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Awe Sparks Prosociality in Children

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Abstract
Rooted in the novel and the mysterious, awe is a common experience in childhood, but research is almost silent with respect to the import of this emotion for children. Awe makes individuals feel small, thereby shifting their attention to the social world. Here, we studied the effects of art-elicited awe on children's prosocial behavior toward an out-group and its unique physiological correlates. In two preregistered studies (Study 1: $N = 159$, Study 2: $N = 353$), children between 8 and 13 years old viewed movie clips that elicited awe, joy, or a neutral (control) response. Children who watched the awe-eliciting clip were more likely to spend their time on an effortful task (Study 1) and to donate their experimental earnings (Studies 1 and 2), all toward benefiting refugees. They also exhibited increased respiratory sinus arrhythmia, an index of parasympathetic nervous system activation associated with social engagement. We discuss implications for fostering prosociality by reimagining children's environments to inspire awe at a critical age.

Keywords
awe, art, children, prosocial behavior, psychophysiology

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Art engagement has deep roots in human ontogeny and powerful effects on children's emotions. Infants as young as 5 months are more likely to smile and rhythmically move their body parts in response to music by Mozart than to baby talk (Zentner & Eerola, 2010), and 6-month-old infants are transfixed more by their mother's signing than by her speaking (Trehub, 2001). Why does art play such a central role in human life? Grounded in recent arguments about the social functions of art (Keltner & Oatley, 2022; Savage et al., 2021), we reason that art promotes prosocial tendencies in children through awe—an emotion central to the experience of art but that remains poorly understood in children (Aknin et al., 2018). We report two preregistered and well-powered experiments that provide the first evidence for the effects of art-produced awe on children's prosocial behavior toward strangers.

Awe, an Aesthetic and Self-Transcendent Emotion

Natural and human-made objects that are vast in relation to the self and transcend our previous knowledge can elicit experiences of awe (Keltner & Haidt, 2003). Symphonies, cathedrals, paintings, and movies are common elicitors of awe, which is often positive in valence.[1] Narratives that present highly unusual or even magical events, and music with unexpected harmonies, sudden dynamics, or major shifts in energy, engage spectators in novel ways of thinking that challenge their frames of reference (Grewe et al., 2011). Art with these features is likely to evoke awe, as opposed to mere aesthetic pleasure or entertainment.

The benefits of such awe are many. Awe produces greater physical health and better social functioning (Stellar et al., 2017). Experiences of awe in adults have been associated with greater parasympathetic nervous system (PNS) activation via the vagus nerve (Gordon et al., 2017; Zickfeld et al., 2020). The vagus nerve controls respiratory sinus arrhythmia (RSA), the covariation of heart rate and respiration, known to be an index

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of cardiac health and predictor of enhanced capacity for emotion regulation (Butler et al., 2006; Kok et al., 2013). Increased PNS activity (i.e., augmentation of RSA) supports calm social engagement in both children and adults (Hastings et al., 2008; Miller et al., 2016; Porges, 2011). These physical benefits of awe have downstream consequences on individuals' social relationships.

Several studies with adults show that awe fosters prosociality—engagement in actions that benefit other people (Keltner et al., 2014). In encounters with vast mysteries, awe makes individuals feel small, humble, and less entitled (Piff et al., 2015; Shiota et al., 2007; Stellar et al., 2018), thereby shifting their attention toward the needs and concerns of others rather than the self (Keltner & Haidt, 2003). Accordingly, experimental inductions of nature-elicited awe promoted prosocial behavior in a variety of forms, including generosity in economic games and donation of time to help other people (Gordon et al., 2017; Piff et al., 2015; Rudd et al., 2012). Awe thus promotes social cohesion by generating feelings of interconnectedness.

Awe in Childhood

Despite the dramatic rise of studies of awe in adults, awe remains scientifically uncharted in childhood. Paradoxically, awe is central to cultural forms—stories, theater, dance, and visual art—that feature prominently in childhood. Reasons for the lack of research on children's awe experiences range from the historical neglect of positive emotions (e.g., Fredrickson, 2001) to assumptions that such a complex emotion may be more fitting for later developmental stages. Even young children, though, experience a diverse set of emotions, including emotions that invoke the self (e.g., shame, pride, embarrassment; M. Lewis, 2008). Moreover, the knowledge-enhancing functions of awe would seem to be essential to knowledge development during childhood (Valdesolo et al., 2017). Children are intrinsically curious explorers and hungry for new information (Schulz, 2012). Given their developing knowledge across domains, it is sound to assume that children will often encounter things that seem vast in relation to the self and transcend their previous knowledge—two critical ingredients of awe (Keltner & Haidt, 2003). Our pilot data confirm this: Children tended to have high dispositional levels of awe (M = 5.12 on a 7-point scale), and parents reported a wide array of events that elicited awe in their children, including technology, nature, new knowledge, and other people, as well as art and music (see the Supplemental Material available online).

It is also worth noting that, to date, there are no validated ways to elicit and measure awe in children (Aknin et al., 2018). To address this lacuna, we developed and validated age-appropriate methods to study awe in children. With our methods, we were able to reliably elicit awe in children, measure its subjective experience as a separate category from joy using pictorial items, and validate the subjective experience of awe with objective physiological measures of PNS activity. These methodological advances enabled us, for the first time, to test hypotheses concerning the prosocial effects of awe in children.

In the current research, our aim was to understand whether awe experiences can catalyze children's prosociality toward individuals perceived as not belonging to their group. We focus on children because in-group favoritism in helping and sharing with others emerges early in development (Dunham, 2018). For example, children as young as 5 gave more stickers to a puppet wearing the same-colored shirt (in-group) than a puppet wearing a different-colored shirt (out-group; Plötner et al., 2015). When sharing between themselves and others, 4- to 6-year-old children made fewer generous allocations toward out-group recipients than in-group recipients (Sparks et al., 2017). Children between 3 and 8 years old were also more likely to share their sweets with their classmates than with children from another school (Fehr et al., 2008; Yu et al., 2016). These nonegalitarian behavioral tendencies raise intriguing questions about whether awe promotes out-group-targeted prosociality among children (Moran & Taylor, 2022).

Statement of Relevance

Intrinsically curious and hungry for the mysterious, children are built for awe—an emotion that makes individuals feel small and shifts their attention to the social world rather than the self. Awe in childhood, however, is rarely studied. Here, we examined how awe-eliciting art influences children's prosocial behavior and their physiological reactions. Across two studies, children between 8 and 13 years old watched clips taken from animation movies that elicited awe, joy, or a neutral (control) response. Results showed that experiences of awe more than joy led children to spend their time counting food items for refugee families as well as to donate items they had earned (a raffle ticket and a chocolate snack) to refugee children. Moreover, children who watched the awe-eliciting clip showed greater parasympathetic nervous system activation, which is known to facilitate calm social engagement. Awe, an aesthetic and moral emotion, helps societies flourish by making children more generous.

The Present Research

We hypothesized that awe would increase children's prosocial behavior compared with another positive emotion (i.e., joy) or a neutral state evoking neither emotion (control). We tested this hypothesis in two preregistered and well-powered studies: an online experiment (Study 1) and a field experiment (Study 2). In both studies, children between 8 and 13 years old watched a clip that elicited either awe or joy or a neutral state, and then they completed two behavioral prosociality tasks measuring their readiness to help refugees. In Study 2, we also measured peripheral physiological reactions to investigate whether PNS activity known to facilitate social engagement (Keltner et al., 2014) accompanies awe in children as it does in adults (e.g., Gordon et al., 2017).

In two additional studies reported in the Supplemental Material, we developed new methods to study awe in age-appropriate ways. We pretested several clips to select the ones that elicited the intended emotions; validated an emoji scale to measure children's experienced emotions, consistent with emotion communication norms of their age (Zilka, 2020); and pretested prosocial tendencies toward several groups to select one toward which children felt less prosocially inclined.

Open Practices Statement

All data, code, and study materials, including the experimental protocol, have been made publicly available on OSF and can be accessed at https://osf.io/8mv7h/. Both studies were preregistered on AsPredicted (Study 1: https://aspredicted.org/Y2F_6B7; Study 2: https://aspredicted.org/2YK_D6R). Exploratory measures and analyses are stated in the preregistration.

Study 1

Method

Participants. A power analysis demonstrated that 158 participants were needed to detect a small effect size (odds ratio = 1.5) in a two-tailed negative binomial regression (α = .05, β = 0.80). We recruited our sample through social media advertisements. Out of 180 participants who started the study, 159 completed it and were included in the analyses (age: M = 10.25 years, SD = 1.37; 52.8% girls; 86.2% Dutch speaking). The study was approved by the institutional review board of the Faculty of Social and Behavioral Sciences at the University of Amsterdam.

Procedure. The study employed a between-subjects design. After parents provided consent, children completed a practice session in which they learned how to play a video in full screen, read instructions explaining the difference between joy and awe, and learned how to use a 5-point Likert scale to report their emotions. They were then randomly assigned to watch a clip from an animated film that elicited awe (n = 55), a clip from an animated film that elicited joy (n = 53), or an instructional clip that evoked a neutral state (control condition; n = 51). The three clips were pretested and selected from among 15 other clips (see Study S2 in the Supplemental Material). The awe-eliciting clip was from the film *Song of the Sea*, in which the main character turns into a seal and transforms the city while flying above it. The joy-eliciting clip was from the film *Fantasia*, in which the main character, Dionysus, celebrates with friends. The control clip was an instructional video, in which the main character demonstrates how to paint walls. Each clip lasted approximately 4 min, 20 s. After watching the clip, participants reported their emotional response to it using a six-item pictorial scale featuring emojis corresponding to fear, anger, boredom, sadness, joy, and awe expressions; response options for each item ranged from neutral to very intense (Fig. 1; see Study S1 in the Supplemental Material for scale validation). Next, we measured prosocial behavior.

Prosocial behavior measures. Prosocial behavior was measured with two tasks. The first required participants to complete an easy yet time-consuming assignment (Zhang et al., 2014). Participants were told that a local university organized a food drive in which people could donate food to refugees by marking the number of food items they wanted to donate on a list. However, food items on each list had to be tallied to ensure that refugees got the food quickly. Participants were asked to tally the food items by sorting through a large number of donation lists. The task included 30 lists with seven different food items that each could be donated up to 10 times. Participants were told that completing this task was voluntary and that they could stop counting food items at will. The task was explained in a video with audiovisual instructions to ensure participants understood the task and concepts mentioned in it (e.g., refugee).

The second task measured donating behavior (Barnett et al., 1979). After the counting task, participants were informed that the experiment ended and were given a numbered raffle ticket, which would allow them to visit a local museum as a reward for their participation. Participants were then asked whether they would like to donate their ticket to a refugee family.

Results

Manipulation check. We first tested whether participants experienced the intended emotion in each condition. A series of t tests showed that participants who

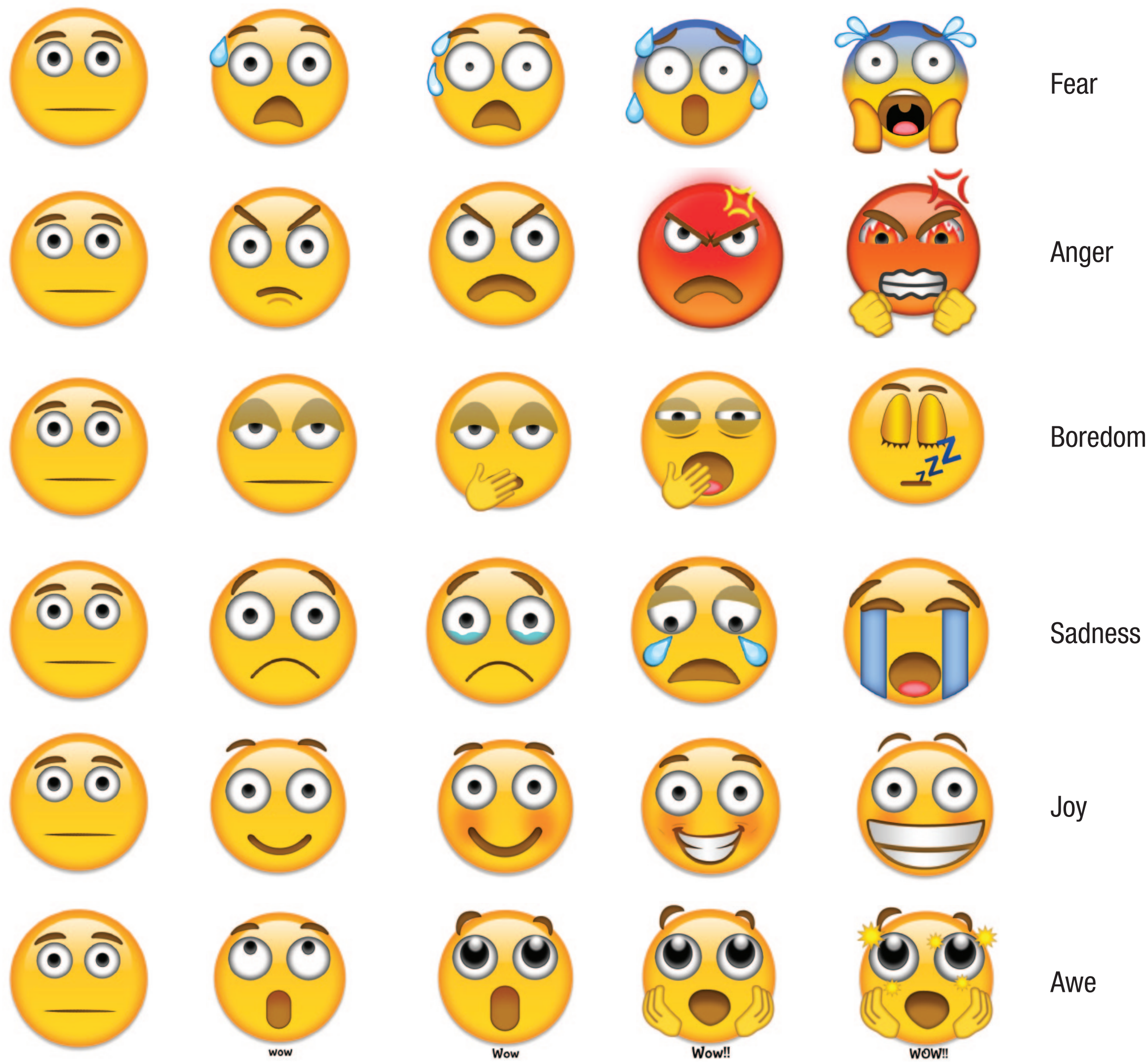

Fig. 1. Validated emoji scales used to assess each of the six experienced emotions in Studies 1 and 2. From left to right, response options ranged from 1 (*not at all*) to 5 (*extremely*).

watched *Song of the Sea* experienced greater feelings of awe (M = 3.04, SD = 1.29) than of joy (M = 2.56, SD = 1.15), $t(54) = -2.78$, p = .007, Cohen's d = −0.38, 95% confidence interval (CI) = [−0.65, −0.10]; participants who watched *Fantasia* experienced greater feelings of joy (M = 2.81, SD = 1.36) than of awe (M = 1.89, SD = 1.09), $t(52) = -6.28$, $p < .001$, Cohen's d = 0.86, 95% CI = [0.54, 1.18]; and participants who watched the *Wall Painting* clip did not significantly differ in their experiences of awe (M = 1.78, SD = 1.19) and of joy (M = 1.88, SD = 0.93), $t(50) = 0.63$, p = .534. These results indicate that the clips successfully elicited the intended emotions, lending further credence to the experimental manipulation (see the Supplemental Material for further analyses).

Prosocial behavior. We conducted a negative binomial regression to examine whether condition predicted the average number of accurately counted food items. Negative binomial regression allows the conditional variance of the outcome variable to be greater than its conditional mean (i.e., data overdispersion), making it appropriate for analyzing the current data. Our preregistered analyses revealed a significant difference between conditions, Wald $\chi^2(2, N = 159) = 14.14$, $p < .001$. Participants in the awe condition (M = 43.87, SD = 5.98) counted 1.50 times (95% CI = [1.02, 2.20]) more food items than participants in the joy condition (M = 29.28, SD = 4.09), Wald $\chi^2(1, N = 108) = 4.29$, b = 0.40, SE = 0.20, 95% CI = [0.02, 0.79], p = .038. They also counted 2.10 times (95% CI = [1.42,

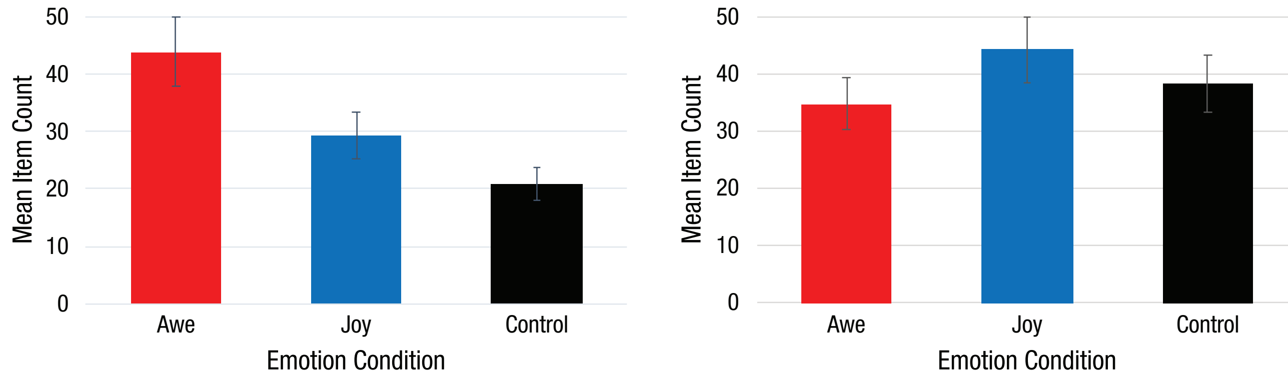

Fig. 2. Item count in each emotion condition in Study 1 (left) and Study 2 (right). Error bars represent standard errors.

3.09]) more food items than participants in the control condition (M = 20.90, SD = 3.00), Wald $\chi^2(1, N = 106) = 14.05$, b = 0.74, SE = 0.20, 95% CI = [0.35, 1.13], $p < .001$ (see Fig. 2, left). There was no significant difference between the joy and control conditions, Wald $\chi^2(1, N = 104) = 2.84$, b = 0.34, SE = 0.20, 95% CI = [−0.01, 0.73], p = .092.

We performed logistic regression to test whether emotion condition predicted the probability that children would donate their ticket. Our preregistered analyses revealed that participants' probability of donation differed across conditions, Wald $\chi^2(2) = 11.87$, p = .003. Odds ratio analysis showed that participants in the awe condition were 2.90 times (95% CI = [1.32, 6.35]) more likely to donate their ticket than participants in the joy condition, Wald $\chi^2(1) = 7.06$, b = 1.06, SE = 0.40, p = .008. They were also 3.77 times (95% CI = [1.69, 8.42]) more likely to donate their ticket than participants in the control condition, Wald $\chi^2(1) = 10.45$, b = 1.33, SE = 0.41, p = .001 (see Fig. 3, left). There was no significant difference between the joy and control conditions, Wald $\chi^2(1) = 0.42$, b = 0.26, SE = 0.40, p = .515.

Exploratory analyses. Exploratory analyses showed that children across conditions differed in their self-reported sense of smallness, $F(2, 156) = 3.46$, p = .034, $\eta_p^2 = .04$, with children in the awe condition experiencing reduced symbolic self size (see also Piff et al., 2015; see the Supplemental Material for descriptive statistics). Furthermore, the effect of emotion condition on donating behavior was mediated by self-reported feelings of awe (awe vs. joy: b = 0.41, SE = 0.25, 95% CI = [0.03, 1.01]; awe vs. control: b = 0.44, SE = 0.27, 95% CI = [0.03, 1.09]), which further supported the awe-prosociality hypothesis tested here (see Table S8 and Figure S4 in the Supplemental Material for full mediation results).

Discussion

Study 1 showed that awe promoted children's prosocial behavior: Children who watched an awe-eliciting movie clip were more likely to spare their time and donate their experimental earnings to benefit refugee families than children who watched a joy-eliciting movie clip

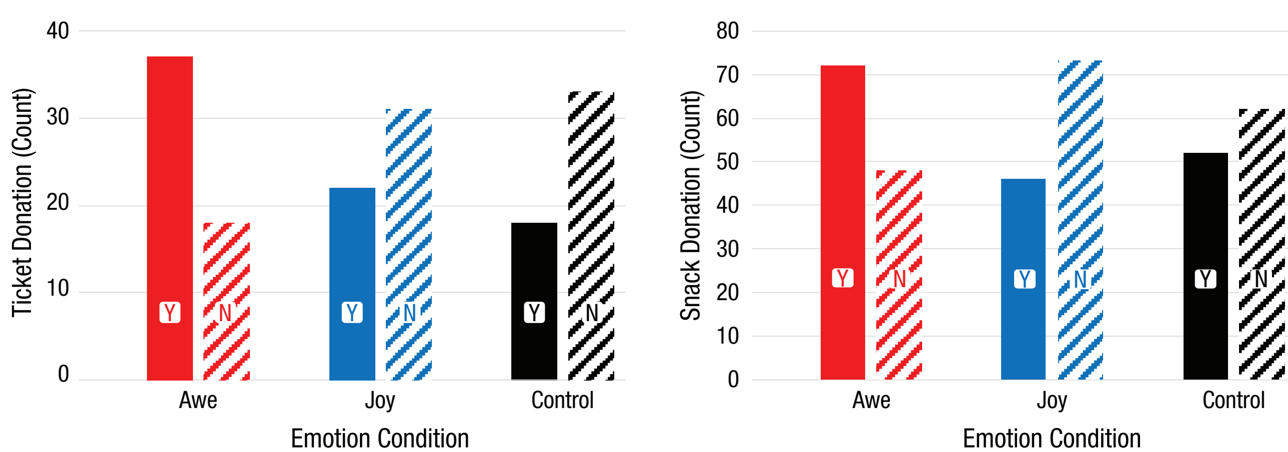

Fig. 3. Number of children who donated (Y = yes) and did not donate (N = no) in each emotion condition in Study 1 (left) and Study 2 (right).

or a neutral instructional clip. These findings demonstrate that awe promotes children's prosociality.

In Study 2, we aimed to replicate the findings of Study 1 and address two open questions. First, in Study 1, awe made children more generous in donating an intangible reward, but would awe propel children to donate a more tangible, immediate reward? Second, would experiences of awe in children be accompanied by shifts in PNS activation, and does the awe physiological profile differ from that of joy? Finally, we addressed a methodological limitation of the control condition in Study 1, which was rated highly on boredom, by replacing the control clip with a less boring one in Study 2 (see the Supplemental Material).

Study 2

Method

Participants. Study 2 was conducted at NEMO Science Museum, which enabled us to recruit visitors as participants through its Science Live program. We committed to collecting data for 3 weeks. We recruited 384 children, 31 of whom were excluded from the analyses for one of the following reasons: failed physiological recording, participated in the pilot test, withdrew consent, had dietary restrictions related to the snack we offered as part of the donation task, were neurodivergent, or parental intervention on the child's donation decision (see the Supplemental Material for details). The final sample comprised 353 children (age: M = 9.94 years, SD = 1.50; 45.9% girls; 89.5% Dutch speaking), each of whom was accompanied by one of their parents (age: M = 42.55 years, SD = 5.69; 55% women).

Procedure. Each child and their parent were seated in adjacent rooms separated by a door. We first applied electrocardiography (ECG) and skin conductance devices to children to assess their physiological activity. After a 2-min measure of basal physiological activity, the experimenter started the experiment on the computer and left the room. Then, children answered demographic questions, watched two videos explaining the emotions joy and awe, and practiced how to use the emoji Likert scales (practice session). Next, each child was randomly assigned to view the awe (n = 120), joy (n = 119), or control (n = 114) video clip, and they reported their emotional reactions to the clip using the same six-item emoji scale as in Study 1. The awe and joy clips were the same as in Study 1, but the control clip was replaced with an instructional video for making coffee. Finally, we assessed children's prosocial behavior. Meanwhile, parents completed a questionnaire that assessed demographics, family socioeconomic status, parent's art interest, child's art exposure, child's dispositional joy and awe, and elicitors of awe in their children, which were included as exploratory measures (see the Supplemental Material for further details).

Prosocial behavior measures. Prosocial behavior was measured with two tasks. For the first task, children watched the same video as in Study 1, which explained the food-counting task. When children decided to stop with the task, they read that this was the end of the experiment and were instructed to ring an electric bell to notify the experimenter. The experimenter then returned to the children's room holding three different chocolate snacks in one hand and a brown nontransparent paper bag in the other. The experimenter detached the electrodes; gave children the bag, which contained a certificate of participation; and asked them to choose one of three snacks as a reward for their participation. After children chose their preferred snack, the experimenter explained that they could either put the snack in their bag to take it with them or drop it in a box on the opposite side of the room to donate it to refugee children (second prosociality task). To prevent any authority biases or bystander effects, the experimenter left the room and closed the door, so children could privately decide about donating their snack (see Fig. 4).

Physiological measures. All physiological measures were recorded with *Vsrrp98* software (Molenkamp, 2011) and analyzed with *R Studio*. Data acquisition was performed by a National Instruments (Austin, TX) NI 6224 data acquisition card sampling at a rate of 1,000 S/s per channel. Cardiovascular activity was recorded using a standard Lead II configuration. The raw ECG signal was filtered at a high-pass frequency of 0.5 Hz with a second-order Butterworth filter. We then applied a second-order band-pass filter at 17 Hz to extract the position of the r-tops from the signal. A QRS detector was applied to the raw ECG to find the actual QRS wave using the positions from the 17-Hz filtered signal. Electrodermal activity was recorded with two curved Ag/AgCl electrodes placed on the middle phalanx of the ring and index fingers of the child's nondominant hand.

Physiological measures were computed for the 2-min baseline period at the start of the experiment; 1-min practice session; and 4-min, 30-s main clip. We computed two physiological indices. First, we computed RSA, a heart rate variability index in which spectral analysis is used to derive the high-frequency component of the interbeat interval cycle using Porges's algorithm (Porges, 1985). The interbeat interval signal was resampled to 4 Hz, and the high-frequency band-pass filter for quantifying RSA was set to range from 0.12 to 1.00 Hz (Butterworth filter, eighth order). RSA scores were normally distributed. Second, we computed electrodermal activity,

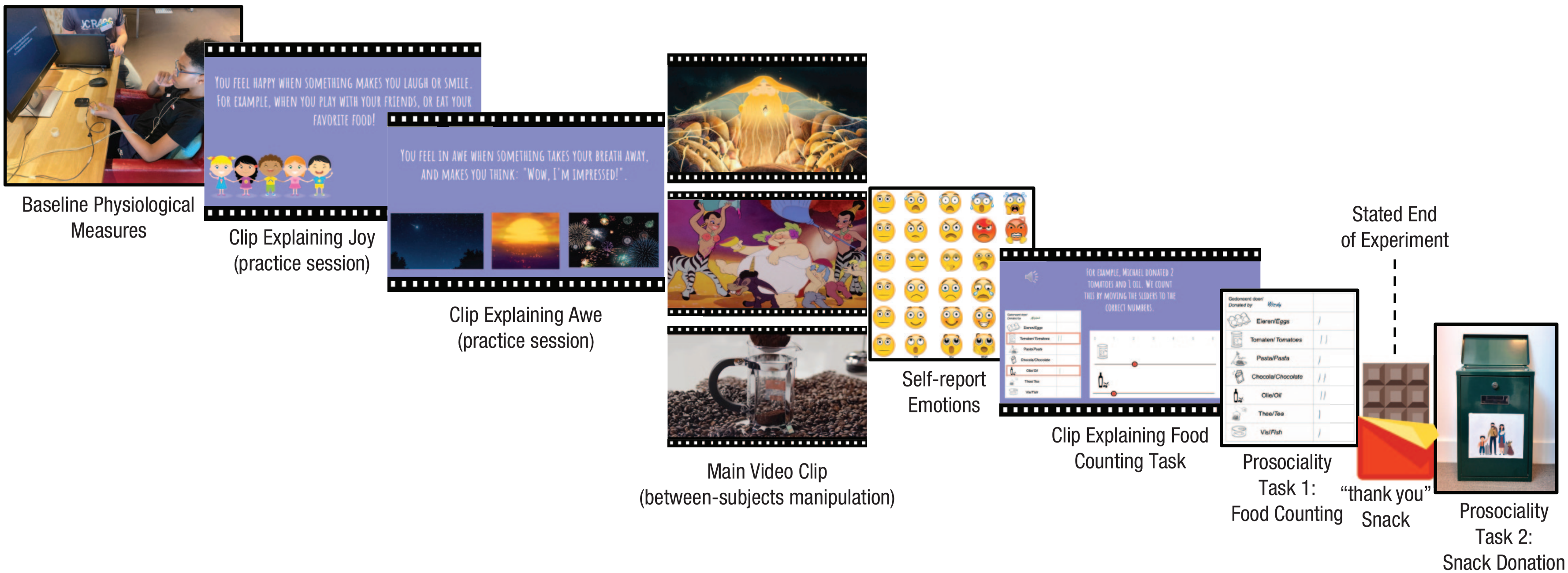

Fig. 4. Experimental procedure of Study 2.

which was measured as skin conductance level (SCL) reported in microsiemens. SCL scores were skewed, so we applied a square-root transformation, which normalized the data distribution.

We averaged physiological scores over the 2-min baseline and 1-min practice session periods. Because the main clips were designed to climax toward the end, RSA and SCL scores during the main video were extracted in 30-s intervals (resulting in nine time points) to capture the buildup of participants' physiological reactions. Porges's algorithm can reliably estimate RSA in 30-s or shorter intervals without violating statistical assumptions of nonstationarity of the interbeat time series (G. F. Lewis et al., 2012).

Results

Manipulation check. A series of t tests assessed the effectiveness of the manipulation. Results showed that participants who watched *Song of the Sea* experienced greater feelings of awe (M = 2.74, SD = 1.23) than of joy (M = 2.38, SD = 1.15), $t(119) = -3.39$, p = .001, Cohen's d = −0.31, 95% CI = [−0.49, −0.13]. Participants who watched *Fantasia* did not significantly differ in their experiences of joy (M = 2.02, SD = 1.14) and awe (M = 1.95, SD = 1.16), $t(113) = 0.82$, p = .412, Cohen's d = 0.08, 95% CI = [−0.11, 0.26]. And participants who watched the *Coffee Making* video experienced greater feelings of joy (M = 2.45, SD = 1.02) than of awe (M = 2.02, SD = 1.06), $t(118)$ = 4.82, p < .001, Cohen's d = 0.44, 95% CI = [0.25, 0.63]. These results indicate that *Song of the Sea* successfully elicited awe, but the *Fantasia* clip did not differentiate between the two emotions. However, the *Coffee Making* clip elicited more joy than awe, thereby allowing us to test whether an artistic clip that elicits awe produces prosocial behavior when compared with an instructional clip that elicits joy or an artistic clip that elicits a neutral state. Henceforth, we will refer to the *Coffee Making* clip as the joy condition and the *Fantasia* clip as the control condition.[2]

Prosocial behavior. A negative binomial regression showed no difference in the number of accurately counted food items between conditions, Wald $\chi^2(2, N = 353)$ = 3.34, p = .188 (see Fig. 2, right). Thus, the effect of emotion condition on participants' willingness to help by counting food items was not replicated.

Logistic regression showed that the probability of participants donating their snack differed across conditions, Wald $\chi^2(2, N = 353) = 11.16$, p = .004. Our preregistered odds ratio analysis showed that participants in the awe condition were 2.38 times (95% CI = [1.42, 4.00]) more likely to donate their snack than participants in the joy condition, Wald $\chi^2(1, N = 239) = 10.72$, b = 0.87, SE = 0.27, p = .001 (see Fig. 3, right). They were also 1.79 times (95% CI = [1.06, 3.01]) more likely to donate their snack than participants in the control condition, Wald $\chi^2(1, N = 234) = 4.82$, b = 0.58, SE = 0.27, p = .028. There was no significant difference between the joy and control conditions, Wald $\chi^2(1, N = 233) = 1.16$, b = 0.29, SE = 0.27, p = .283.

A robustness analysis showed that the effect of emotion condition on donating behavior held after analyses controlled for variables that may influence prosocial behavior (age, gender, family subjective socioeconomic status, family annual income) and awe experiences (parent art interest, child art exposure), which further bolsters the inferences that can be drawn from the present findings (see Tables S7 and S9 in the Supplemental Material).

Physiological activity. The analytical procedure for RSA and SCL was identical. We conducted multilevel regression analyses because physiological responses at nine time points (Level 1) were nested within participants (Level 2). We first explored the time trends without including emotion-condition effects. The pattern of change in RSA and SCL over time was captured by both linear and quadratic trends, consistent with findings of earlier work (Miller et al., 2016; see Tables S10 and S11 in the Supplemental Material). We then regressed RSA or SCL on time, emotion condition, and their interaction while controlling for mean baseline and practice session RSA or SCL, respectively. Results showed significant cross-level interactions between time and emotion condition for RSA (awe vs. joy: $\gamma = -0.02$, SE = 0.01, $t = -2.73$, p = .007; awe vs. control: $\gamma = -0.03$, SE = 0.01, $t = -3.44$, p < .001) and SCL (awe vs. joy: $\gamma = -0.01$, SE = 0.00, $t = -2.84$, p = .005; awe vs. control: $\gamma = -0.01$, SE = 0.00, $t = -3.07$, p = .002). These interactions indicate that the pattern of physiological changes differed depending on which emotion condition participants were assigned to (see Table 13 in the Supplemental Material for all parameter estimates).

We followed up the cross-level interactions with polynomial contrasts to examine whether the interaction trend was best modeled as linear or quadratic. For both RSA and SCL, a linear trend best captured the interaction when we compared the awe and joy conditions (RSA: $\gamma = -3.06$, SE = 1.11, $t = -2.77$, p = .006; SCL: $\gamma = -1.80$, SE = 0.69, $t = -2.60$, p = .009) and when we compared the awe and control conditions (RSA: $\gamma = -3.91$, SE = 1.12, $t = -3.49$, p < .001; SCL: $\gamma = -2.26$, SE = 0.70, $t = -3.22$, p < .001). The quadratic trends were not significant (see Table S14 in the Supplemental Material for all parameter estimates). These findings indicate that the physiological changes across conditions can be described as a linear increase or decline over the course of the main video.

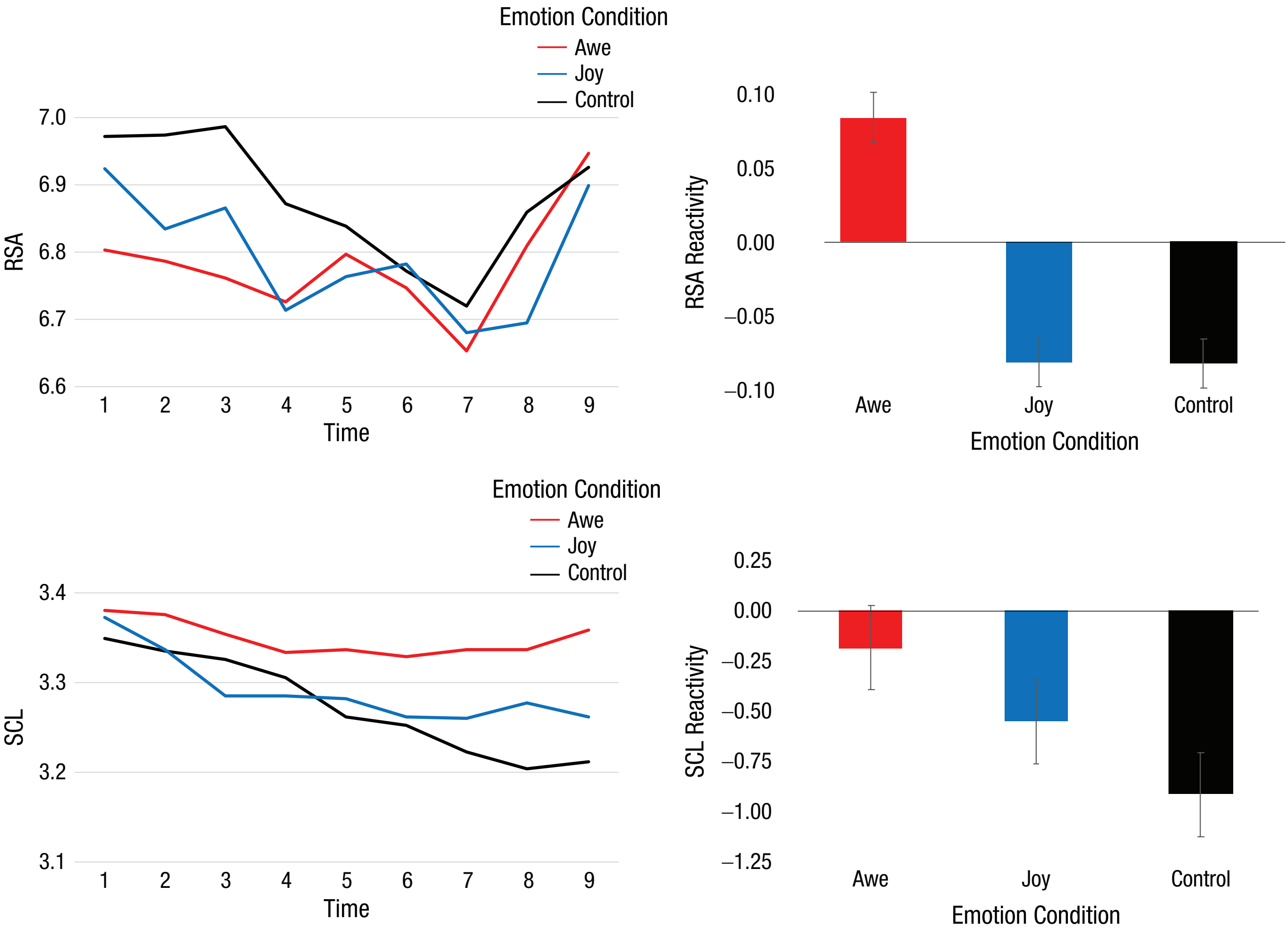

Fig. 5. Respiratory sinus arrhythmia (RSA; top) and skin conductance level (SCL; bottom) in Study 2. The plots on the left show mean RSA and SCL during the main video as a function of time and emotion condition. The graphs on the right show mean RSA and SCL reactivity estimated as difference scores from the end to the start of the main video, separately for each emotion condition. Error bars represent standard errors.

To probe the linear trends, we plotted RSA and SCL across time points and conditions (Fig. 5, left) and estimated changes in RSA and SCL (i.e., reactivity) by subtracting physiological scores during the last 1 min of the main video from scores during the first 1 min (Fig. 5, right). Positive reactivity values thus reflect an increase and negative values a decline in the respective index. We then conducted two analyses of variance to predict physiological reactivity from emotion condition after controlling for baseline and practice session physiological scores.

RSA reactivity differed across conditions, $F(2, 348) = 5.53$, $p = .004$, $\eta_p^2 = .03$. Participants in the awe condition exhibited an increase in RSA, whereas participants in the joy and control conditions exhibited a decline. These differences were significant when we compared the awe and joy conditions, $b = -0.16$, $SE = 0.06$, $t(348) = -2.82$, $p = .005$, $\eta_p^2 = .02$, and the awe and control conditions, $b = -0.17$, $SE = 0.06$, $t(348) = -2.92$, $p = .004$, $\eta_p^2 = .02$. SCL reactivity also differed across conditions, $F(2, 348) = 3.70$, $p = .026$, $\eta_p^2 = .02$. There was a decline in SCL in all conditions. The decline was greater in the control than awe condition, $b = -0.70$, $SE = 0.26$, $t(348) = -2.71$, $p = .007$, $\eta_p^2 = .02$. The decline in the joy condition did not differ from that in the awe condition, $b = -0.30$, $SE = 0.26$, $t(348) = -1.18$, $p = .240$, $\eta_p^2 < .01$ (see Table S15 in the Supplemental Material for descriptive statistics).

In sum, the physiological results indicate that participants in the awe condition exhibited greater PNS activity, as reflected in an increase in RSA from the start to the end of the video, whereas their sympathetic nervous system (SNS) activity remained relatively steady, as reflected in rather stable SCL.

Exploratory analyses. Exploratory analyses showed that RSA reactivity correlated positively with self-reported experiences of awe, $r(353) = .13$, $p = .013$, and did not correlate significantly with self-reported experiences of joy, sadness, boredom, anger, and fear (see Table S16 in the Supplemental Material). These findings provide suggestive evidence that RSA may be an important aspect of the physiological signature of awe in children (see the Supplemental Material for further analyses on RSA and emotional experiences).

Discussion

In Study 2, children led to feel awe in a museum donated more of a tangible and immediate reward—their preferred chocolate snack—to refugees than did children led to feel joy or a neutral state. Although we found consistent effects on donating behavior across studies, the effect we observed on the counting task in Study 1 was not replicated in Study 2, perhaps because the task was experienced differently across studies. Specifically, a minor change in Study 2 might have rendered the task less effortful and thus less able to capture costly prosocial behavior: In Study 1, the counting bars appeared right underneath the food item lists, requiring participants to scroll back and forth in order to tally the items. In Study 2, the counting bars appeared right next to the food item lists, allowing participants to complete the task more efficiently. In fact, Study 2 participants spent 40% less time (M = 129 s, SD = 107) to count 20% more items (M = 39.09, SD = 45.12) than did Study 1 participants (M = 213 s, SD = 210; M = 31.64 items, SD = 40.26).

Importantly, Study 2 lends important insights into the physiology of awe in children. Children who watched the awe clip exhibited greater PNS activity, as indexed by increased RSA, a physiological state that fosters calm social engagement (Porges, 2011).

General Discussion

Our research examined whether awe-eliciting art affects children's prosocial behavior toward an out-group and brings about peripheral physiological changes. Across two preregistered experiments, children between 8 and 13 years old watched clips that elicited awe, joy, or a neutral state. Children led to feel awe were more likely to forgo self-gain to help refugees. They also experienced greater PNS activation. Our research is the first to demonstrate that awe-eliciting art can spark prosociality in children, even encouraging them to donate tangible resources, and this effect concurs with physiological processes associated with social engagement (Miller et al., 2015; Porges, 2011).

Theoretical and practical implications

Our work informs the theoretical understanding of awe in childhood and has important implications for socializing prosociality. Awe is a common experience in childhood that is elicited by a rich gamut of events, and it has a unique physiological signature and direct consequences on children's behavior. Although children from an early age are more likely to help in-group than out-group members (Dunham, 2018; Fehr et al., 2008; Sierksma et al., 2015; Yu et al., 2016), our findings show that awe can open them up to helping members of a national minority. The current results thus provide guidance for building children's environments in ways that can foster prosociality at a young age. Research on art programs in schools could integrate measures of awe and prosociality to pinpoint the large-scale effects of art on children's prosociality. Future research should also examine whether the effect of awe on prosocial helping varies as a function of the help recipient's group membership.

Our research extends our understanding of the role of emotions on children's prosociality. Whereas sadness has consistently been shown to constrain prosocial behavior, research on joy has yielded mixed findings: Some studies show that feeling happy makes children more generous (Rosenhan et al., 1974; Underwood et al., 1977), but another study shows no such effects (Barnett et al., 1979). We show that awe promoted children's prosocial behavior in two different contexts, whereas joy did not. Although awe and joy are both positive emotions, they have substantial differences as aesthetic emotions. Awe is associated with self-transcendence, whereas joy is associated with pleasure. Recent studies that use computational tools to map people's emotional experiences in response to music, visual art, and brief videos show that people's semantic space clearly separates feelings of awe and wonder from mere pleasure and liking (Cowen et al., 2020; Cowen & Keltner, 2017; Stamkou et al., 2022). Accordingly, our research shows differential behavioral effects of aesthetic awe and joy, further supporting their distinct nature.

Our findings have important implications for philosophical theories of art. Although art has been documented to bear significant benefits to the individual, including better emotional well-being, life satisfaction, and mental health (Totterdell & Poerio, 2021), research on how art engagement benefits others is scarce. This lack of attention to interpersonal effects is consistent with the still-common perception that art has hardly any real-world consequences on human behavior because art experiences are bracketed in imaginary, nonreal worlds (Menninghaus et al., 2019). This view of art assumes that effects of art are situated within the individual and are irrelevant for social behavior, which explains why the vast majority of studies on art focus on intrapersonal effects, such as individual well-being (Carroll, 2001; Stamkou et al., 2018). Our research provides concrete evidence for art's behavioral consequences on outcomes that promote other people's well-being. Thus, studying behavioral effects of aesthetic emotions may be a promising direction for future research in the arts.

Limitations and future directions

Although our research demonstrated the power of awe to promote children's prosocial behavior, it is important to consider potential limits on the generalizability of the findings. Our sample consisted of mostly Dutch children recruited in a museum or through social media ads who volunteered to participate in the study. Future research should examine whether our findings generalize to non-Western samples of randomly selected children. Furthermore, even though we pilot-tested and validated the videos and measures used in the study, the effects of awe on children's prosocial behavior and physiology were demonstrated with two behavioral tasks that measured prosocial helping immediately after exposure to a single awe-eliciting clip. Future studies could examine the longevity of the effects of awe in a longitudinal design using a greater range of prosociality tasks and alternative awe-eliciting media commonly used by children (e.g., video games, music videos).

Conclusion

In the fast-paced world where children of today grow up, art that evokes awe allows them to pause, ponder, and act prosocially.

Transparency

Action Editor: Paul Jose
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Author Contributions

Eftychia Stamkou: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Supervision; Validation; Visualization; Writing – original draft; Writing – review & editing.
Eddie Brummelman: Conceptualization; Investigation; Methodology; Writing – review & editing.
Rohan Dunham: Formal analysis; Investigation; Supervision; Visualization; Writing – review & editing.
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Dacher Keltner: Conceptualization; Methodology, Writing – review & editing.

Declaration of Conflicting Interests

The author(s) declared that there were no conflicts of interest with respect to the authorship or the publication of this article.

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Supplemental Material

Additional supporting information can be found at http://journals.sagepub.com/doi/suppl/10.1177/09567976221150616

Notes

1. Although a negative variant of awe tinged with elements of fear exists, here we focused on the positive variant that is more commonly experienced in response to art.
2. We speculate that the museum context of Study 2 might have altered the experience of the clips. The *Fantasia* clip, created in 1940, might have been less engaging in a technologically advanced science museum. The *Coffee Making* clip, which provided elaborate information about the history and production of coffee, might have satisfied children's learning expectations—a rewarding experience in itself—in the context of an education-oriented museum.

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