiota et al. (2007) showed a correlation between dispositional awe proneness and the need for cognitive closure (an index of an individual's discomfort with uncertainty and desire for consistency; Webster & Kruglanski, 1994). Specifically, awe-prone individuals were less likely to demonstrate such a need, which suggests that individuals who chronically experience awe are more comfortable

revising existing mental schemas to assimilate novel information.

Although dispositional awe proneness might be associated with a greater tolerance for uncertainty as individuals become accustomed to the psychological consequences associated with the state, manipulated awe might have the opposite effect, eliciting feelings of lost certainty and control and motivating a search for resolution. Indeed, negative states, such as confusion and disorientation, are thought to accompany immediate failures to assimilate information into existing mental structures (cf. Keltner & Haidt, 2003). In other words, uncertainty could mark failed efforts at assimilation and represent the motivational force behind accommodation.

Such a relationship would predict an influence of awe on social judgments associated with the resolution of uncertainty, such as *agency detection*, or the tendency to interpret events as the consequence of intentional and purpose-driven agents. Thinkers from Søren Kierkegaard (1843/1983) to William James (1902/1987) have associated awe with such uncertainty, along with an accompanying desire to see meaning in the world. We sought to test this relationship in two distinct domains: belief in the

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supernatural (Studies 1, 2, and 5) and perceptions of pattern randomness (Studies 3 and 4).

Uncertainty and Belief in Supernatural Agents

Agency detection has been posited as a “foundation for human belief in God” (K. Gray & Wegner, 2010, p. 9). On this account, humans are equipped with a “hyperactive agency-detection device” (Barrett, 2000), which attributes environmental occurrences to the behavior of agents (Atran, 2002). Humans rely on supernatural agents to explain the world when natural explanations are lacking. This tendency should be particularly pronounced when the motivation to explain the world is strong or the ability to do so is weak.

Past work has explored the relationship between feelings of uncertainty and belief in supernatural concepts. Within this body of work, researchers have found a relationship between tolerance of uncertainty and phenomena such as magical thinking (Keinan, 1994) and superstitious behavior (Keinan, 2002), which suggests that when feelings of personal control are low, people turn to supernatural explanations as a means of restoring such control.

More recent incarnations of such theories have taken two forms: those that concern the influence of *effectance motivation* on supernatural belief and those that concern supernatural belief as *compensatory control*. One way in which effectance motivation, or the basic motivation to attain mastery of one’s environment, can be satisfied is through belief in the power of humanlike causal agents (Waytz, Gray, Epley, & Wegner, 2010). Given that gods are considered the paradigmatic agents (H. M. Gray, Gray, & Wegner, 2007)—beings of great power, ability, size, and virtue—they are turned to in a variety of circumstances as explanations for worldly events (cf. K. Gray & Wegner, 2010) and might be relied on more when motivation to explain is strong.

These findings are consistent with results reported in a separate literature on religious belief as compensatory control, or the desire to protect a belief in a nonrandom world (Kay, Whitson, Gaucher, & Galinsky, 2009). Experimental manipulations that lowered personal control resulted in increased belief in religious deities as a means of restoring such control (Kay, Gaucher, McGregor, & Nash, 2010).

This literature, taken together with preliminary findings that awe is related to the need for cognitive closure, motivated the hypothesis tested in our first two, and final, studies: Awe will increase belief in supernatural agents as a function of its effects on uncertainty tolerance. Although religious experience is frequently anecdotally associated with awe (e.g., James, 1902/1987), to our knowledge, no

researchers have directly tested how feelings of awe might influence belief in supernatural agents.

Uncertainty and Perceived Randomness

If awe influences agency detection via motivations to reduce uncertainty, then the effects of such motivations should be domain independent. Although supernatural belief might be its most obvious effect, awe should also influence other kinds of decisions that are empirically associated with agency detection and conceptually distinct from belief in the supernatural. Such evidence is crucial given findings that manipulations of awe activate concepts associated with religiosity (at least for those individuals who identify as religious; Van Cappellen & Saroglou, 2012).

One such religion-distinct domain is judgments of randomness. Humans are motivated to avoid perceiving the world as random because such beliefs are typically accompanied by negative arousal (Kruglanski, 1989; Laurin, Kay, & Moscovitch, 2008; Schwartzberg & Janoff-Bulman, 1991). Such motivations can cause individuals to perceive patterns and order where there are none (Whitson & Galinsky, 2008). Furthermore, judgments associated with agency, such as intentionality, have been found to predict the degree to which individuals perceive patterns in randomness (Caruso, Waytz, & Epley, 2010). The effects of randomness on stress can be attenuated if events can be reinterpreted as a product of the design of intentional agents (Bering, 2003; Clark, 1996). Thus, another consequence of awe’s effects on uncertainty tolerance may be an increased tendency for individuals to infer the hand of intentional agency in randomness. This literature, taken together with preliminary findings that awe is related to the need for cognitive closure, motivated the hypothesis tested in Studies 3 and 4: Awe will increase perceptions of human agency in random numerical patterns as a function of its effects on uncertainty tolerance.

Overview of Experiments

In the present research, we tested the relationship between awe, uncertainty tolerance, and agency detection in two ways. In Studies 1, 2, and 5, we tested whether manipulations of awe (compared with general positivity and neutral mood) increase belief in supernatural agents as a function of changes in uncertainty tolerance. In Studies 3 and 4, we tested whether manipulations of awe (compared with general positivity and neutral mood) increase the perception of human agency in random patterns as a function of changes in uncertainty tolerance. We hypothesized that awe would increase agency

detection across both domains as a means of resolving the uncertainty triggered by the emotional state.

With these predictions, we built on previous work in several important ways. We sought to provide the first experimental support for the relationship between awe and uncertainty tolerance while also testing a novel consequence of experiencing awe—agency detection. Furthermore, we isolated an emotion-specific function by pitting awe's effects on agency detection against the effects of more general, positive emotional states.

Study 1

Method

Participants. A total of 120 participants (73 female, 47 male; median age = 20) were approached by experimenters on a college campus and were asked to participate in an iPad-based study in return for \$3. Participants were randomly assigned to one of three conditions: neutral, awe, or positivity.

Procedure. Participants were told they would be taking part in a study on “personality and decision making” in which they would watch a 5-min video and complete a series of questionnaires. After providing consent, participants put on headphones and watched a neutral clip (a 1959 news interview conducted by Mike Wallace), an awe-inducing clip (a 5-min montage of nature clips from the BBC's *Planet Earth*, composed primarily of grand, sweeping shots of plains, mountains, space, and canyons; <http://www.youtube.com/watch?v=oWMUX3ugaRU>), or a clip meant to elicit amusement (a montage of comedic nature clips from the BBC's *Walk on the Wild Side*). The clips were selected in light of research suggesting that awe is elicited by vast scenes of natural beauty (cf. Keltner & Haidt, 2003) and that eliciting amusement is a commonly employed method of inducing general positivity (cf. Bartlett & DeSteno, 2006; Forgas, 2001).

Participants then answered eight questions, adapted from previous research, that tapped their belief in supernatural forces. The dependent variable of interest was a three-item index of belief in *supernatural control* (Kay et al., 2009) that measured belief that the universe is controlled by God or supernatural forces, such as karma; responses were made using 10-point scales from 1, *tremendously doubtful*, to 10, *extremely likely* (example item: “The events that occur in this world unfold according to God's or some other nonhuman entity's plan”). We also included a general measure of belief in God (Shenhav, Rand, & Greene, 2012) and four items related to other supernatural beliefs (curses, ghosts, miracles, and angels; Epley, Waytz, Akalis, & Cacioppo, 2008). Participants then completed an eight-item emotion-manipulation check (example item: “To what extent did you experience awe while watching the video clip?”); responses were made using 7-point scales from 1, *not at all*, to 7, *extremely*.

Results and discussion

One participant was removed from analysis for having statistically aberrant scores on several of the emotion-manipulation-check items. Planned contrasts revealed that participants experienced more awe in the awe condition than in the neutral and positivity conditions, $F(1, 116) = 91.07, p < .001, \eta_p^2 = .47$, and more amusement in the positivity condition than in the awe and neutral conditions, $F(1, 116) = 41.44, p < .001$. Other differences in emotional responding across conditions emerged as well (see Table 1 for mean scores for self-reported emotional states in Studies 1 and 3).

Of primary interest, responses on the scale of belief in supernatural control ($\alpha = .87$) also varied by condition. Planned contrasts revealed that participants' belief in supernatural control was stronger in the awe condition ($M = 6.17$) compared with the neutral ($M = 4.68$) and positivity ($M = 5.08$) conditions, $F(1, 116) = 2.55, p = .012$,

Table 1. Mean Scores for Self-Reported Emotional States in Studies 1 and 3

| Study and condition | Happiness | Amusement | Awe | Fear | Sadness | Anger | Gratitude | Disgust |
|---------------------|---------------------------|--------------------------|--------------------------|--------------------------|---------------------------|--------------------------|---------------------------|--------------------------|
| Study 1 | | | | | | | | |
| Awe | 5.03 ^a (1.44) | 3.33 ^b (1.9) | 5.58 ^{ab} (1.3) | 2.2 ^b (1.45) | 2.18 ^b (1.13) | 1.45 (1.1) | 4.3 ^{ab} (1.87) | 1.13 (0.463) |
| Neutral | 2.59 ^b (1.069) | 3.41 ^b (1.49) | 2.33 (1.26) | 1.67 ^b (1.26) | 1.74 ^b (1.019) | 1.47 (1.03) | 2.05 (1.47) | 1.28 (0.793) |
| Positivity | 5.33 ^a (1.542) | 6.1 ^a (1.15) | 2.98 (1.87) | 1.03 (0.158) | 1.1 (0.379) | 1.05 (0.221) | 2.78 (2.02) | 1.08 (0.267) |
| Study 3 | | | | | | | | |
| Awe | 5.29 ^a (1.35) | 4.16 (1.97) | 6.0 ^{ab} (1.45) | 1.87 ^b (1.07) | 2.24 ^b (1.58) | 1.34 ^a (0.85) | 4.82 ^{ab} (1.86) | 1.26 ^a (0.72) |
| Neutral | 2.24 (1.62) | 3.42 ^b (1.85) | 3.0 (1.56) | 2.42 ^b (1.9) | 2.55 ^b (1.7) | 2.7 (2.07) | 2.37 (1.65) | 2.66 (2.12) |
| Positivity | 5.15 ^a (1.74) | 5.08 ^a (2.08) | 3.38 (1.85) | 1.0 ^a (0.0) | 1.03 ^a (0.16) | 1.05 ^a (0.22) | 2.4 (1.82) | 1.1 ^a (0.30) |

Note: Standard deviations are shown in parentheses. For all items, responses were made using 7-point scales, with higher values indicating greater intensity of emotion.

^aThese means are significantly different from those in the neutral condition ($p < .05$). ^bThese means are significantly different from those in the positivity condition ($p < .05$).

$\eta_p^2 = .06$. Participants' reported belief in God followed the same pattern, with greater belief reported in the awe condition ($M = 6.95$) compared with the neutral ($M = 4.87$) and positivity ($M = 5.1$) conditions, $F(1, 116) = 3.30$, $p = .001$, $\eta_p^2 = .09$.

To explore the causal relationships among the variables, we conducted a mediational analysis using data from the awe and neutral conditions.¹ Zero-order correlations of condition, awe, and supernatural control were significant, but when supernatural control was regressed on reported awe and condition simultaneously, only awe remained a reliable predictor (see the mediation model in Fig. 1). The decrease in the ability of condition to predict supernatural control was significant, Freedman-Schatzkin $t(78) = -4.75$, $p < .001$. This result suggests that no effect of the experimental manipulation independent of reported awe possessed causal efficacy in predicting supernatural belief. Furthermore, no other emotional state (happiness, amusement, sadness, fear, anger, gratitude, or disgust) mediated the relationship between condition and agency detection. In sum, the experience of awe had a causal effect on supernatural beliefs, and the effect was mediated by the reported experience of this (but no other) emotion.

Study 2

Study 1 supported the prediction that awe motivates agency detection within the domain of supernatural belief in a way distinct from other emotional states. Study 2 replicated the design of Study 1 with three exceptions:

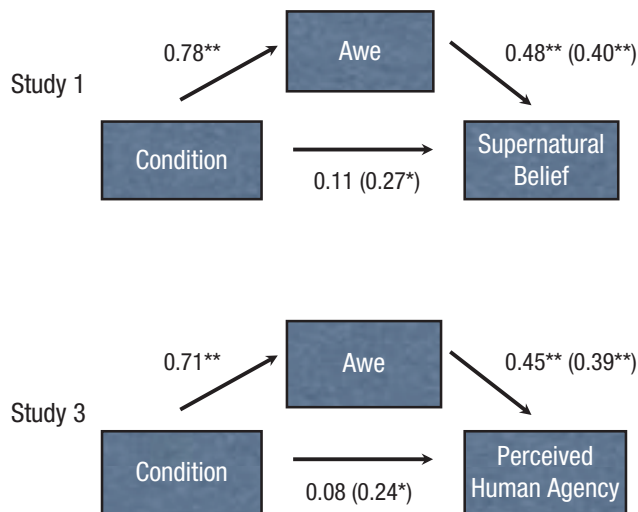


Fig. 1. Mediation models showing the effect of condition, as mediated by awe, on supernatural belief in Study 1 and on perceptions of human agency in Study 3. Standardized regression coefficients are shown (with standard errors in parentheses). Condition is dummy-coded, with higher values indicating awe. Asterisks indicate significant results ($*p < .05$, $**p < .01$).

(a) Study 2 was conducted in a controlled laboratory setting, (b) the positivity condition was dropped from the design, given that we found no relationship (both across conditions and in mediational analyses) between general positivity and supernatural belief, and (c) a measure of uncertainty tolerance was included. We hypothesized that awe would increase belief in supernatural forces, thereby replicating the results from Study 1, and that this effect would be driven by awe-induced changes in individuals' uncertainty tolerance.

Method

Participants. A total of 81 college students (51 female, 30 male; median age = 19) participated in a computer-based study in return for course credit. Participants were randomly assigned to one of two conditions: neutral or awe.

Procedure. Participants were told that the topic of the study was "personality and decision making" and were asked to watch a video on their computer and complete a series of questionnaires. The procedure then followed that of Study 1, with the exception that the nine-item Ambiguity subscale of the Need for Closure Scale (Webster & Kruglanski, 1994) was included as an index of individuals' uncertainty tolerance (example item: "I feel uncomfortable when I don't understand the reason why an event occurred in my life") and was administered directly after participants had watched the video. Participants responded to the items using scales from 1, *totally disagree*, to 6, *totally agree*. We also included four items known to be influenced by awe to further validate our experimental manipulation (example item: "I felt small or insignificant"; cf. Shiota et al., 2007). Finally, we administered the same emotional-state items used in Study 1, except that we replaced the item measuring amusement with one measuring joy as an index of positivity to ensure that the results from Study 1 did not depend on the arbitrary labeling of positive emotional states.

Results and discussion

Two participants were removed from analysis for failing manipulation checks. Participants in the awe condition experienced significantly more awe than did participants in the neutral condition, $t(77) = 11.26$, $p < .001$, $d = 2.54$. Participants also reported differences in other emotional states (see Table 2 for mean scores for self-reported emotional states in Studies 2 and 4). Validating the awe manipulation, results showed significant differences in the predicted direction for the items taken from Shiota et al. (2007; all $ps < .001$).

Replicating and extending results from Study 1, findings from Study 2 showed that participants' belief in

Table 2. Mean Scores for Self-Reported Emotional States in Studies 2 and 4

| Study and condition | Joy | Contentedness | Awe | Fear | Sadness | Anger | Gratitude | Disgust |
|---------------------|--------------|---------------|--------------|-------------|-------------|-------------|--------------|--------------|
| Study 2 | | | | | | | | |
| Awe | 3.9* (2.01) | 5.5* (1.27) | 6.28* (1.21) | 2.08 (1.49) | 2.64 (1.69) | 1.82 (1.67) | 4.95* (1.85) | 1.59 (1.39) |
| Neutral | 3.02 (1.59) | 2.63 (1.53) | 2.75 (1.55) | 1.5 (1.06) | 2.4 (1.5) | 1.6 (1.03) | 2.7 (1.9) | 2.18 (1.52) |
| Study 4 | | | | | | | | |
| Awe | 4.03* (2.78) | 5.67* (1.32) | 6.12* (1.0) | 1.82* (1.1) | 2.54 (1.57) | 1.38 (0.88) | 5.05* (1.62) | 1.38* (0.81) |
| Neutral | 2.78 (1.6) | 2.84 (1.44) | 3.0 (1.87) | 1.22 (0.53) | 2.08 (1.38) | 1.38 (0.92) | 2.97 (1.88) | 2.05 (1.22) |

Note: The table presents means for each measure. Standard deviations are shown in parentheses. For all items, responses were made using 7-point scales, with higher values indicating greater intensity of emotion. Asterisks indicate significant differences from the neutral condition (* $p < .05$).

supernatural control ($\alpha = .89$) was significantly greater in the awe condition ($M = 6.33$) compared with the neutral condition ($M = 5.16$), $t(77) = 2.06$, $p = .04$, $d = 0.47$. Reported belief in God followed the same pattern (awe: $M = 6.31$; neutral: $M = 4.88$), $t(77) = 2.67$, $p = .01$, $d = 0.60$.

Awe (and no other emotional state) mediated the relationship between condition and supernatural control. When awe was included in a model regressing supernatural control on condition, the decrease in the ability of condition to predict belief was significant, Freedman-Schatzkin $t(78) = 1.71$, $p < .05$. Also, as predicted, participants reported an increased intolerance for uncertainty ($\alpha = .72$) in the awe condition ($M = 4.44$) compared with the neutral condition ($M = 3.97$), $t(77) = 3.02$, $p = .003$, $d = 0.68$. To test the causal impact of awe on intolerance for uncertainty and belief in supernatural control, we conducted the path analysis depicted in Figure 2. As noted earlier, assignment to the awe condition predicted increased awe. The magnitude of the causal path linking condition to intolerance for uncertainty through awe approached significance, thereby suggesting mediation of intolerance for uncertainty by reported awe (MacKinnon's product of coefficient $Z' = 1.92$, $p = .054$). As predicted, increased intolerance for uncertainty directly led to increased belief in supernatural control. Finally, although condition did affect positivity, positivity did not affect intolerance for uncertainty. In sum, it appears that the effect of condition on supernatural belief occurs through awe-induced changes in uncertainty tolerance.²

Taken together, Studies 1 and 2 suggest an effect of awe on agency detection as a function of uncertainty tolerance. One possible alternative explanation for our results is that awe merely primes supernatural concepts (Van Cappellen & Saroglou, 2012). Although the mediation via uncertainty tolerance argues against this explanation, more definitive evidence would come from a demonstration of awe's effect on agency detection in a separate domain. Studies 3 and 4 provided this demonstration.

Study 3

If awe influences agency detection via uncertainty tolerance, then this effect should be domain independent. In Studies 3 and 4, we tested whether awe would affect intentional-pattern perception. Given that research has demonstrated individuals' motivation to see order in the world, and that one way to satisfy this motivation is to reinterpret random events as the product of intentional design (Bering, 2003; Clark, 1996; Epley et al., 2008), we reasoned that awe would increase the tendency to infer the hand of human agency in randomness as a function of increased intolerance for uncertainty.

Method

Participants. The study sample comprised 120 participants (78 female, 42 male; median age = 21) who were approached on a college campus and asked to participate in a study in return for \$3. Participants were randomly assigned to one of three conditions: neutral, awe, or positivity.

Procedure. We replicated the procedure used in Study 1 with the exception that we replaced the items measuring supernatural belief with a measure of *intentional design*. After viewing the video, participants completed a series of questionnaires presented on the iPad. The first was a numerical-judgment task that served as our index of intentional design. Participants were told that they would be presented with a series of ten 12-digit number strings of 1s and 2s that were either randomly generated by a computer program or intentionally designed by a human. Their task was to indicate the degree to which the numbers looked as if they had been generated by a human; responses were made using 10-point scales from 1, *definitely random*, to 10, *definitely human*. All number sequences were in fact randomly generated, identical across conditions, and randomized within trials. After completing this task, participants completed the same

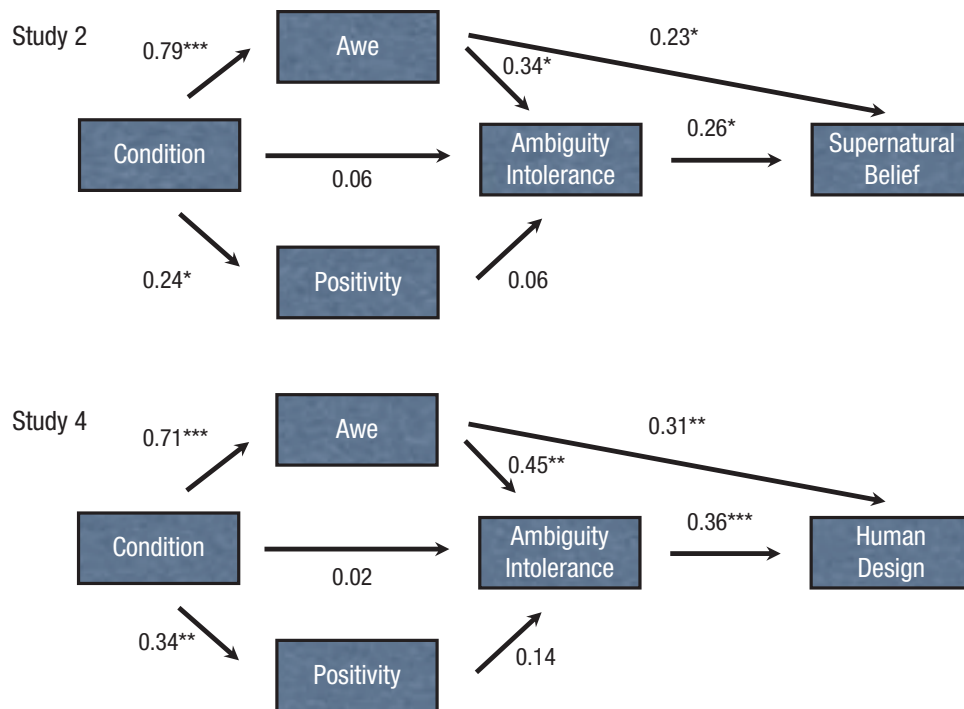


Fig. 2. Path models depicting the effect of condition, as mediated by emotional state (awe vs. positivity) and ambiguity intolerance, on supernatural belief in Study 2 and agency detection in Study 4. Parameters were estimated simultaneously. Condition is dummy-coded, with higher values indicating awe. Asterisks indicate significant paths (* $p < .05$, ** $p < .01$, *** $p < .001$).

emotion-manipulation checks used in the previous studies.

Results and discussion

Four participants were removed from analyses for not answering all items on the questionnaire. Participants experienced more awe in the awe condition compared with the neutral and positivity conditions, $F(1, 113) = 8.38$, $p < .001$, $\eta_p^2 = .39$. (see Table 1). Participants also experienced greater amusement in the positivity condition compared with the awe and neutral conditions, $F(1, 113) = 3.40$, $p = .001$. Other differences in emotional responding across conditions emerged as well (see Table 1).

The index of intentional design was created by averaging responses across the 10 numerical-judgment items ($\alpha = .67$). Of primary interest was the degree to which responses along this measure varied by condition. Participants' belief that random-digit strings were designed by human agents was significantly stronger in the awe condition ($M = 5.71$) compared with the neutral ($M = 5.14$) and positivity ($M = 4.74$) conditions, $F(1, 113) = 3.57$, $p = .001$, $\eta_p^2 = .12$. To test the causal relationship between variables, we conducted a mediational analysis using

data from the awe and neutral conditions. All zero-order correlations were significant (see Fig. 1), but when intentional design was regressed on awe and condition simultaneously, only awe remained a reliable predictor. The decrease in the ability of condition to predict belief was significant, Freedman-Schatzkin $t(74) = -5.14$, $p < .001$. This finding suggests that no other influence of the experimental manipulation independent of reported awe (e.g., differences in other emotional states) possessed causal efficacy in predicting judgments of intentional design. Furthermore, no other emotional state mediated the relationship between condition and agency detection.

Study 4

Study 3 supported the prediction that awe motivates agency detection within the domain of design judgments in a way distinct from other emotional states. Study 4 replicated the design of Study 3, except that (as with Study 2) it was performed in the lab, with the positivity condition omitted and a measure of uncertainty tolerance added. We hypothesized not only that awe would increase perception of intentional design, thereby replicating the effect found in Study 3, but also that this effect

would be mediated by changes in individuals' uncertainty tolerance.

Method

Participants. A total of 76 college students (41 female, 35 male; median age = 19) participated in a computer-based study in return for course credit. Participants were assigned to one of two conditions: neutral or awe.

Procedure. The procedure for Study 4 was the same as that for Study 2 with the exception that the questions about supernatural belief were replaced with the measure of intentional design from Study 3.

Results and discussion

Participants in the awe condition experienced significantly more awe than did participants in the neutral condition, $t(74) = 9.15$, $p < .001$, $d = 2.08$, and showed significant differences in scores on the items from Shiota et al. (2007; all $ps < .001$). Participants also reported differences in other emotional states (see Table 1). One item was dropped from the intentional-design scale because of low item-total correlation, which resulted in a nine-item scale ($\alpha = .66$).³ Replicating findings from Study 3, results showed that judgments of intentional design were significantly stronger in participants in the awe condition ($M = 6.14$) compared with participants in the neutral condition ($M = 5.39$), $t(74) = 3.40$, $p = .001$, $d = 0.77$. Again, awe (and no other emotional state) mediated the relationship between condition and design judgments. When awe was included in a model regressing design on condition, the decrease in the ability of condition to predict judgments was significant, Freedman-Schatzkin $t(74) = 4.49$, $p < .001$. Also, as predicted, participants reported an increased intolerance for uncertainty ($\alpha = .80$) in the awe condition ($M = 4.39$) compared with the neutral condition ($M = 3.92$), $t(74) = 2.45$, $p = .017$, $d = 0.56$.

To test the causal impact of awe on intolerance for uncertainty and intentional design, we conducted the path analysis depicted in Figure 2. As noted earlier, the manipulation of awe resulted in increased awe. The magnitude of the causal path linking awe to supernatural belief through intolerance for uncertainty was reliable, thereby demonstrating partial mediation of awe's effect on agency detection by intolerance for uncertainty (MacKinnon's product of coefficient $Z' = 2.07$, $p = .04$). Also as predicted, increased uncertainty intolerance directly led to increased judgments of human design. Finally, although condition did affect positivity, positivity did not affect uncertainty intolerance. In sum, it appears that the effect of condition on judgments of design occurred through awe-induced changes in intolerance for uncertainty.

Study 5

Although the results of Studies 1 through 4 suggest that the relationship between awe and agency detection is domain independent, one potential limitation to the effect's generalizability is the studies' reliance on one manipulation of awe. This limitation is particularly concerning with regard to effects on supernatural control given the conceptual relationship between awe and religiosity (Van Cappellen & Saroglou, 2012), as well as the possibility that seeing images of natural beauty might conjure thoughts of supernatural creators. To further establish the generalizability of our effect, in Study 5, we sought to replicate the effect found in Study 1 using a distinct manipulation borrowed from previous research on awe (Rudd et al., 2012). It is important to note that the stimuli used in this manipulation did not contain scenes of natural beauty but, instead, depictions of seemingly realistic but impossible images (e.g., waterfalls in city streets). Consequently, a successful replication of the results of Study 1 would provide further evidence that the effect of awe on agency detection cannot be explained by an association between natural beauty, or any other particular property of the stimuli used, and belief in the power of a creator.

Method

Participants. An online sample of 112 individuals (62 female, 50 male; median age = 33.5) recruited from Mechanical Turk participated in the study in return for \$1. Participants were assigned to one of two conditions: positivity or awe.

Procedure. The Study 5 procedure was identical to that of Study 1 with several exceptions. Participants watched either an awe-eliciting or a positivity-eliciting commercial for an LCD television (cf. Rudd et al., 2012), after which they completed a questionnaire that included the same set of dependent variables used in Study 1 but with two additions: attention checks related to the content of the video and a measure of the emotional state *elevation* (Haidt, 2003).

Results

Eighteen participants were excluded from analyses for failing attention checks. Replicating previous effects, results showed that condition predicted awe (positivity: $M = 2.55$; awe: $M = 4.66$), $t(92) = 6.43$, $p < .001$, as well as belief in supernatural control (positivity: $M = 4.58$; awe: $M = 5.79$), $t(92) = 2.15$, $p = .035$. Although differences in other emotional states once again emerged (gratitude, elevation, and sadness), only awe mediated the relationship between condition and agency

detection, Freedman-Schatzkin $t(92) = 2.60$, $p < .01$. Participants' reported belief in God also varied by condition (positivity: $M = 4.70$; awe: $M = 6.55$), $t(92) = 2.68$, $p = .009$.

General Discussion

The five studies reported here (a) provide the first experimental evidence that awe affects tolerance for uncertainty, (b) demonstrate a novel consequence of experiencing awe (agency detection), (c) distinguish the effects of awe from those of other emotional states (although future work might test specificity further through experimental manipulations of conceptually related states), and (d) identify intolerance of uncertainty as a mediator of awe's effect on agency detection. We predicted and found that experiencing awe, compared with other emotional states, heightened participants' agency detection in the context of both supernatural belief (Studies 1, 2, and 5) and judgments of intentional design (Studies 3 and 4). We also found evidence that these effects were partially mediated by awe-induced changes in participants' tolerance for ambiguity and uncertainty (Studies 2 and 4). Importantly, we report both conceptual and direct replications of these effects (cf. Makel, Plucker, & Hegarty, 2012).

In sum, feelings of awe increase agency detection in both supernatural and mundane contexts, and the effect is produced, at least in part, by an increase in uncertainty tolerance. Although the chronic relation between experiences of awe and uncertainty tolerance (Shiota et al., 2007) suggests that uncertainty tolerance can be strengthened over time, the present results suggest that in the moment of awe, some of the fear and trembling can be mitigated by perceiving an author's hand in the experience.

Author Contributions

P. Valdesolo and J. Graham designed the studies and composed and edited the manuscript. P. Valdesolo conducted the studies and data analysis.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

Notes

1. Given that amusement is a separate emotional state with no effect (relative to neutral mood) on belief in supernatural control, this condition was not included in mediational analyses.
2. Awe maintained a significant effect on agency detection when we controlled for intolerance for ambiguity (in Studies 2 and 4). Whether this result reflects the impact of awe through an unmeasured mediator or the limitations of our measure of

intolerance for ambiguity and uncertainty remains an open question.

3. The pattern of results was identical when this item was left in.

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