

# When Awe Strikes: The Ebb of Loneliness in Response to Awe and Human Connection

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## ABSTRACT

The current work examined whether awe fosters social connections to either large or small collectives and, if so, if such connections predict lower loneliness. In two studies, participants watched a video designed to elicit awe or amusement and then reported their feelings of social connections to humanity, social connections to close friends, and loneliness. Findings in both studies showed that awe had an indirect effect on loneliness via social connections with humanity, such that awe (compared to amusement) triggered greater social connections to humanity, which predicted less loneliness. Implications for the awe and loneliness literatures are discussed.

## Introduction

In July 2022, NASA publicly revealed the first images from its Webb telescope in a live-streamed broadcast. Those images showed the vastness and wonder of the universe with a sharpness and precision never before seen. Viewers around the globe were likely awestruck. How might such feelings impact these stargazers?

Attempts to answer such questions – to determine the downstream consequences of emotional experiences – are not new. Indeed, such pursuits have been of interest to psychologists for decades (e.g., Isbell & Lair, 2013; van Kleef & Côté, 2022). Many of the so-called basic emotions, like sadness, anger, and fear, have been studied at length. And, to date, scholars know much about the cognitions and behaviors they trigger. Yet, relatively less is known about the sequelae of complex emotions we frequently experience, such as jealousy, shame, and awe. In this work, we aim to study the latter of these emotions – awe – and its possible impact on loneliness.

## Awe and Loneliness

Awe is an emotional response to a stimulus that is “vast and...requires accommodation” (Keltner & Haidt, 2003, p. 297). Vastness can (and often does) originate from large physical size, but can also arise from features that cause a person to rethink their typical conceptualization of a stimulus on other dimensions as well, including space, time, ability, or complexity (Shiota et al., 2007). Because awe changes one’s typical frame of reference, this necessitates an attempt to accommodate – to expand or change one’s current schemas to include the stimulus at hand (Shiota et al., 2007). This helps explain the wide array of seemingly disparate stimuli that can prompt awe, including sweeping nature scenes, encounters with inspirational leaders, and witnessing childbirth (Keltner & Haidt, 2003).

Awe is considered a self-transcendent emotion. One critical function of such emotions is to “foster healthy social relationships, binding individuals together through prosociality” (Stellar et al., 2017, p. 203). To date, there is ample empirical evidence that awe does indeed serve a social function. For instance, in multiple studies, awe made people feel small and, because of this, shifted their attention to the needs of others, resulting in a variety of prosocial actions (Piff et al., 2015). Additionally, those living where they could fully view the 2017 solar eclipse (compared to those living elsewhere) used more prosocial, affiliative, and collective language in their Twitter remarks on that day,

and these effects were mediated by expressed awe in that language (Goldy et al., 2022). Relatedly, adults aged 60+ assigned to take repeated weekly “awe walks” (compared to repeated control walks) experienced increases over time in prosocial emotions, such as compassion and admiration (Sturm et al., 2022).

The apparent social-enhancing function of awe, we believe, may have implications for one’s current feelings of loneliness. Loneliness is a “distressing feeling that accompanies the perception that one’s social needs are not being met by the quantity or especially the quality of one’s social relationships” (Hawkley & Cacioppo, 2010, p. 218). To date, there is no existing work directly investigating whether awe causally impacts loneliness. However, experiencing awe might feasibly trigger temporary reductions in loneliness given that lonely people feel that their social bonds are lacking, and awe fosters sociality via prosocial tendencies and emotions. Non-experimental evidence provides some indirect support for this prediction. Namely, those who score higher on a combined measure of dispositional awe and gratitude report being less lonely (Büssing et al., 2021).

If awe does reduce loneliness by facilitating feelings of social connection, as we predict, what is the nature of this social connection? Analysis of the literature suggests that awe could foster (1) social connections to especially large groups or (2) social connections to more intimate groups. For instance, in one experiment, participants were induced to feel awe or not and then completed a social connections scale that included items like “I felt a strong sense of intimacy with the people I spend time with” as well as “I felt close and connected with all of humanity” (Nelson-Coffey et al., 2019; Exp 2; see their online supplemental materials). Those in the awe condition scored higher on this measure. Because this measure tapped a combined index of social connections to both large and small groups, it is plausible that awe facilitates both. Thus, either type of social connection could mediate awe’s hypothesized impact on loneliness.

In the current work, the large social group of interest is all of humanity. Beyond the findings of Nelson-Coffey and colleagues (2019), there are multiple other works showing that awe may foster connections to humanity specifically. For instance, Shiota and colleagues (2007) found that people feeling awe-struck (compared to a neutral control condition) more frequently finished “Who am I?” prompts with “universal” terms, such as describing one’s self as “an inhabitant of the Earth” (Shiota et al., 2007, p. 957), implying that awe induces a sense of oneness within vast social collectives, like all of humanity. Indeed, those who wrote about a beautiful nature scene (the awe condition) reported stronger feelings of connection with “the world around me” than did those who wrote about feeling proud (Shiota et al., 2007, p. 952).

Awe might facilitate connections with all of humanity for two reasons. First, recall that accommodation is one of the key ingredients of awe. Typical mental schemas of our social networks likely include friends, family, co-workers, and identity-salient cultural groups. Awe prompts an attempt to change current schemas in ways that may allow the integration of new exemplars (Shiota et al., 2007). Thus, in the face of awe, one’s conceptualization of available social networks may expand to include humanity as a whole – a group most people are not likely to consider as a social connection source.

Second, awe reliably elicits feelings of the so-called “small self” (e.g., Bai et al., 2017; Piff et al., 2015; see also Chen & Mongrain, 2021 for a brief review). In the face of a vast, awe-eliciting stimulus, people feel comparatively tiny and insignificant. This foregrounds the vastness of the environment or even the entire outside world. Thus, all of humanity is perhaps more perceptually salient than normal.

Complementing the work showing possible social connections with large collectives, research also shows that awe can and does trigger deeper feelings of social connection to smaller and more intimate groups as well. For instance, among participants from a collectivist culture (China), those experimentally induced to experience awe (versus amusement) portrayed smaller distance (in a drawing) between themselves and members of their social network, indicating greater psychological closeness to important specific people in their lives (Bai et al., 2017). In this same study, awe-induced (versus amusement-induced) people from an individualistic culture (America) portrayed a significantly larger number of people in their social network drawings (Bai et al., 2017). Moreover, in other work, as a

person's religiosity increased, their perceived closeness with their friends also increased after watching an awe-inducing video showing childbirth (this same effect was absent after watching a humor-inducing video or an awe-inducing video of nature; Van Cappellen & Saroglou, 2012).

In summary, then, awe may foster a greater sense of social closeness with small groups, such as one's family members or close friends, and awe may foster social connections by expanding the scope of our social networks to include large collectives, like all of humanity. Loneliness is a subjective state triggered by feeling that one lacks sufficient, high-quality social connections. Thus, if awe fosters or enhances either type of social connection, it might logically ease loneliness. The loneliness-easing pathway via connections to friends makes intuitive sense. If awe makes social connections with small groups, like existing friends, seem richer and closer, this necessarily enhances the perceived quality of those relationships, which should theoretically ease loneliness.

A possible loneliness-easing pathway via social connections to humanity might occur for one of two reasons. First, if awe fosters social connections with all of humanity, this may make people more cognizant of a wider pool of potential social prospects with which to make high-quality friendships. That is, perhaps awe makes people more socially optimistic – expanding the perceived pool of social opportunities – which might lessen feelings of loneliness.

Second, it is possible that a perceived connection to all of humanity acts as a type of para-social (one-way) relationship. In para-social relationships, a person has affinity for (or closeness with) another entity, even though that entity does not reciprocate (e.g., in the case of a celebrity) or cannot reciprocate those feelings (e.g., in the case of a fictional person, like a TV character). Despite the one-way nature of these “relationships,” evidence shows that they can ease thoughts of loneliness and buffer people from social belonging threats (e.g., Derrick et al., 2009). Of relevance to this work, people can have para-social feelings of connection to vast entities, such as nature (e.g., Nisbet et al., 2011). Indeed, Yang et al. (2021) showed that viewing scenes of nature (versus control scenes) buffered people psychologically following ostracism. These findings suggest that feeling connected to nature provides some benefits of social belonging, even though nature cannot directly provide one with a conventional social relationship in return. Therefore, it seems completely feasible that feeling more connected to all of humanity might, too, foster feelings of social belonging in a para-social manner, even though all of humanity cannot have reciprocal feelings.

## Hypotheses and Overview

The goal of this work was to explore the possible impact of awe on loneliness. In each of two studies, participants watched a video that induced awe or amusement (control condition) and then reported their feelings of social connection to humanity and their close friends, as well as their current levels of loneliness. Both studies explored the hypothesis that those in the awe (relative to the amusement) condition would reported lower loneliness. Moreover, and for reasons articulated previously, we expected that social connections with humanity and/or social connections with close friends would mediate this effect. That is, we expected that awe-induced participants would feel less lonely because they felt more connected to humanity, to their friends, or to both.

To our knowledge, this is the first work to examine whether awe has a causal impact on loneliness and, if it does, to examine any mediators of this effect. Loneliness leaves people vulnerable to problems beyond mere emotional distress. It predicts a variety of physical ailments, such as arthritis and emphysema (Tomaka et al., 2006), as well as mental illnesses such as depression, generalized anxiety, and suicidal ideation (Beutel et al., 2017). Most seriously, loneliness can prove fatal. In a meta-analysis, researchers found that loneliness increased mortality by 26% (Holt-Lunstad et al., 2015). Therefore, investigating factors that might ease loneliness could prove useful for scholars and practitioners looking to protect physical health and well-being.

## Experiment 1

### Participants

We recruited students from a public, Midwestern university to participate in this study for course credit. To determine our target sample size, we assumed a medium effect ( $d=.5$ , per Cohen, 1992) and conducted power analyses with the aid of G\*Power (Faul et al., 2007). These analyses indicated that 64 participants per condition (or a total  $N = 128$ ) were necessary to achieve 80% power (assuming an alpha level of .05) to detect the hypothesized mean difference in loneliness across the awe and amusement conditions.

To ensure we acquired at least the target  $N$  of 128, we posted experimental appointment slots beyond the needed 128 to account for “no show” participants. This over-booking technique helped ensure that we attained the minimum target  $N$  efficiently but, in this case, resulted in a greater number of participants than targeted. Thus, in total, 129 students participated (27 male-identified, 99 female-identified, 1 transgender-identified, 1 gender-fluid identified, and 1 who declined to report their gender identification). Participants were approximately 79% White, 5% African American, 1% Latino/a, 8.5% Asian, and 4% multiracial, while 2% did not report their racial/ethnic identification. All participants were retained in all analyses (i.e., no participants were omitted for any reason), and data analysis did not begin until all data collection ceased. All data for this study can be found on this project’s Open Science Framework page ([https://osf.io/wbr87/?view\\_only=d16595f2c6d84003833690ec82e55198](https://osf.io/wbr87/?view_only=d16595f2c6d84003833690ec82e55198)).

### Measures and Materials

#### *Emotion Manipulation*

To manipulate emotional experience, participants watched one of two videos. The awe-inducing video was roughly 5 minutes featuring segments from BBC’s *Planet Earth* depicting majestic nature scenes (shots of mountains, canyons, etc.). The amusement-inducing video was roughly 5 minutes featuring scenes from BBC’s *Walk on the Wild Side* depicting footage of animals in their natural environment with comedic narration. Previous studies have used these videos to evoke the targeted emotional states (e.g., Valdesolo & Graham, 2014), and the authors wish to thank Piercarlo Valdesolo for providing access to these videos. The amusement-inducing video served as an especially good comparison condition because, just like the awe-inducing video, it also should induce a positive emotional state, and it depicted nature throughout. Therefore, if the awe condition produced greater feelings of social connection or reduced loneliness compared to the amusement condition, such differences could not be attributable to global positivity or exposure to nature. We do wish to note that the experienced valence of awe is more complex than many other emotions. Awe often feels positive, though this can vary by context. For instance, awe may feel negative if elicited by threatening stimuli, such as a tornado (Gordon et al., 2017). In the current work, the awe-eliciting stimuli were not threatening, and thus awe was likely experientially positive.

#### *Feelings of Social Connection*

To assess feelings of social connection, we used the Identification with All Humanity Scale (IWAH; McFarland et al., 2012). This measures connections to (or closeness with) all humanity. In the original scale-development work, McFarland et al. (2012) compared connections with humanity to other groups (e.g., “people in my community,” Americans; p. 832). For the purposes of the current study, participants rated their social connections to their close friends and all humanity.

This instrument has 18 total items, 9 each that assess social connections with close friends and humanity. Participants responded to each item using a 5-point Likert scale, with end-point options that changed depending on

the question. A sample item is: “How close do you feel to the following group?” and participants responded from 1 (*not at all close*) to 5 (*very close*). Participants completed this question twice, once for their close friends and once for all of humanity. The nine items were averaged, separately for each group, to create indices capturing social connections to close friends and social connections to humanity. Responses on both indices were highly reliable ( $\alpha_{\text{Friends}} = 0.82$  and  $\alpha_{\text{Humanity}} = 0.81$ ).

### *Loneliness*

To assess feelings of loneliness, we used the twenty-item UCLA Loneliness Scale (Version 3; Russell, 1996). This scale in its original form measures chronic loneliness, but due to the current research question, we modified the scale wording slightly to refer to the participant in first-person and to capture current (state) loneliness. For instance, an original item asks participants “How often do you feel alone?” In the current work, this item instead read, “I feel alone,” and participants rated the degree to which they currently felt this way on a 4-point Likert scale ranging from 1 (*Not at all*) to 4 (*A great deal*). After appropriate reverse scoring, all items were averaged into a loneliness index ( $\alpha = 0.94$ ).

### *Emotion Measure*

To determine the effectiveness of the emotion manipulation, participants self-reported their emotional states. Using a 7-point Likert scale ranging from 1 (*Not at all*) to 7 (*Extremely*), participants reported their current feelings of awe, fear, amusement, anger, happiness, disgust, and sadness (measure taken from Bai et al., 2017; Exp 5). Of interest were the single items capturing awe and amusement.

### *Procedure*

Participants reported to an on-campus psychology laboratory and were greeted by a research assistant. After consenting, participants completed the study on a computer in a private room. They first watched either the awe- or the amusement-inducing video (determined via random assignment). Following the videos, participants completed the emotion measure, which served as a manipulation check. Subsequently, they completed the UCLA Loneliness Scale (Version 3) and the IWAH Scale (assessing social connections to both humanity and their close friends). The computer randomized whether the loneliness or the IWAH measure appeared first. Finally, participants reported demographic information, and then were debriefed, thanked, and dismissed by the research assistant.

### *Results and Discussion*

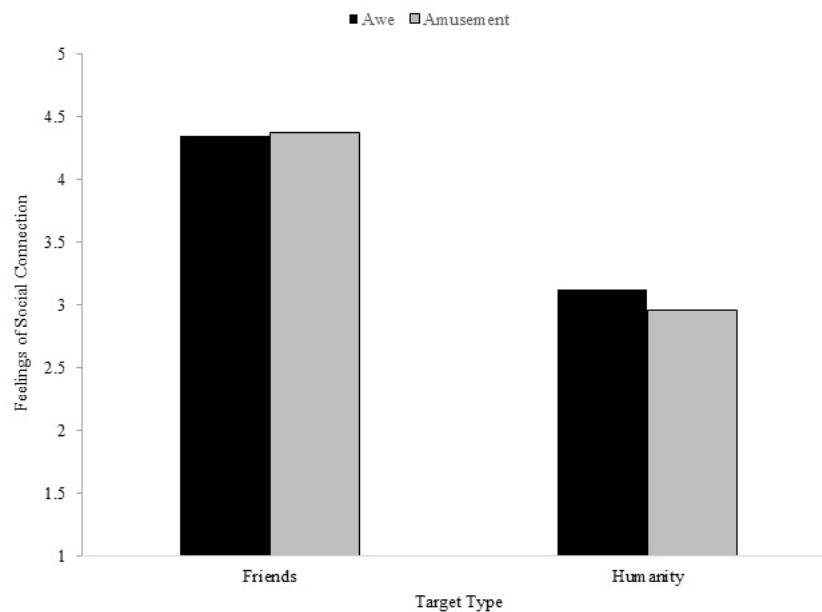
#### *Manipulation Check*

To determine whether the emotion manipulation produced the target emotions, we ran independent samples *t*-tests comparing those in the awe and amusement conditions on the single-item measure of self-reported awe and amusement (separately). As anticipated, participants in the awe condition ( $M = 5.59$ ,  $SD = 1.41$ ) felt more awe than those in the amusement condition ( $M = 3.34$ ,  $SD = 1.73$ );  $t(127) = 8.12$ ,  $p < 0.001$ . Also as expected, participants in the amusement condition ( $M = 5.52$ ,  $SD = 1.44$ ) felt more amusement than those in the awe condition ( $M = 4.44$ ,  $SD = 1.81$ );  $t(127) = -3.78$ ,  $p < 0.001$ . These findings suggest the emotion manipulation was successful.

### Hypothesis Testing

We hypothesized that those in the awe (relative to the amusement) condition would report less loneliness. For reasons articulated in the introduction, we expected that either or both social connections with humanity or social connections with close friends might act as a mediator of this effect. That is, we expected that awe-induced participants would feel less lonely because they felt more socially connected to humanity and/or to friends.

As a preliminary examination, we first ran a  $2 \times 2$  mixed-model ANOVA, with Induced Emotion (Awe, Amusement) as the between-subjects factor and Target (Humanity, Close Friends) as the within-subjects factor, to determine if the emotion manipulation differentially impacted feelings of social connection to close friends and humanity. Not surprisingly, this analysis revealed a main effect of Target, such that participants reported greater social connections overall to their close friends ( $M = 4.36$ ,  $SE = 0.04$ ) than to all of humanity ( $M = 3.03$ ,  $SE = 0.05$ );  $F(1,127) = 661.23$ ,  $p < 0.001$ . Of greater theoretical relevance, this analysis also revealed an interaction between Induced Emotion and Target that just missed conventional levels of significance,  $F(1,127) = 3.78$ ,  $p = 0.054$ . As shown in Figure 1, participants felt directionally more socially connected to humanity in the awe ( $M = 3.12$ ) as compared to the amusement condition ( $M = 2.95$ ,  $p = 0.089$ ), but there was no difference across the awe ( $M = 4.34$ ) and amusement conditions ( $M = 4.37$ ) on social connections to close friends,  $p = 0.722$ .



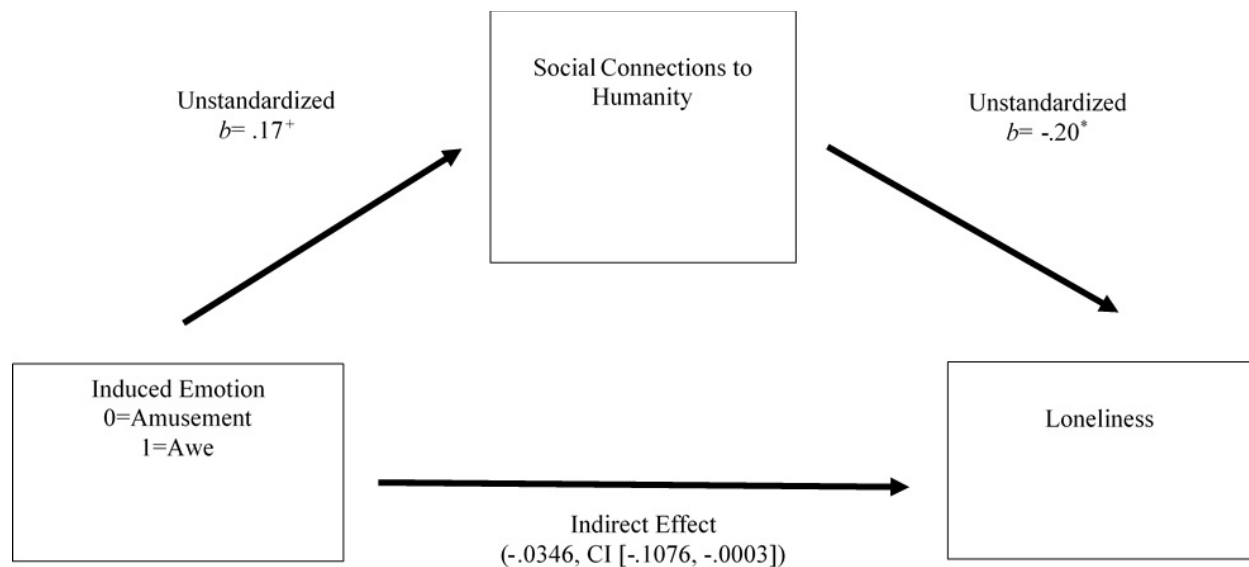
**Figure 1.** Feelings of social connection as a function of target type and induced emotion (Experiment 1).

Next, we examined whether awe impacted loneliness in a direct, unmediated manner. To do this, we ran an independent samples  $t$ -test comparing participants in the awe and amusement conditions on the loneliness index. Results revealed that those in the awe condition ( $M = 1.84$ ,  $SD = 0.55$ ) did not report less loneliness than those in the amusement condition ( $M = 1.83$ ,  $SD = 0.56$ ),  $t(127) = 0.17$ ,  $p = 0.864$ . Therefore, the results of this analysis suggested that awe does not directly impact loneliness.

Despite the absence of this direct effect, our hypothesized indirect effect of awe on loneliness, as mediated by social connections with humanity and/or friends, remained possible. To test this mediational hypothesis, we used Hayes's (2013) PROCESS macro (model 4; Version 2.16.3) with Induced Emotion (0=amusement; 1=awe) as the independent variable, social connections as the mediator, and loneliness as the outcome variable. We ran two versions

of this model. In the first, social connections to humanity was the mediator and, in the second, social connections to friends was the mediator.

In the first model, the predicted indirect effect emerged; Indirect effect:  $-.0346$ ,  $SE = .0251$  [95% CI:  $-.1076$ ,  $-.0003$ ]. Relative to amusement, awe triggered greater social connections to humanity, and, as people experienced more social connections to humanity, they reported lowered feelings of loneliness (see Figure 2). The second model, that used social connections to close friends as the mediator, did not yield a similar indirect effect:  $.0193$ ,  $SE = .0545$  [95% CI:  $-.0895$ ,  $.1305$ ]. Thus, these effects support the conclusion that awe-induced (relative to amusement-induced) participants felt less lonely because they felt more connected to humanity specifically.



**Figure 2.** Effect of induced emotion on loneliness as mediated by social connections to humanity (Experiment 1). Note: +  $p < .1$ ; \*  $p < .05$ .

Overall, the findings of Experiment 1 provided initial, though somewhat tentative, support for our hypothesis that feelings of social connection mediate the predicted impact of awe on lower reported loneliness. In these initial data, it was social connections to humanity only that emerged as a mediator. Though this indirect effect emerged, one link in this model (between awe and connections to humanity) just missed conventional levels of statistical significance.

In preparation for Experiment 1, we assumed a medium effect size for the power analysis to detect a mean difference in loneliness between the awe and amusement conditions. However, our specific hypothesis did not anticipate a simple mean difference, but instead predicted a mediated, indirect effect. Thus, ideally, we should have performed a power analysis to determine the needed sample size for the latter instead of the former type of effect. Without this power analysis, the acquired sample size in Experiment 1 may not have been adequate to test the hypothesized effect with sufficient power.

Therefore, in advance of Experiment 2, we conducted a more appropriate power calculation: one designed to determine the needed sample size for a mediational effect specifically. Moreover, in Experiment 2 we based our estimation of the relevant effect size on the observed relations among variables in Experiment 1. Thus, the purpose of Experiment 2 was to attempt to replicate Experiment 1's findings in a more appropriately powered study.



## Experiment 2

### Participants

Before launching Experiment 2, we conducted a power analysis aided by Schoemann and colleagues' (2017) Monte Carlo-based tool to determine the relevant sample size needed to detect the mediated effect of induced emotion (awe versus amusement) on loneliness via social connections. Into this tool, we input the desired power (70%), and the expected correlations between X (induced emotion condition), Y (loneliness), and M (social connections; specifically to humanity, as this was the social connection type that seemed most viable). We used the observed correlations among these variables from Experiment 1 to determine the estimates. Namely, in Experiment 1, the X-M relation was  $r = .15$ , the M-Y relation was  $r = -.20$ , and the X-Y relation was  $r = .02$ . The tool also requires the standard deviations for each respective variable (which, again, were taken from Experiment 1). The analysis suggested that  $N = 245$  participants would yield 70% power to detect the hypothesized effect, with a 90% CI range of [.66, .75].

To ensure we acquired at least the target  $N$  of 245, we again used the over-booking technique (described earlier in Experiment 1). In doing so, we recruited 259 students (73 male-identified, 185 female-identified, and 1 “non-binary female” identified). Participants were approximately 74% White, 3% African American, 3.5% Latino/a, 16% Asian, 0.4% Pacific Islander, and 3% multiracial, while 0.4% declined to report their racial/ethnic identification. As was the case in Experiment 1, all participants in Experiment 2 were retained in all analyses (i.e., no participants were omitted for any reason), and data analysis did not begin until data collection ceased. As was the case for Experiment 1, all data for Experiment 2 can be found publicly here:

([https://osf.io/wbr87/?view\\_only=d16595f2c6d84003833690ec82e55198](https://osf.io/wbr87/?view_only=d16595f2c6d84003833690ec82e55198)).

### Procedure

The procedures for Experiment 2 followed those used in Experiment 1, with one minor exception. In Experiment 1, the computer randomized the order of the loneliness and the IWAH scales. In Experiment 2, the proposed mediator always came first, followed by the loneliness measure.

## Results and Discussion

### *Manipulation Check*

To determine whether the emotion manipulation produced the target emotions, we ran independent samples  $t$ -tests comparing those in the awe and amusement conditions on the single-item measure of self-reported awe and amusement (separately). As anticipated, participants in the awe condition ( $M = 5.75$ ,  $SD = 1.30$ ) felt more awe than those in the amusement condition ( $M = 3.32$ ,  $SD = 1.55$ );  $t(257) = 13.70$ ,  $p < 0.001$ . Also as expected, participants in the amusement condition ( $M = 5.12$ ,  $SD = 1.60$ ) felt more amusement than those in the awe condition ( $M = 4.62$ ,  $SD = 1.65$ );  $t(257) = -2.48$ ,  $p = 0.014$ . These findings suggest the emotion manipulation was again successful in this second experiment.

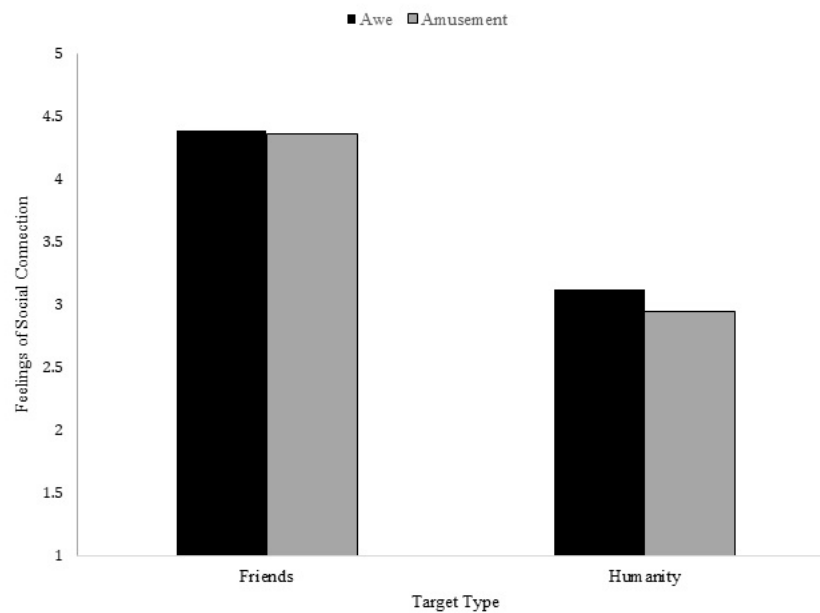
### *Hypothesis Testing*

As in Experiment 1, we again hypothesized that those in the awe (relative to the amusement) condition would report less loneliness via its impact on social connections. That is, we expected that awe-induced participants would feel less lonely because they felt more socially connected.



Just as in Experiment 1, we began by conducting a  $2 \times 2$  mixed-model ANOVA, with Induced Emotion (Awe, Amusement) as the between-subjects factor and Target (Humanity, Close Friends) as the within-subjects factor, to determine if the emotion manipulation differentially impacted feelings of social connection to close friends ( $\alpha_{\text{Friends}} = 0.82$ ) and humanity ( $\alpha_{\text{Humanity}} = 0.78$ ). Replicating Experiment 1, participants reported greater social connections overall to their close friends ( $M = 4.38, SE = 0.03$ ) than to all of humanity ( $M = 3.03, SE = 0.03$ );  $F(1,257) = 1293.29, p < 0.001$ . This analysis also yielded a main effect of Induced Emotion, such that participants in the awe condition reported stronger social connections ( $M = 3.76, SE = 0.03$ ), collapsing across type, than did participants in the amusement condition ( $M = 3.65, SE = 0.03$ );  $F(1,257) = 4.97, p = 0.027$ .

These main effects were subsumed by a significant interaction between Induced Emotion and Target,  $F(1,257) = 4.04, p = 0.046$ . As shown in Figure 3, participants felt more socially connected to humanity in the awe ( $M = 3.12$ ) as compared to the amusement condition ( $M = 2.94, p = 0.005$ ), but there was no difference across the awe ( $M = 4.39$ ) and amusement conditions ( $M = 4.36$ ) on social connections to close friends,  $p = 0.566$ . Thus, as was suggested in Experiment 1, awe (relative to amusement) seemed to enhance social connections specifically to humanity.



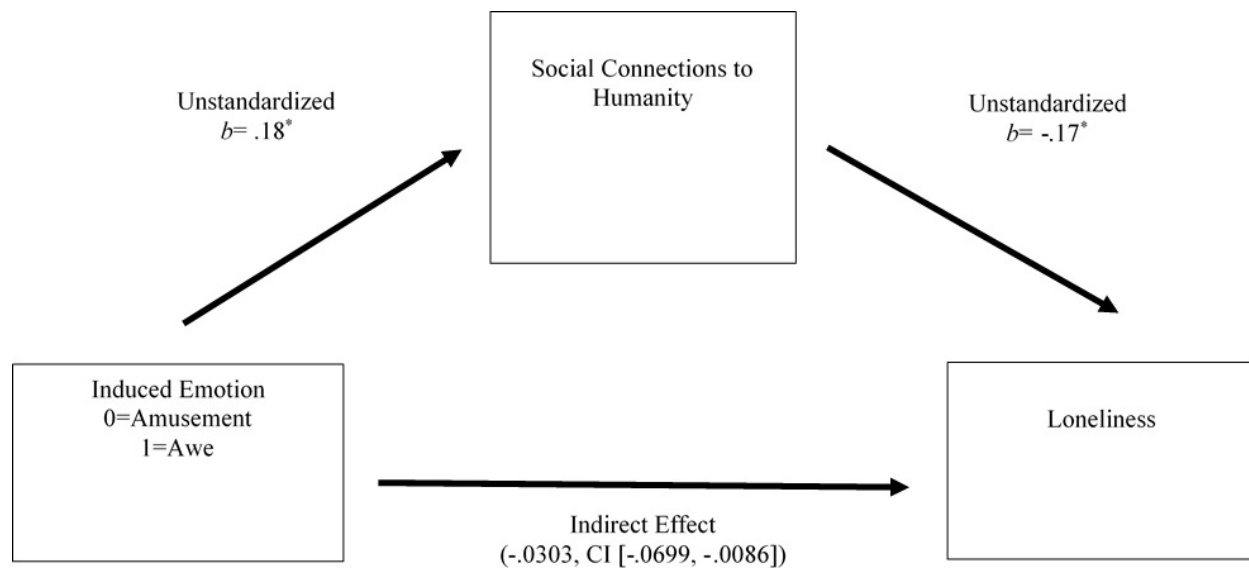
**Figure 3.** Feelings of social connection as a function of target type and induced emotion (Experiment 2).

Next, to examine awe's possible direct, unmediated impact on loneliness, we ran an independent samples  $t$ -test comparing participants in the awe and amusement conditions on the loneliness index ( $\alpha=0.92$ ). Mirroring Experiment 1's results, those in the awe condition ( $M = 1.79, SD = 0.48$ ) did not report less loneliness than those in the amusement condition ( $M = 1.78, SD = 0.48$ );  $t(257) = 0.15, p = 0.881$ . Thus, as in Experiment 1, the results of this analysis suggested that awe does not directly impact loneliness.

Next, as we did in Experiment 1, we tested the hypothesized indirect effect of awe on loneliness, as mediated by social connections. To do this, we again used Hayes's PROCESS macro (model 4; Version 2.16.3) with Induced Emotion (0=amusement; 1=awe) as the independent variable, social connections as the mediator, and loneliness as the outcome variable. Mirroring Experiment 1, we again ran two versions of this model. In the first, social connections to humanity acted as the potential mediator. In the second model, social connections to friends acted as the potential mediator.

Replicating Experiment 1, we observed a significant indirect effect in the first model; Indirect effect:  $-.0303, SE = .015$  [95% CI:  $-.0699, -.0086$ ]. The pattern of this indirect effect was identical to Experiment 1: relative to

amusement, awe triggered greater connections to humanity, and, as people experienced more social connections to humanity, they reported lowered feelings of loneliness (see Figure 4). The second model, that used social connections to close friends as the mediator, did not yield a similar indirect effect:  $-.0167$ ,  $SE = .0294$  [95% CI:  $-.0740, .0422$ ].



**Figure 4.** Effect of induced emotion on loneliness as mediated by social connections to humanity (Experiment 2). Note: \*  $p < .005$ .

Thus, these effects supported the hypothesis that awe-induced (relative to amusement-induced) participants felt less lonely because they felt more socially connected. As in Experiment 1, only social connections with humanity (but not social connections with friends) acted as the mediator. Overall, then, these mediational results replicated the findings from Experiment 1, and did so with a sample twice as large, yielding additional confidence in the reliability of the observed findings.

## General Discussion

In this work, we hypothesized that awe (relative to amusement) would elicit lower loneliness via greater social connections to humanity, to friends, or to both groups. In both Experiments 1 and 2, we found support for this prediction, with social connections to humanity (only) acting as a mediator. Specifically, awe-induced participants reported greater feelings of social connections with humanity and, to the extent they did so, this predicted less loneliness. However, awe (relative to amusement) did not change participants' sense of social connections to their close friends, and there was no indirect effect of awe on loneliness via these latter connections. Overall, then, it appears that awe – via connections to humanity specifically – triggers less loneliness.

The current investigation adds to our theoretical understanding of awe and its psychological consequences in three primary ways. First, this work supports the classification of awe as a self-transcendent emotion (Stellar et al., 2017). Such emotions are thought to help bind people to others. In the current work, awe (but not amusement) did increase subjective social connections with humanity. Thus, this work further bolsters the empirical basis to place awe alongside the broader class of other self-transcendent emotional states.

Second, this work illustrates that awe can predict lower feelings of loneliness via its impact on connections to humanity. To our knowledge, this work is the first to examine loneliness in response to an awe manipulation,

establishing that awe has more profound psychological benefits than were previously known. This effect aligns with our understanding of self-transcendent emotions. If awe, as a self-transcendent emotion, can foster social bonds, a logical consequence of this is that it might counteract subjective feelings of insufficient social relationships, which would reduce loneliness by definition (e.g., Hawkley & Cacioppo, 2010). This work illustrated such a relationship for the first time.

Third, this work may prompt greater theoretical development and understanding of precisely which types of social connections awe fosters. In both the current two experiments, awe (relative to amusement) triggered greater perceived connection/closeness with all of humanity. This finding is quite consistent with several other findings showing that awe makes people feel connected to things much larger than the self (e.g., Shiota et al., 2007). Yet, awe did not foster greater feelings of perceived connection/closeness with their close friends, inconsistent with some prior work.

Though we had not predicted this null finding regarding connections to friends, there are hints in the literature that awe's link to perceived closeness to friends may be nuanced and complex. Namely, consider the work of Bai et al. (2017), described earlier in the introduction. Those authors found that awe prompted greater feelings of closeness with members of one's social network for Chinese participants, but prompted American participants to report a significantly larger number of people in their social networks. Thus, that work suggests that awe may foster greater feelings of social relatedness, but the manner or expression of such connection may be culturally influenced. Indeed, based on their synthesis of the literature, Bai et al. (2017) argued that "individuals from collectivist cultures seek security and strong ties with known others, whereas people from individualistic cultures tend to prefer a wider and more loosely connected social network, with ties to strangers as well as intimates" (p. 188), and their findings supported this conjecture.

In the two currently reported studies, the participants were recruited from an American university (an individualistic culture). Thus, if Bai et al.'s analysis is correct, in retrospect, it is perhaps less surprising that awe didn't have an impact on enhancing feelings of closeness to existing "intimates" (p. 188) as its function for individualists may be to *expand* perceptions of our social networks. Given that awe, for these types of participants in our study, impacted feelings of social connection to humanity, but not friends, may add greater support to Bai et al.'s (2017) cultural analysis of the ways in which awe may function.

At the applied level, the current work suggests that awe inductions might be fruitful for treatments designed to bolster mental health, physical health, or other indicators of positive well-being. As noted earlier, loneliness is a risk factor for a range of mental and physical health problems (e.g., Hawkley & Cacioppo, 2010). If inducing awe does, indeed, reduce such feelings indirectly, this feasibly could buffer people from the typical harmful effects of loneliness. Indeed, the possibility that awe might provide broad-scale psychological benefits is found in other work. For instance, Rudd and colleagues (2012) showed that those randomly assigned to an awe (versus a neutral) condition reported greater life satisfaction. Future work is needed to determine if awe's apparent indirect impact on reductions in loneliness may elicit other mental/physical health benefits.

## Limitations and Future Directions

Despite their contributions to the existing awe and loneliness literatures, the current studies have limitations that should be addressed in future investigations. First, the current work relied on a single awe manipulation. Future studies should use other methods of inducing awe, such as placing people in-vivo within an awe-striking scene (e.g., Piff et al., 2015). Doing this would help confirm that the current results are not unique to the specific videos used here. Second, this work examined only the short-term impact of awe on state loneliness. Thus, it is not known whether the feeling of awe can be sustained across time or whether awe's indirect impact on reduced loneliness could remain hours, days, or weeks after exposure to it. Future research should test these possibilities.

Third, this study used amusement as the only comparison condition to awe. As noted earlier, this design is beneficial for ruling out an alternative explanation that awe had its impact on human connection and loneliness simply

due to its positivity. Moreover, this approach – of comparing experimentally-induced awe to another experimentally-induced positive emotion as the only comparison group – is fairly common in this literature (e.g., Bai et al., 2017). Yet, because this study did not also include a neutral (non-emotional) condition, one might object that the current design makes it unclear whether (1) awe is increasing connections to humanity (and thus decreasing loneliness) or (2) whether amusement is decreasing connections to humanity (and thus increasing loneliness). If the study had included a third condition that induced no emotion, this interpretational ambiguity would be diminished.

Despite the absence of neutral control, there are three reasons to believe that our effect on human connections is driven by awe and not amusement. First, in studies that include an awe condition, a neutral control condition, and another positive emotion condition (like pride or amusement), the non-awe positive emotion condition often does not statistically differ from the neutral control on the outcome of interest (e.g., Piff et al., 2015). Second, there is no a priori theoretical reason to expect amusement to drive down human connection (and subsequently increase loneliness). Third, there is an a priori theoretical reason, as already articulated in the introduction, to expect that awe should foster social connections. Given this, the most parsimonious interpretation of our results is the one we have provided here.

Finally, the current work examined only two forms of social connection as potential mediators of awe's impact on loneliness. Future work should examine others. For instance, people obviously have social connections to groups other than their friends and all of humanity. Given our results, it seems that connections with relatively larger social collectives might be more reliable or robust mediators of awe's impact on loneliness. Thus, examining social connections to one's country/fellow citizens or to one's religious group members might act as a mediator of awe's impact on loneliness. Additionally, it is quite conceivable that awe prompts feelings of a small self, which in turn predicts greater social connections, which in turn predicts less loneliness (in a serial manner). Put differently, it is feasible that the impact of awe on sociality is itself mediated by feelings of the small self, as has been found in other work (e.g., Piff et al., 2015). Examinations of other social connection mediators or of more complex serial mediational models warrant further consideration.

## Conclusion

Despite these limitations, this work offers evidence for novel impacts of awe on critically important psychological outcomes: it makes people feel more connected to humanity which, in turn, predicts reduced feelings of loneliness. Because loneliness, when left untreated, can trigger a host of negative outcomes and even hasten death, work like this is vital and illustrates the profound link between mind and body. Indeed, this work suggests that Albert Einstein's observation about awe is not simply metaphor: "He who can no longer pause to wonder and stand rapt in awe, is as good as dead; his eyes are closed."

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