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Running head: AWE AND CREATIVITY

Awe is Associated with Creative Personality, Convergent Creativity, and Everyday Creativity

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Abstract

Creativity has many benefits, such as workplace performance and life satisfaction. Three studies extended a small body of work to examine whether awe was associated with creative personality, convergent creativity, and everyday creative behaviors ($N = 1,844$). Study 1 demonstrated that trait awe was associated with a more creative personality among adolescents and adults in the USA, Iran, and Malaysia. Study 2 showed that trait awe was associated with an increased likelihood of solving the Duncker's Candle problem. Finally, Study 3 found that on days when participants felt more daily awe than they typically do, they reported having done more everyday creative activities. The effects of awe were independent of amusement (Studies 1-3) and Big Five personality (Study 3). Moreover, we found that daily curiosity explained the link between daily awe and daily creativity in Study 3. These results are the first to demonstrate a consistent link between awe and complementary measures of creativity. The discussion focuses on the limitations of the present work as well as implications of the present results for future research on awe and creativity.

Keywords: Awe, convergent creativity, curiosity, creative personality, everyday creativity

Awe is Associated with Creative Personality, Convergent Creativity, and Everyday Creativity

Creative individuals perform better academically (Chamorro-Premuzic, 2006); receive better job-performance ratings from supervisors and make more sales (Gong et al., 2009); report greater career satisfaction and feel more included in their organizations (Kim et al., 2009); and are more satisfied with life (Tan et al., 2008). Given these and other benefits of creativity (Feist, 1998; Gajda et al., 2017; Ma, 2009), it is important to identify different ways to foster creativity. A consistent antecedent of increased creativity is positive emotion (Baas et al., 2008; Lyubomirsky et al., 2005). This literature, though, has generally focused on positive emotion and has not ascertained whether some positive emotions promote creativity more than others. In one exception, however, researchers found that participants specifically induced to feel awe, compared to neutral, produced more creative product-improvement suggestions (Chirico et al., 2018). Although this study demonstrated the effect of awe on creativity, it used a small convenience sample ($N = 52$) and did not explore specific facets of creativity or examine plausible mechanisms between awe and creativity.

The present research improves on this small body of work on the link between awe and creativity in several ways. First, we employed an *individual difference* approach that tested if trait and daily awe were associated with creativity. Second, we measured creativity with a multi-faceted approach, including creative personality, convergent creativity, and everyday creative activities to increase the generalization of the awe and creativity link. Third, we explored curiosity as a plausible mechanism of the association between awe and creativity. Last, we explored if the effect of awe was independent from another positive emotion, namely amusement.

The Multi-Faceted Approach to Measuring Creativity

Creativity is generally conceived of as the generation of ideas, insights, or solutions that are novel and potentially useful (Amabile, 1983; Simonton, 2000; Sternberg, 1999; Stein, 1953). Although there is a consensus definition of creativity, there is not a best way to assess creativity. Instead, most researchers studying creativity as an outcome usually employ multiple channels to capture its multi-faceted nature. Among these are divergent thinking tests and ideation tasks that instruct participants to generate solutions. For example, in one task, participants are asked to generate possible uses for a brick (Lamm & Trommsdorff, 1973), and people who generate uncommon and infrequent ideas are considered more original, which reflects the ability to approach problems with novel perspectives. Creativity also depends on others' evaluation of real-world usefulness like supervisor or peer ratings of workplace creativity (George & Zhou, 2001). A benefit of distinguishing among different facets of creativity is that some facets of creativity may be functions of different psychological mechanisms. In the present research, we also employed a multi-faceted approach and focused on creative personality, convergent creativity, and everyday creative activities to assess creativity (Feist, 1998; Gino & Ariely, 2011; Maddux & Galinsky, 2009; Silvia et al., 2014; see Table 1 for a summary).

Creative personality. One method to measure creativity is to assess creative personality, performance and achievement, thinking styles, and motivation. For example, Hocevar (1980) developed a series of activities and achievements that creative people should have done (e.g., having been an editor for a school literary publication or having received an award for musical accomplishment) to assess creative activity, behavior, and accomplishments. People who had attained or participated in these achievements were more frequently rated by peers as creative people. Moreover, Gough (1979) developed a series of adjectives that described creative people (e.g., *insightful*, *original*, and *unconventional*) and that people could use to appraise themselves

is a commonly used measure of creativity (Carson et al., 2005; McRae, 1987; Wolfradt & Pretz, 2001). More recently, Lee and Ashton (2004) developed the HEXACO personality inventory that contains the four-item unconventionality (e.g., “I think of myself as a somewhat eccentric person”) and four-item creativity (e.g., I would enjoy creating a work of art, such as a novel, a song, or a painting”) subscales within the openness to experience factor. Since then, the factor structures of these scales have been replicated in different cultures (e.g., Dutch, French, Germany, Japan, & Korea; Ashton et al., 2007; Boies et al., 2004; De Vries et al., 2004; Wakabayashi, 2014). Most importantly, the HEXACO self-report measures of creativity, which we used in these studies, has been shown to predict peer-reports of creativity and nonconformity over the lifespan (Helson, 1999) and actual creative achievements (Silvia et al., 2011), suggesting that it has strong evidence of validity of a creative person.

Convergent creativity. Another method to measure creativity is through convergent creativity tasks, which usually require individuals to find a single solution to a clearly defined problem. The correct solution is typically inconsistent with the preexisting associations and expectations these individuals bring to the task, and to arrive at that solution, they must alter and reapply existing knowledge and distinguish the correct solution from alternatives (Cropley, 2006). A typical convergent creativity problem is the Duncker’s Candle Problem (Duncker & Lee, 1945). In this task, participants are presented with a picture of a cardboard wall and a table containing a candle, a box of tacks, and a pack of matches, and they must find a way to attach the candle to the wall so that it burns without dripping wax on the table or the floor. The correct solution is to empty the box of tacks, tack the box to the wall, light the candle, and place the candle in the box. Thus, a creative person should be able to recognize existing conceptual relations that are seemingly dissociated (e.g., tacks can be pinned on board) and generate a

solution that unites the concepts. This task has been commonly utilized as a measure of convergent creativity (Gino & Wiltermuth, 2014; Maddux & Galinsky, 2007).

Everyday creativity. Finally, we examined the frequency of people who naturally engaged in creative activities in their everyday lives. These activities may not be particularly groundbreaking or innovative, but they are creative nonetheless (Richards, 2007). For example, writing a haiku to express love for a romantic partner, setting up traps on a bird feeder to prevent squirrels from eating the food pellets, or performing a magic trick to wow passersby may each be considered acts of everyday creativity. Some evidence for everyday creativity came from an experience-sampling study that found that around 22% of respondents reported doing at least one act of everyday creativity within a 12-hour window (Silvia et al., 2014). These authors also found that feeling happy and feeling active were both independent predictors of everyday creativity. In short, everyday creative acts are common and serves as another lens into creativity embedded in daily life.

In the current research, we employed various measures of creativity which tap into each of these facets (creative personality, convergent creativity, everyday creativity) to ensure that any observed effect of awe upon creativity would be generalizable and not an artifact of a specific measure of creativity.

Awe and Creativity

Background on awe. Awe is felt in some of the most significant human interactions and has appeared as a topic of discussion in many areas of study (e.g., philosophy, arts, sociology, etc.). Keltner and Haidt (2003) proposed two central features that underlie the prototypical experience of awe: vastness and accommodation. *Vastness* refers to the appraisal that a stimulus is beyond the usual frame of reference in terms of physical or symbolic size. Although *vastness*

typically refers to physical size, stimuli can be vast in other dimensions (e.g., fame or status). They are transcendent within a given frame of reference and, therefore, elicit awe. Another term, *accommodation*, refers to an appraisal that something that elicits awe requires the updating of current knowledge structures. In other words, stimuli that transcend an individual's current beliefs and understanding require that the individual restructure beliefs, categories, causal understandings, and frames of reference. This process of mental accommodation, whether successful or not, elicits awe. In short, the feeling of awe is characterized by the perception of being in the presence of something vast that the individual does not immediately understand (Stellar et al., 2017). Guided by this, Keltner and Haidt (2003) proposed seven dimensions or situations that should elicit vastness and accommodation and, thereby, elicit awe and no other emotion. Among these are social (e.g., meeting a powerful leader), physical (e.g., seeing a grand vista), and cognitive (e.g., hearing an expensive theory) elicitors. Keltner and Haidt considered nature a particularly prominent elicitor of awe, even saying, "perhaps the most common experience of awe . . . is the response to natural objects, such as mountains, vistas, and oceans" (p. 309). In recent years, the field of emotion has taken important steps in understanding the correlates, elicitors, and consequences of awe. Dispositional awe (compared with pride and joy) is associated with more universal self-concepts (Shiota et al., 2007) and higher creativity, love of learning, gratitude, and appreciation of beauty (Guswell & Ruch, 2012). Compared with amusement and pride, awe has distinct patterns of facial and upper body expressions (Shiota et al., 2003) and elicits qualitatively distinct autonomic nervous system responses (Shiota et al., 2011). Lastly, the experience of awe produces various psychological benefits and social connections, such as decreased stress, prosocial behaviors, and humility (Stellar et al., 2017).

Awe and creativity. The appraisals of vastness and accommodation, in turn, lead to the experience of awe and are believed to cause people to explore the environment, gain new information, and create new ways of thinking (Shiota et al., 2004; Zhang & Keltner, 2015). Consistent with this model, people often report themes related to exploring environment, altering extant worldviews, and generating novel perspectives in retrospective accounts of awe-related experiences (Campos et al., 2013; Shiota et al., 2007). Therefore, the experience of awe can lead to an open mindset and orient people to explore and approach experiences with unconventional perspectives—all of which are processes critical to creativity. For example, people prone to experience awe, compared to amusement, are more likely to possess intellectual character strengths related to creativity (e.g., love of learning; Gusewell & Ruch, 2012). In another study, people who recounted an awe experience instead of a happy one reported being more willing to engage in a creative activity in the next hour (Shiota et al., 2007). Most relevant to the current research, participants who were exposed to an awe-inducing 3D-video, compared to a neutral video, in a within-subject design, demonstrated greater fluency, flexibility, and originality in product improvement and on the Unusual Uses creativity test (Chirico et al., 2018).

Awe, Curiosity, and Creativity

A secondary aim of the current research was to explore *why* awe predicts increased creativity. We propose curiosity as a key motivational mechanism that explains the link between awe and creativity. Curiosity is a positive motivational state characterized by the proactive, intentional tendency to recognize and seek new experiences (Kashdan et al., 2004; Kashdan et al., 2018) and stems from information that makes the individual aware of gaps in existing knowledge (Kashdan, 2004; Kashdan & Steger, 2007; Kashdan et al., 2013; Silvia & Kashdan, 2009). Thus, as accommodation functions to promote awe, so curiosity's drive to seek new

experience should propel people toward creativity, which often promotes novel, different, or unfamiliar experiences. Particularly relevant to the current research, one study found that trait awe in participants was positively related to curiosity as rated by themselves and by friends (Anderson et al., 2019), supporting the assertion that awe promotes curiosity. In other studies, trait curiosity was associated with greater self-assessments of creativity (Karwowski, 2012) and with more creative solutions to increase sales in a hypothetical marketing problem (Hardy III et al., 2017). People who were led to feel curiosity, compared to a neutral state, generated more creative magic trick ideas (Hagtvedt et al., 2019). A meta-analysis of 10 studies found a moderate relationship between curiosity and various creative outcomes ($r = .41$; Schutte & Malouff, 2020). Therefore, the experience of awe can lead to an open mindset, orient people to explore, and approach novel experiences—all of which may promote curiosity, a motivational state that, in turn, should foster creativity.

The Current Research

We conducted three studies ($N = 1,844$) using an *individual differences* approach, which improved on the small body of work on the link between awe and creativity (Chirico et al., 2018) and used larger, more diverse samples¹. Moreover, we assessed creativity with a multi-faceted approach, including creative personality, convergent creativity, and everyday creative activities to increase the generalization of the awe and creativity link. A benefit of distinguishing among different facets of creativity is that some facets of creativity may be functions of different predictors *or* the same predictor. If the former is true, then we should see awe to only correlate with some of the creativity measures that we employed. If the latter is true, then we should awe to be correlated with all the creativity measures that we employed. We also explored curiosity as a plausible mechanism of the link between awe and creativity. Study 1 examined whether trait

awe was associated with creative personality in the USA, Iran, and Malaysia. Study 2 examined whether trait awe was associated with greater likelihood to solve the Duncker Candle Task (Duncker & Lee, 1945). Then, Study 3 collected daily diaries over seven days to determine if daily variations in awe were associated with within-person changes in daily creative behaviors. Study 3 also tested if daily curiosity, assessed as daily curious emotions and daily curious personality, mediated the association between daily awe and creativity. We also tested alternative explanations of the hypothesized association between awe and creativity. Previous research has demonstrated that positive emotions and openness to experience can lead to increases in creativity (see Lyubomirsky et al., 2005; Silvia et al., 2009), which raises the question of the extent to which the hypothesized influences of awe on creativity are unique to awe or simply part of the more general tendency for openness to experience or positive states to increase creativity. Considering this concern, we pitted awe against amusement across studies and, additionally, the Big Five Personality in Study 3 to ensure the specific contribution of awe to creativity is not due to personality.

Pilot Study to Validate HEXACO Unconventionality and Creativity Personality

We first wanted to document that the unconventionality and creativity subscales from the HEXACO (Ashton & Lee, 2007), which we used to measure creative personality in Study 1, has strong evidence of validity of creative outputs. To do this, we recruited 177 participants from Amazon Mechanical Turk ($M_{age} = 35.5$, $SD = 11.00$; 48% Female; 84% Caucasian Americans) who completed the unconventionality and creativity subscales, as well as the Creative Behavior Inventory (CBI; “*Wrote poetry*”; Hocevar, 1980), Gough’s Creative Personality Scale (GCPS; “*Clever*”, “*Inventive*”; Gough, 1979), and Creative Cognitive Style (CCS; “*I have a lot of creative ideas*”; “*I prefer tasks that enable me to think creatively*”; “*I cope with several new*

ideas at the same time”; “*I will always think of something when stuck*”; “*I have fresh perspectives on old problems*”) in this order, all of which were used in Gino and Ariely (2011) and validated in prior research to robustly predict creative performance (Barron & Harrington, 1981; Tierney & Farmer, 2002; Zhou & Oldham, 2001).

First, participants indicated their agreement with four items that measured unconventionality (e.g., “*I like people who have unconventional views*”; $\alpha = .58$) and the four items that measured creativity (e.g., “*People have often told me that I have a good imagination*”; $\alpha = .77$) on a 7-point scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Next, they completed the CBI, which is a list of 77 activities that are deemed as creative (e.g., “*Worked as an editor for a newspaper or similar organization.*”). Participants indicated the frequency that they engaged in those activities on a 4-point scale from 1 (*never*) to 4 (*more than 5 times*). We averaged the participants rating for each activity ($M = 1.60$, $SD = 0.40$). Afterward, participants chose adjectives that described them from a list of 30. Participants received a point every time they checked an adjective (e.g., insightful, original; $M = 3.30$, $SD = 1.30$). Finally, participants answered the 5-item CCS on a 7-point scale from 1 (*strongly disagree*) to 7 (*strongly agree*; $M = 5.00$, $SD = 1.30$; $\alpha = .90$).

We standardized all the measures and reported the zero-order correlations in Table 2. We found that the unconventionality and creativity subscales were positively correlated with all three creative personality scales. These results provide support for the unconventionality and creativity subscales have strong evidence of validity of a creative personality.

Study 1: The Association of Trait Awe and Creative Personality in the US, Iran, and Malaysia

Study 1 tested whether trait awe, compared to trait amusement, was associated with unconventionality and creativity personality (Ashton & Lee, 2007). We expected trait awe to be uniquely associated with unconventionality and creative personality above and beyond trait amusement. To increase the generalizability of our results, we tested our hypothesis on adolescents in the USA and adults from three other cultures. The inclusion of three diverse cultures with differences in the frequency of experiencing awe (Razavi et al., 2016), as well as important personality correlates of creativity like openness to experience, informed us about the robustness and generalizability of the relationship between awe and creativity in a diverse cultural environment.

Method

Participants and Procedures

The four samples consisted of (a) 506 community adults (Study 1a; $M_{age} = 40.41$, $SD = 13.03$, range 18-89; 48.5% female, 71% Caucasian) from CloudResearch (Turk Prime; Litman et al., 2017) who participated for nominal compensation; (b) 387 adolescents from a public high school in northern California (Study 1b; $M_{age} = 15.90$, $SD = 1.34$, range 12-20; 56% female, 26% Caucasian) who participated for a nominal compensation; (c) 255 Iranian adults (Study 1c; $M_{age} = 31.60$, $SD = 8.90$, range 19-67; 65% female) who participated for a raffle entry; and (d) 286 students (Study 1d; $M_{age} = 21$, $SD = 1.70$, range 18-29; 85% female) from a private university in Malaysia who participated for partial course credit. Participants in sample 1a and 1c completed the study online: they provided informed consent and completed the trait awe and amusement scales (Razavi et al., 2016; Shiota et al., 2006;) and the unconventionality and creativity scales (Ashton & Lee, 2007). Adolescents in sample 1b were given a packet that included an invitation letter, parental consent form, adolescent assent form, and the study survey. Students who

returned the completed materials constituted the sample. Malaysia students in sample 1d completed a packet that included a consent form and the study survey at the beginning of class. For the Iranian sample, all measures were translated into Persian by one of the co-authors and independently back-translated into English by a separate co-author—both authors are bilingual Persian-English speakers. Disagreements between the translators were resolved by discussion. The Malaysian students were all fluent in English and completed the study in English.

Measures

Trait discrete emotions. All participants completed the trait awe (e.g., “*I often feel awe*”) and trait amusement (e.g., “*I find humor in almost everything*”) subscale from the Trait Positive Emotions Scale (Dixon et al., 2018; Razavi et al., 2016) on a 7-point scale from 1 (*strongly disagree*) to 7 (*strongly agree*; Study 1a: $M_{awe} = 4.66$, $SD = 1.15$, $\alpha = .84$; $M_{amusement} = 4.25$, $SD = 1.31$, $\alpha = .84$; Study 1b: $M_{awe} = 4.75$, $SD = 1.10$, $\alpha = .85$; $M_{amusement} = 4.81$, $SD = 1.15$, $\alpha = .80$; Study 1c: $M_{awe} = 4.16$, $SD = 1.15$, $\alpha = .77$; $M_{amusement} = 4.07$, $SD = 1.37$, $\alpha = .79$; Study 1d: $M_{awe} = 4.52$, $SD = 0.95$, $\alpha = .75$; $M_{amusement} = 4.67$, $SD = 1.16$, $\alpha = .78$). Awe and amusement are positively correlated across samples ($r_s \geq .38$, $p_s < .001$).

Curiosity. Participants in samples 1a and 1b completed the 10-item Curiosity and Exploration Inventory–II (e.g., “*I am the kind of person who embraces unfamiliar people, events, and places*”; Kashdan et al., 2009), which has items measured on a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*; Study 1a: $M = 4.34$, $SD = 1.23$, $\alpha = .92$; Study 1a: $M = 4.62$, $SD = 1.09$, $\alpha = .91$). Participants in samples 1c and 1d completed the 7-item Curiosity and Exploration Inventory (e.g., “*Everywhere I go, I am out looking for new things or experiences*”; Kashdan et

al., 2004) to measure curiosity on a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*; Study 1c: $M = 5.15$, $SD = 1.08$, $\alpha = .74$; Study 1d: $M = 4.94$, $SD = 0.75$, $\alpha = .56$).

Creative personality. Participants completed the unconventionality and creativity subscales from The HEXACO Personality Inventory (Ashton & Lee, 2007) to measure two facets of the creative person. Participants in sample 1a, 1b, and 1c rated their level of agreement with each statement from 1 (*Strongly Disagree*) to 7 (*Strongly Agree*), and participants in sample 1d rated from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). Four items assessed unconventionality (e.g., “*I think that paying attention to radical ideas is a waste of time*”; Study 1a: $M = 4.54$, $SD = 1.18$, $\alpha = .65$; Study 1b: $M = 3.43$, $SD = 0.64$, $\alpha = .50$; Study 1c: $M = 4.53$, $SD = 1.14$, $\alpha = .44$; Study 1d: $M = 4.77$, $SD = 0.85$, $\alpha = .50$), and four items assessed creativity (e.g., “*People have often told me that I have a good imagination*”; Study 1a: $M = 4.49$, $SD = 1.40$, $\alpha = .80$; Study 1b: $M = 3.47$, $SD = 0.81$, $\alpha = .65$; Study 1c: $M = 5.33$, $SD = 1.29$, $\alpha = .68$; Study 1d: $M = 4.43$, $SD = 1.27$, $\alpha = .73$). Unconventionality and creativity were moderately correlated across samples ($r_s \geq .25$, $p_s < .001$).

Results and Brief Discussion

Is trait awe associated with curiosity and creative personality? As shown in Table 3, awe was associated with greater curiosity ($r_s \geq .39$, $p_s < .001$), unconventionality ($r_s \geq .26$, $p_s < .001$) and creativity ($r_s \geq .30$, $p_s < .001$) in all samples. Conversely, although amusement also showed positive relations with curiosity, unconventionality and creativity, the correlations were smaller and less consistent than those for trait awe. We computed the meta-analytic correlations between trait awe and trait amusement with unconventionality and creativity. As expected, the meta-analytic correlations (Fisher r to z transformation) demonstrated that trait awe had a higher

correlation with both creativity outcomes ($r = .32$, 95% CI [.27, .37]) than with trait amusement ($r = .15$, 95% CI [.09, .21]), $Z = 5.97$, $p < .001$.

Is trait awe uniquely associated with curiosity and creative personality? We used partial correlations to test whether trait awe was associated with curiosity and creative personality independent of amusement across the four samples. In all samples, we found that the relationships among trait awe, curiosity, and creative personality remained after controlling for trait amusement. However, the relationships among trait amusement, curiosity, and the creative personality were mostly reduced to non-significance after controlling for trait awe (see Table 3).

Study 1 provided preliminary support that showed trait awe was uniquely associated with curiosity and creative personality independent of trait amusement in adults and adolescents. Given potential biases in self-report assessments of creativity, in Study 2, we tested the hypothesis that trait awe would predict increased convergent creativity, as assessed with the Duncker's Candle Problem, independent of amusement.

Study 2: Trait Awe and Convergent Creativity

Study 2 tested whether trait awe was related to convergent creativity. Specifically, participants were instructed to complete the Duncker's Candle Problem (Duncker & Lee, 1945), a task used to measure convergent creativity (Gino & Ariely, 2011; Isen et al., 1987; Maddux & Galinsky, 2009; Maddux et al., 2010). Moreover, we continued to control for trait amusement to ascertain the unique effect of trait awe on creativity.

Method

Participants and Procedures

Study 2 consisted of 301 students ($M_{age} = 21.20$, $SD = 2.70$, age range 18-47; 61% female, 18% Caucasian Americans) from a large American university on the West Coast who participated for partial course credit. Participants completed the trait awe and trait amusement subscales from the DPES (Dixon et al., 2018), the Duncker's Candle Problem (Duncker & Lee, 1945), and a demographic questionnaire.

Measures

Trait awe and amusement. Similar to previous studies, participants completed the trait awe (e.g., “*I often feel awe*”; $M = 4.80$, $SD = 1.00$, $\alpha = .82$) and trait amusement subscales (e.g., “*I am very easily amused*”; $M = 4.70$, $SD = 1.09$, $\alpha = .81$) from the DPES. Awe and amusement were positively correlated ($r = .62$, $p < .001$).

Convergent Creativity. In this task, participants were presented with a picture of the Duncker's Candle problem, which shows a candle, a box of tacks, and a pack of matches on a table next to a cardboard wall (see Supplemental Materials for the picture). Participants were instructed to think of a solution to attach the candle to the wall so that it could burn without dripping wax on the table or the floor. The correct solution was to empty the box of tacks, use the tacks to attach the box onto the wall, light the candle, and place the candle in the box. Thus, the correct solution requires participants to view the objects beyond their typical functions. Similar to previous research (Gino & Ariely, 2011; Isen et al., 1987; Maddux & Galinsky, 2009; Maddux et al., 2010), we instructed a research assistant to code participant's solution as correct only if the response included the use of the box as a candleholder. Overall, 145 of the 301 participants solved the problem correctly (48%).

Results and Brief Discussion

We standardized trait awe and trait amusement and conducted a logistic regression.

Whereas trait awe was significantly correlated with achieving a correct solution, in keeping with our hypothesis ($B = .32$, $SE = .16$, Wald = 4.16, $p = .041$, Exp[B] = 1.37, $d = 0.17$, 95% CI [1.01, 1.86]; see Table 4), trait amusement was not ($B = .06$, $SE = .15$, Wald = 0.15, $p = .69$, Exp[B] = 1.06, 95% CI [-.79, 1.43]). In other words, people who are prone to experience awe are 37% more likely to solve the Duncker's Candle problem than people less prone to awe.

Study 3: Daily Awe and Everyday Creative Activities Over Seven Days

Study 3 used daily diary methods to provide a more ecologically valid demonstration of the link between awe and everyday creativity in everyday life. By surveying the same people daily, we were able to test whether people reported more creative behaviors on days when they also felt more awe than typical. Guided by previous research (Bai et al., 2017; Stellar et al., 2018), we assessed daily awe using three emotions: awe, wonder, and amazed. We examined daily curiosity as a possible mediator between daily awe and daily creativity. We also assessed daily amusement and daily Big Five personality to ascertain the unique relation between daily awe and daily creativity. We conducted a power-analysis using the “powerlmm” package for multilevel modeling in R and determined that we need to collect 100 participants, which would yield 80% power at a medium effect size.

Method

Participants and Procedure

We recruited 112 people via CloudResearch (formally TurkPrime; Litman et al., 2016; $M_{age} = 38.46$, $SD = 11.74$; 47.3% female; 71% Caucasian) who received a nominal compensation. We emailed participants a link to an online survey for seven consecutive nights. The diary survey measured their daily awe, daily amusement, daily Big Five personality, daily

curiosity, and daily creativity in randomized order. The survey instructed the participants to respond to how they felt ‘today’. We kept the survey brief to maintain participant motivation and maximize responses (Reis & Gable, 2000). In total, the participants completed 621 diary entries (*Median* = 3 completed entries).

Measures

Daily awe. Participants responded to three items that we adapted from previous research to measure daily awe (i.e., “awe”, “wonder”, and “amazed”; Bai et al., 2017; Piff et al., 2015) on a 5-point scale (1 = *not at all*, 5 = *a lot*; $M = 2.13$, $SD = 1.09$, *Omega* $\Omega = .90$).

Daily amusement. Participants responded to two items that we adapted from previous research to measure daily amusement (i.e., “amused” and “humorous”; Piff et al., 2015) on a 5-point scale (1 = *not at all*, 5 = *a lot*; $M = 2.74$, $SD = 1.11$, *Omega* $\Omega = .84$).

Daily curiosity emotion. Participants responded to two items that we adapted from previous research to measure daily curiosity emotions (i.e., “curious” and “interested”; Anderson et al., 2019) on a 5-point scale (1 = *not at all*, 5 = *a lot*; $M = 3.02$, $SD = 1.05$, *Omega* $\Omega = .71$).

Daily curiosity personality. Participants completed the 10-item Curiosity and Exploration Inventory–II (e.g., “*I actively sought as much information as I can in new situations*”; Kashdan et al., 2009) to measure daily curiosity personality on a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*; $M = 3.28$, $SD = 1.50$, *Omega* $\Omega = .95$).

Daily Big Five personality. Participants responded to the Ten Item Personality Inventory, which assessed their daily openness to experience (e.g., “*open to new experiences, complex*”; $M = 4.33$, $SD = 1.43$, *Omega* $\Omega = .43$), conscientiousness ($M = 5.40$, $SD = 1.34$, *Omega* $\Omega = .57$), extraversion (e.g., “*extraverted, enthusiastic*”; $M = 3.73$, $SD = 1.51$, *Omega* $\Omega = .60$), agreeableness (e.g., “*sympathetic, warm*”; $M = 5.23$, $SD = 1.24$, *Omega* $\Omega = .43$), and

neuroticism (e.g., “*anxious, easily upset*”; $M = 2.86$, $SD = 1.49$, $\text{Omega } \Omega = .76$) on a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*).

Daily creativity question. Participants completed a single creativity question that we adapted from previous research (“Did you do something creative today?”; Silvia et al., 2014) on a 5-point scale (0 = *No, not at all* [41.8%], 1 = *a little* [27.6%], 2 = *moderately* [14.7%], 3 = *quite a bit* [8.4%], 4 = *Yes, Definitely* [7.4%]; $M = 1.12$, $SD = 1.25$).

Daily creative behaviors. Participants also completed a self-report of whether they engaged in a list of 34 everyday creativity behaviors using The Biographical Inventory of Creative Behaviors (e.g., “*writing a poem*”, “*made a joke*”, Batey, 2007). Participants responded to each everyday creativity behaviors on a 0 (*No, not at all*) and 1 (*Yes, definitely*) scale ($M = 2.00$, $SD = 3.43$; see Supplemental Materials for percentages of each creative behaviors).

Results and Brief Discussion

Data analyses. We analyzed the data using the linear mixed models function in the SPSS statistical program to account for the nested nature of the data (i.e., days nested within people). The predictors were centered on each participant’s mean (i.e., group-mean centered) across the whole diary study. Group-mean centering assesses if day-to-day deviations from a participant’s mean on the predictors (i.e., daily awe, daily amusement, or daily curiosity) are associated with changes in the outcome variable (daily creativity). Lastly, we used the MLmed computational macro for SPSS that simplifies the Monte Carlo method for assessing parallel multilevel mediation (Hayes & Rockwood, 2020). All analyses were entirely within-persons and conducted with the intercepts fixed while the slopes could vary.

Direct effect. Our central prediction was that increases in daily awe would predict greater daily creativity, independent of daily amusement and Big Five personality traits. Daily awe

predicted the daily creativity question ($B = .42$, $SE = .06$, $t = 7.43$, $r = .31$, 95% CI [.31, .53]) and daily creative behaviors ($B = .73$, $SE = .13$, $t = 5.51$, $r = .24$, 95% CI [.47, .99]; see Table 5) without covariates. However, daily amusement did not predict daily creativity question ($B = .08$, $SE = .05$, $t = 1.55$, $r = .07$, 95% CI [-.02, .19]) and daily creative behaviors ($B = .12$, $SE = .12$, $t = 0.95$, $r = .04$, 95% CI [-.13, .36]) without covariates. More importantly, daily awe was an independent significant predictor of the daily creativity question ($B = .17$, $SE = .06$, $t = 2.67$, $r = .12$, 95% CI [.05, .30]) and daily creative behaviors ($B = .56$, $SE = .16$, $t = 3.55$, $r = .16$, 95% CI [.25, .88]) with daily amusement and daily Big Five personality in the same model (see Table 5). That is, on days when participants reported higher awe than typical during the study period, they were also more likely to report greater creativity.

Lagged effect. We also conducted lagged analyses (testing the association of variables from one day to the next) and found that the awe from one day predicted the creativity of the next day ($b = .13$, $p = .035$, 95% CI [.01, .25]) but not the creative behaviors ($b = .10$, $p = .49$, 95% CI [-.18, .38]). Thus, there was some causal evidence that awe led to next-day creativity. However, given that awe only predicted one of two creativity outcomes, we only focused on within-day effects for the analyses below. Additionally, same-day awe significantly predicted the same-day creativity question ($B = .17$, $SE = .06$, $t = 2.67$, $r = .12$, 95% CI [.05, .30]) and creative behaviors ($B = .55$, $SE = .15$, $t = 3.55$, $r = .16$, 95% CI [.25, .87]), even with same-day amusement, Big Five personality, and the prior day's creativity question and creative behaviors in the same model, respectively. Lastly, we found that the prior day's creativity question did not predict the next day's awe ($b = .05$, $p = .14$, 95% CI [-.02, .12]). Also, the prior day's creative behaviors did not predict the next day's awe ($b = .01$, $p = .53$, 95% CI [-.02, .03]).

Indirect effect. We used the MLmed computational macro for SPSS that simplifies the Monte Carlo method for assessing parallel multilevel mediation (Hayes & Rockwood, 2020). To test if the indirect effect through the two curiosity measures was significantly different from zero, we constructed 95% confidence intervals (bias-corrected and accelerated) using 10,000 bootstrap samples. Table 6 displays the unstandardized path coefficients without any covariates. The indirect effect through daily curiosity emotions (point estimate = .11, SE = .03, $t = 3.14$, $r = .13$, 95% CI [.04, .10]) and daily curiosity personality (point estimate = .22, SE = .03, $t = 6.73$, $r = .26$, 95% CI [.16, .29]) were both significant.

Consistent with our central hypothesis, daily awe predicted everyday creativity with and without controlling for daily amusement, daily Big Five personality, *and* prior-day creativity. Also, the mediation model was consistent with the statistical possibility that daily curiosity explains the proposed relation between increased daily awe and enhanced creativity.

General Discussion

Creativity has many benefits that have inspired scientists to understand its components and determinants. The current research extends a couple of recent studies on the link between awe on creativity. We found that people who report high levels of trait awe demonstrated greater creativity on various components of the construct. Our two trait-based studies found that trait awe predicted more creative personality among adolescents in the USA and adults in the USA, Iran, and Malaysia and, in terms of creative behavior, also predicted an increased likelihood of solving a creativity problem. Study 3 demonstrated that participants reported doing more everyday creative behaviors on days when they also reported feeling more awe than typical. These associations remained robust when controlling for daily amusement, daily Big Five personality, and prior-day creative behaviors. With respect to understanding how awe leads to

creativity, we found that daily curiosity explained the link between daily awe and daily creativity. Overall, the present findings reveal that awe is an important source for different facets of creativity.

Implications and Future Directions

Chirico et al. (2018) found that induced awe, compared to a neutral state, led to more creative product improvement in a small sample of students ($N = 52$). However, they used a small sample that did not compare awe with other positive emotions and only used divergent measures of creativity. We built upon this research and found that people who were higher on trait awe and who experienced daily awe more frequently were also more creative across three creativity measures. This was the first set of findings that consistently documented the link between awe and creativity across various cultures while using different methodologies and creativity measures. Furthermore, we showed that the effects of trait and daily awe on creativity were independent of trait and daily amusement, which effectively ruled out one version of a valenced-based hypothesis that general positivity predicts creativity. However, it is important to note that the current findings did not establish a causal link between awe and creativity. That is, we cannot conclusively state whether it is awe that leads to creativity or creativity that leads to awe. Thus, future research would be well served by testing and replicating the causal link between awe, compared to other positive emotions, on various measures of creativity. One way to do this is using a longitudinal design, which would enable researchers to conduct cross-lagged analyses to explore temporal changes.

Critically, future experimental research on awe and creativity needs to attend to the positive and negative forms of awe. A recent investigation documented that threat-related awe (e.g., witnessing a natural disaster) produces thought processes and physiological responses that

are different from positive forms of awe (Gordon et al., 2016). It is quite plausible that threat-based awe dampens creativity, given the narrowing effects of fear on cognitive processing (Mineka & Sutton, 1992). On the other hand, however, others have shown that negative emotions can lead people to produce greater artistic creativity (Akinola & Mendes, 2008). These findings point to interesting lines of inquiry. First, it may be pertinent to compare the effects of threat-based and positive awe on different creative outcomes. The results of this type of research could illuminate the extent to which the variations of awe experiences lead to creativity. It could also be important to examine the effect of the positive and negative variants of awe experiences on domain-specific measures of creativity. Unlike domain general measures of creativity (e.g., finding different uses of bricks), using specific measures of creativity could reveal that some emotions promote some types of creativity more than awe. For example, one could examine whether induced compassion lead people to come up with creative ways to help a person who is suffering to a greater extent compared to induced awe. This kind of study could sharpen our understanding of how and when awe promotes creativity.

Our aim to study awe as a predictor of creativity was based on the growing evidence of the benefits of creativity (Chamorro-Premuzic, 2006; Tan et al., 2008). However, it is also important to recognize the potential downsides of creativity. For example, Gino and Ariely (2012) found that a creative personality and a creative mindset led people to act more unethically via a greater ability to justify dishonest behaviors. Given that awe has been shown to promote collective actions and mindsets characteristics like prosocial behaviors (Piff et al., 2015), a sense of small self (Bai et al., 2017), and humility (Stellar et al., 2018), a logical extension would be to test whether awe can buffer the effect of creativity on ‘dark’ outcomes, such as dishonesty. The results would add to the argument that awe is a collective emotion that binds instead of divides.

Limitations

The present research has several limitations. We produced cross-sectional evidence that daily awe promoted more creativity via curiosity. A cross-sectional mediation approach may not accurately reflect the true nature of the underlying processes involved (MacKinnon & Fairchild, 2009; Maxwell & Cole, 2007). For instance, our cross-sectional mediation model presumed that awe causes curiosity and, over time, creativity. Another presumption of cross-sectional mediation is that the mediated effect is stable over time, which may not be the case. Future studies that manipulate curiosity are needed to establish such causal claims. Still, our mediation results provide at least an initial empirical basis for further inquiry into why awe influences creativity.

Some people may be concerned by the low reliabilities of the unconventionality measure in the Malaysian and Iranian samples in Study 1. It is important to note that all other alpha reliabilities were acceptable in Study 1. Moreover, we used the classic back-translation method to make sure the wordings and meanings were as consistent with the original measure as possible. The HEXACO scale has also been well-validated, including whether it measures what it purports to measure, across multiple cultures using multiple languages (Ashton & Lee, 2009). Also, alpha reliability is the result of a combination of the intercorrelations between the items and the number of items in a scale. When the scale is short, we expect alpha reliability to be lower. A good example is the 10-item Big Five Inventory (Rammstedt & John, 2007), which consist of 2-item per facet and reliability of the facets tend to be lower than the Big Five Inventory (Soto & John, 2017). Moreover, low alpha reliability is a conservative test of the correlations between trait awe and trait unconventionality because lower alpha reliability suppresses the potential size of the correlations between the constructs. In short, the lower alpha

reliability for the unconventionality construct in the two cultures may be an exception rather than the rule. Nonetheless, we recommend future research to run follow-up studies to see if they can replicate our results using the unconventionality measure.

The present investigation was also limited in terms of the operationalization of creativity. Although we tested the effect of awe on established measures of creativity, there are other aspects of creativity that future research should examine. These may include a teacher's rating of a student's creative performance or a supervisor's evaluation of a teams' brainstorming session. If awe improves individual creative performance, we expect people who are awe-prone to display more creativity in daily life and to be observed by others as creative people. Researchers could measure employees' trait-level awe and use an experience sampling method to collect daily creative performance measures (e.g., ideas generated during meetings) through self-report and/or reports from co-workers, as well as supervisors. Such studies would provide intriguing external validity to our established awe and creativity link. Lastly, we did not collect time spent on task in Study 2. It is possible that people who spent more time were better able to solve the Duncker Candle Task. Another limitation in Study 2 was that we cannot rule out creative personality from the connection between trait awe and odds of solving the Duncker's Candle problem. It would be important for future research to assess whether trait awe predict solving the Duncker's Candle problem above and beyond creative personality.

Researchers have discussed the demographic limitations of most psychology studies, characterizing most psychological samples as White, Educated, Industrialized, Rich, and Democratic (Henrich et al., 2010). Additionally, other researchers have raised questions about the importance of replication (Simmons et al., 2011). Considering these concerns, it is important to note that we replicated our trait-level results among people across cultures. With that said, we

urge future research to replicate our findings across a wider range of people. Another limitation is that we used different types of incentives in Study 1 to recruit participants from different countries.

Conclusion

Creativity is a highly sought-after skill. We discovered that the experience of awe is conducive to creativity. Our results add to the burgeoning science of awe, demonstrating the widespread benefits of this understudied positive emotion. Awe-triggering experiences, such as the simple act of looking up at the sky, abound in everyday life and may prove to be a potent source of creativity. In sum, we urge people to “pause to wonder and stand rapt in awe” (Einstein, 1931) because it could open a gateway to their creative potential.

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Footnote

1. Studies 1 and 2 in this research came from the first author's dissertation. The dissertation included 3 additional experimental studies that explored whether manipulated awe led to creativity. We did not include them in this manuscript because we could not replicate the findings across these three studies. The complete methodology and results can be found here: [https://digitalassets.lib.berkeley.edu/etd/ucb/text/Zhang_berkeley_0028E_16852.pdf].

Figure Caption

Figure 1. Multilevel parallel mediation of daily curious emotions and daily curious personality on the relationship between daily awe and daily creative question.

Figure 2. Multilevel parallel mediation of daily curious emotions and daily curious personality on the relationship between daily awe and daily creative behaviors.

Table 1

A Synopsis of the Components, Definitions, Selected Studies, and Measures of Creativity

Components	Definition	Selected studies	Sample measures	Studies
Creative personality	Individuals who naturally have a creative predisposition	Gino & Ariely (2011)	Gough's creativity personality scale; Hocevar's creative behavior inventory; Creative cognitive style	Pilot study & Study 1
		Silvia et al. (2011)	HEXACO – unconventionality & creativity	
Convergent creativity	Individual's ability to formulate a single best solution to a problem	Gino & Ariely (2011) & Maddux et al., (2010)	Duncker's Candle problem	Study 2
Everyday creativity	Creative actions that are common among ordinary people in daily life	Silvia et al., (2014)	e.g., drawing, making recipes, writing, etc.	Study 3

Table 2

A Pilot Study Verifying the Relationship between HEXACO Unconventional and Creativity Scales with the Creative Personality Scales used in Gino and Ariely (2011)

	HEXACO unconventionality	HEXACO creativity	Hocevar creative behavior inventory	Gough creative personality checklist	Creative cognitive style
HEXACO unconventionality	-				
HEXACO creativity	.50*	-			
Hocevar creative behavior inventory	.68*	.49*	-		
Gough creative personality checklist	.56*	.31*	.54*	-	
Creative cognitive style	.50*	.41*	.57*	.44*	-

Note. * $p < .05$

Table 3

Zero Order and Partial Correlations between Trait Awe, Trait Amusement, and Creative Personality Measures

	Trait awe	Trait amusement	Curiosity	Unconventionality	Creativity
HEXACO (Study 1a; Community adults)					
Trait awe	-				
Trait amusement	.39*	-			
Curiosity	.65* (.59*)	.39* (.20*)	-		
Unconventionality	.34* (.29*)	.20* (.08)	.40*	-	
Creativity	.40* (.35*)	.22* (.07)	.46*	.58*	-
HEXACO (Study 1b; USA high school students)					
Trait awe	-				
Trait amusement	.38*	-			
Curiosity	.53* (.47*)	.30* (.12*)	-		
Unconventionality	.32* (.25*)	.24* (.14*)	.33*	-	
Creativity	.30* (.30*)	.07 (-.05)	.27*	.24*	-
HEXACO (Study 1c; Iran adults)					
Trait awe	-				
Trait amusement	.25*	-			
Curiosity	.46* (.45*)	.09 (-.02)	-		
Unconventionality	.26* (.25*)	.09 (.03)	.24*	-	
Creativity	.35* (.31*)	.23* (.16*)	.36*	.31*	-
HEXACO (Study 1d; Malaysia college students)					
Trait awe	-				
Trait amusement	.36*	-			
Curiosity	.45* (.39*)	.28* (.14*)	-		
Unconventionality	.30* (.25*)	.19* (.09)	.32*	-	
Creativity	.38* (.32*)	.23* (.11)	.26*	.38*	-

Note. Correlations in the parentheses are partial correlations controlling for trait amusement or trait awe; The meta-analytic average of awe and creativity measures is .32, 95% CI [.27, .37] and between amusement and creativity measures is .15, 95% CI [.09, .21] (Fisher r to z transformation). The meta-analytic effect of awe is significantly different from amusement, $Z = 5.97$, $p < .001$; * $p < .05$.

Table 4

Summary of Logistic Regression Analysis for Trait Awe and Trait Amusement Predicting Odds of Solving Duncker's Candle Problem

Predictors	Duncker's candle problem						
	B	SE	Wald	<i>p</i>	Exp(B)	95% CI Lower	95% CI Upper
Trait awe	.32*	.16	4.16	.041	1.37	1.01	1.86
Trait amusement	.06	.15	.15	.69	1.06	-.79	1.43

Note. Exp(B) is the odds ratio. Exp(B) value indicates that trait awe predicted 37% more likely to solve the Duncker's Candle Problem.

Table 5

Daily Awe, Amusement, Big Five Traits, and Curiosity Predicting Daily Creativity Question and Behaviors in Study 3

	Creativity question					Creative behaviors				
	<i>b</i>	SE	<i>t</i>	95% CI	<i>r</i>	<i>b</i>	SE	<i>t</i>	95% CI	<i>r</i>
Step 1										
Daily awe	.42	.06	7.43	.31, .53	.31	.73	.13	5.51	.47, .99	.24
Step 2										
Daily awe	.32	.16	2.01	.01, .63	.09	.09	.06	1.41	-.03, .21	.06
Daily curios emotion	.14	.15	.91	-.16, .44	.04	.19	.06	3.22	.08, .31	.14
Daily curios personality	.60	.12	5.13	.37, .83	.22	.39	.05	8.53	.30, .48	.35
Step 3										
Daily awe	.17	.06	2.67	.05, .30	.12	.55	.15	3.55	.25, .87	.16
Daily amusement	.03	.06	0.55	-.08, .15	.02	-.19	.15	-1.29	-.48, .10	-.06
Daily openness	.15	.04	3.83	.07, .23	.16	.31	.10	3.16	.12, .51	.14
Daily conscientiousness	.14	.05	2.82	.04, .24	.13	.10	.12	0.81	-.14, .34	.04
Daily extraversion	.08	.04	1.85	-.004, .15	.08	.05	.10	0.52	-.14, .25	.02
Daily agreeableness	.02	.05	0.43	-.08, .13	.02	-.02	.13	-0.17	-.28, .24	.01
Daily neuroticism	-.09	.05	-1.98	-.18, -.0006	-.09	-.10	.11	-0.88	-.32, .12	-.04

Note. Lagged analyses demonstrated that prior day's awe did predict the next-day's creativity question ($b = .13, p = .035, 95\% \text{ CI } [.01, .25]$) but not creative behaviors ($b = .10, p = .49, 95\% \text{ CI } [-.18, .38]$). Prior day's awe still predicted the next day's creativity question controlling for the effect of prior day's creativity question, amusement, and Big Five traits ($b = .15, p = .037, \text{ CI } [.10, .30]$).

Table 6

Multilevel Mediation of Daily Curiosity on the Relationship between Daily Awe and Daily Creativity question, as well as Daily Creative Behaviors in Study 3

	Creativity question				
	Label	Estimate	SE	t	95% CI (LL, UL)
Daily awe (X) → Daily creativity question (Y)	<i>c</i>	.42	.06	7.43	.31, .53
Daily awe (X) → Daily creativity question (Y)	<i>c'</i>	.09	.06	1.42	-.03, .21
Daily awe (X) → Daily curiosity emotions (M1)	<i>a</i> ₁	.55	.04	13.69	.47, .63
Daily awe (X) → Daily curiosity personality (M2)	<i>a</i> ₂	.57	.05	11.03	.47, .68
Daily curiosity emotions (M1) → Daily creativity question (Y)	<i>b</i> ₁	.19	.06	3.23	.08, .31
Daily curiosity personality (M2) → Daily creativity question (Y)	<i>b</i> ₂	.39	.05	8.55	.30, .48
Daily awe (X) → Daily curiosity emotions (M1) → Daily creativity question (Y)	<i>Indirect effect</i>	.11	.03	3.14	.04, .17
Daily awe (X) → Daily curiosity personality (M2) → Daily creative question (Y)	<i>Indirect effect</i>	.22	.03	6.73	.16, .29
	Creativity behaviors				
	Label	Estimate	SE	t	95% CI (LL, UL)
Daily awe (X) → Daily creative behaviors (Y)	<i>c</i>	.73	.13	5.51	.47, .99
Daily awe (X) → Daily creative behaviors (Y)	<i>c'</i>	.31	.16	2.02	.008, .62
Daily awe (X) → Daily curiosity emotions (M1)	<i>a</i> ₁	.55	.04	13.69	.47, .63
Daily awe (X) → Daily curiosity personality (M2)	<i>a</i> ₂	.57	.05	11.03	.47, .68
Daily curiosity emotions (M1) → Daily creative behaviors (Y)	<i>b</i> ₁	.14	.15	0.91	-.16, .44
Daily curiosity personality (M2) → Daily creative behaviors (Y)	<i>b</i> ₂	.60	.12	5.15	.37, .82
Daily awe (X) → Daily curiosity emotions (M1) → Daily creative behaviors (Y)	<i>Indirect effect</i>	.08	.08	0.91	-.09, .24
Daily awe (X) → Daily curiosity personality (M2) → Daily creative behaviors (Y)	<i>Indirect effect</i>	.34	.07	4.64	.20, .49

Note. Controlling for daily amusement, daily openness and daily conscientiousness did not change the results for either creativity outcomes.

Figure 1

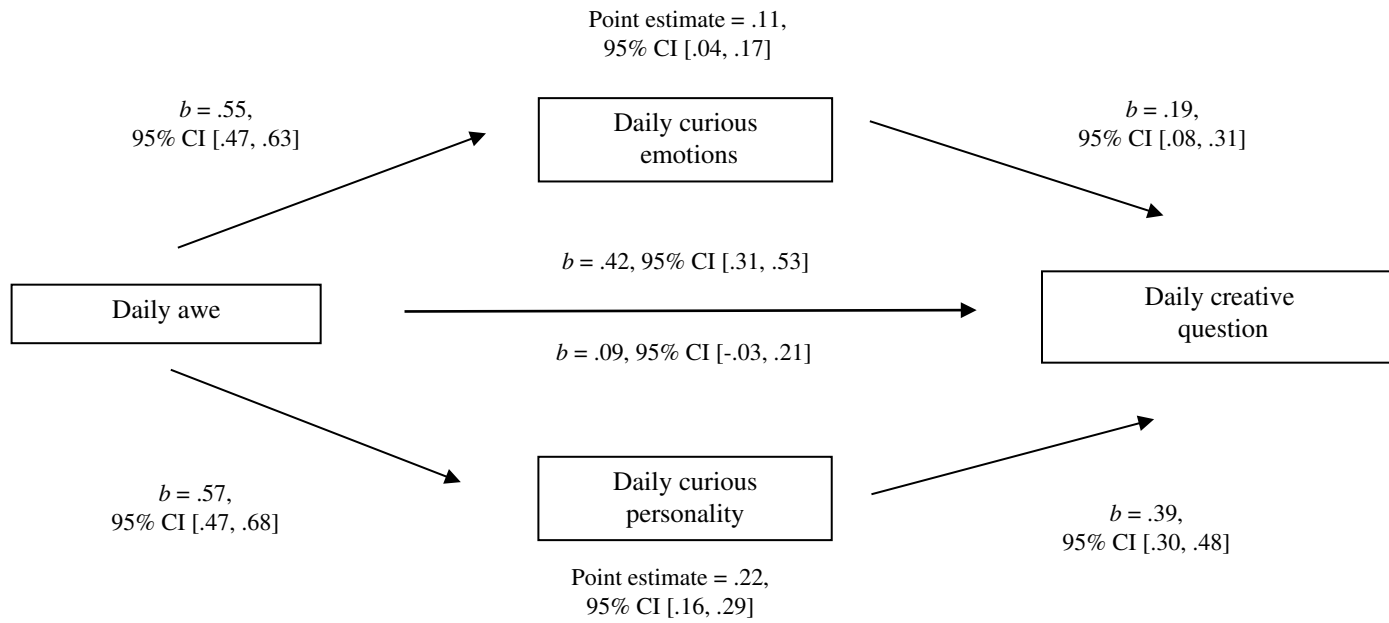


Figure 2

