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Awe predicts well-being via positive attention bias: Evidence from longitudinal and daily diary studies

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Abstract

Awe is a mixed emotion that is considered important in the protection of well-being during crisis, such as COVID-19. However, there is limited understanding of the long-term and dynamic effects of awe on well-being and the pathways behind these effects. Drawing on the broaden-and-build theory of positive emotions and the theory of mood-congruent bias, the present study utilized longitudinal and daily diary approaches to investigate the relationship between awe and well-being, as well as the mediating role of attention bias. In longitudinal Study 1, 524 participants ($N_{female} = 365$, 69.7%), aged from 18 to 72, completed online surveys three times with 1-month intervals. Cross-lagged analyses demonstrated that awe exerted a significant predictive effect on individuals' well-being. Moreover, positive attention bias served as a mediator in this relationship. In diary Study 2, 183 college students ($N_{female} = 126$, 68.85%) completed surveys for 14 consecutive days. The results of Hierarchical Linear Modeling and Multilevel Structural Equation Modeling showed that awe positively predicted individuals' well-being, and positive attention bias mediated this relationship. Taken together, these findings not only deepen our comprehension of the underlying connections between awe and well-being but also offer valuable theoretical

insights for developing awe-based intervention measures aimed at improving positive attention bias and well-being.

KEYWORDS

awe, dairy study, longitudinal study, positive attention bias, well-being

INTRODUCTION

Extreme weather, health emergency (e.g. the COVID-19 pandemic), war, and other crises have caused people to feel great uncertainty about the future, leading them to endure physiological and psychological health risks, such as sleep problems, depression, anxiety, and post-traumatic stress disorder, and also reducing people's well-being (Fluhrer & Kraehnert, 2022; Goldrick-Rab et al., 2022; Teague et al., 2022; Xiong et al., 2020). Furthermore, with the increase in individualism and the decrease in collectivism, there has been a heightened emphasis on self-actualization and freedom (Twenge et al., 2016; Zeng & Greenfield, 2015). However, Maslow (1967) argues that an overemphasis on the self can lead to egocentricity, which is detrimental to our mental health and overall well-being (Barragan et al., 2021; Sobirova, 2020). The issue of how to enhance well-being has emerged as a prominent research topic within the realm of psychology. Maslow (1967) suggests that humans need something greater than themselves to trigger the experience of awe, allowing them to transcend the self. This shift in focus from the self to the external world helps individuals find beauty and ultimately enhances public mental health and well-being (Schneider, 2009). Therefore, this study aims to utilize both longitudinal and daily diary methodologies to examine the longitudinal and dynamic effects of awe on well-being and explore the underlying mechanisms through the lens of attention bias.

Well-being

Well-being is an important theme in the field of psychology and philosophy that attracts a significant amount of researchers' attention. Well-being is a broad construct that consists of the presence of positive affection (e.g. happiness and enthusiasm), the absence of negative affection (e.g. anxiety, depression, and sadness), and high levels of life satisfaction, reflecting individuals' evaluations and feelings towards their life (Diener et al., 1985). In addition, Chinese culture values inner peace and harmony, emphasizing low-arousal positive affect more than high-arousal positive affect, which is also a critical aspect of well-being (Lee et al., 2012). Therefore, in the present study, well-being is defined as individuals' increased experience of positive emotion, higher levels of life satisfaction and inner peace, and decreased experience of negative affect in their daily lives. Meantime, we divided well-being into positive and negative indexes. The measures of the former included positive affect, satisfaction with life, and peace of mind, while the measures of the latter comprised negative affect.

Awe and well-being

Awe is a mixed emotion that emerges when individuals encounter something vast that challenges them to expand their current perspective (Keltner & Haidt, 2003). In essence, when faced with something grand that exceeds their usual frame of reference, individuals are compelled to adapt to this new experience, leading to feelings of awe. This sensation can arise from various sources, such as admiring a breathtaking view from a tall vantage point, beholding the Earth from space, witnessing majestic natural landscapes, meeting a remarkable individual, listening to beautiful music, experiencing extraordinary works of art, or encountering a profound theory (Bai et al., 2017; Gordon et al., 2017; Keltner & Haidt, 2003). Research has demonstrated that awe can have enduring impacts on individuals' values, morality, cognition, and decision-making processes (Bussing et al., 2021; Gottlieb et al., 2018; Jiang et al., 2018; Luo et al., 2023; Villar et al., 2022; Williams et al., 2022).

Research on the relationship between awe and well-being has been comprehensively developed. Dispositional and state awe have consistently demonstrated their positive impact on well-being. Emotionally, they lead to higher levels of emotional well-being and life satisfaction (Bai et al., 2021; Bernstein & Patrick, 2020; Gordon et al., 2017; Monroy et al., 2023; Monroy & Keltner, 2023; Rankin et al., 2020; Rudd et al., 2012), reduced anxiety and discomfort (Atamba, 2019; Rankin et al., 2020), and decreased daily stress (Anderson et al., 2018; Bai et al., 2021). Physiologically, participants experiencing awe exhibit increased activation of the parasympathetic nervous system (such as elevated breathing rate) and decreased activation of the sympathetic nervous system (like respiratory sinus arrhythmia), which is directly associated with emotional well-being (Bai et al., 2021; Gordon et al., 2017). In the context of intervention, outdoor awe-inspiring walks have been shown to enhance the positive emotions and smile intensity of the elderly and alleviate daily distress (Sturm et al., 2022). Moreover, in the field of psychotherapy, counselors in transpersonal psychology often guide clients to experience awe to foster spiritual growth and relieve psychological symptoms (Bonner & Edward, 2016; Luo et al., 2021). Taken together, these diverse lines of evidence converge to support the conclusion that awe can promote well-being.

Nevertheless, current research mainly relies on cross-sectional surveys or experimental methods, leaving the long-term and dynamic effects of awe on well-being inadequately understood. Thus, building upon prior research, this study intends to conduct longitudinal studies and utilize daily diary methods to further explore the impact of awe on well-being. Based on existing research outcomes, it is hypothesized that awe can enhance positive well-being indices such as life satisfaction, positive emotions, and peace of mind, while diminishing negative indices like negative emotions (H1).

The role of attention bias

Though various studies have shown a link between awe and well-being, the underlying mechanism behind this relationship remains poorly understood. Our hypothesis is that attention bias mediates the connection between awe and well-being. The following is the rationale for this hypothesis.

Attention bias refers to individual differences in the allocation of attention to positive or negative information, leading to selective processing preferences for different types of information (Duschek et al., 2014). Attention bias can be categorized into positive and negative

attention biases. While there has been no study to investigate the relationship between awe and attention bias, the broaden-and-build theory of positive emotions suggests that positive emotions can expand individuals' attention resources (Fredrickson, 2001). Furthermore, the theory of mood-congruent bias posits that individuals tend to maintain consistency between their emotions and cognition (Voelkle et al., 2014). Indirect evidence suggests that individuals with higher dispositional gratitude, a self-transcendent positive emotion like awe, exhibit a prominent positive attention bias and a decrease in negative attention bias in go/no-go and emotional Stroop tasks (Yang, 2016). Additionally, positive psychological interventions (PPIs), which include activities utilizing positive constructs such as gratitude interventions, have also been shown to decrease attention to negative stimuli and improve focus on positive aspects (Hendriks et al., 2020; Stone et al., 2022; Vazquez et al., 2018). Therefore, based on these theories and findings, it can be hypothesized that awe may enhance cognitive processing advantage for stimuli with positive valence (H2).

The cognitive theory suggests that attention biases are important variables that influence emotional disorders, as well as well-being (Beck, 2008; Leung et al., 2022). Specifically, studies have shown that positive attention bias is correlated with positive emotions and life satisfaction, while negative attention bias is associated with negative emotions and mood disorders, such as depression and anxiety (Gotlib & Joormann, 2010; Hou et al., 2021; Leung et al., 2022; Nejati et al., 2019; Sanchez & Vazquez, 2014; Zhang, 2022). Individuals with higher levels of negative attentional bias tend to perceive the world as threatening or unsafe, leading to lower levels of life satisfaction and happiness. Conversely, those with positive attentional bias tend to focus on positive and rewarding aspects of their environment and generally experience higher levels of well-being. Clinical research has also found that cognitive training can modify attention biases in individuals with mood disorders, resulting in higher positive attention bias and lower negative attention bias, which leads to a decrease in depression scores (Nejati et al., 2019). Participants who received training in positive attention bias modification were able to immediately enhance their attention bias and subsequently improve their emotional states (Stone et al., 2022). Based on the analysis above, we hypothesize that attention bias may act as a mediating factor through which awe can influence well-being (H3).

The present study

The study employed longitudinal and daily diary research methodologies to probe into the long-term and immediate consequences of experiencing awe on well-being. The longitudinal methodology, involving repeated data collection from the same group of participants over time (Fang & Wen, 2023; Verbeke et al., 2014), is especially conducive to scrutinizing the enduring influence of awe on well-being. In contrast to the cross-sectional method that obtains data at a solitary moment, the longitudinal technique offers a more dependable appraisal of causal associations among variables (Fang & Wen, 2023; Verbeke et al., 2014). The daily diary study, a form of intensive design, mandated participants to record their daily experiences and behaviors over successive days or weeks (Bai et al., 2021; Emmons & McCullough, 2003). This methodology is optimal for investigating well-being within the ambit of daily existence, reducing biases in memory reconstruction, and augmenting ecological validity (Bai et al., 2021; Bolger et al., 2003). The current study extends prior research by

delving into the long-term and dynamic effects of awe on well-being and exploring the underlying mechanisms. Through the combination of these two methodologies, we strive to attain a more holistic comprehension of the relationship between awe and well-being, proffering insights to aid individuals in augmenting their well-being in the intricate real world. The present research can expand upon previous investigations in two respects. Firstly, although prior studies have explored the link between experiencing awe and well-being, the long-term and dynamic effects, along with the underlying explanations, have not been comprehensively examined. Hence, this study endeavors to deepen our cognizance of awe and its ramifications on well-being. Secondly, by exploring this topic, individuals might be enabled to rectify their attention biases and unearth efficacious means to enhance well-being in the complex real world.

In Study 1, we aimed to utilize a longitudinal methodology, which can track continuous changes in variables and make reasonable inferences about causal relationships. Data were collected after the relaxation of COVID-19 policies in China from December 2022 to February 2023. With the loosening of epidemic restrictions, experts predicted a rapid spread of COVID-19 in China within 2 months, potentially resulting in various uncertainties, increased risk of psychological disorders, and undermining happiness. Participants completed three waves of online surveys, with a 1-month interval. Cross-lagged panel models were used to examine the impact of awe on well-being and the mediating effect of attention bias. In Study 2, considering the biases in memory reconstruction, which may not accurately reflect reality experienced on a day-to-day basis, we utilized a daily measurements approach to capture the dynamic of well-being, which is ideal for examining well-being within the ecologically rich contexts of everyday life (Bolger et al., 2003). Participants completed questionnaires over a continuous 14-day period, and the data were analyzed using Hierarchical Linear Modeling (HLM) and Multilevel Structural Equation Model (MSEM). Ethical approval for all aspects of the study design and procedures was obtained from the Neijiang Normal University Institutional Review Board. The present study proposed the following hypotheses:

H1. Based on previous studies about awe and well-being (Bai et al., 2021; Bernstein & Patrick, 2020; Monroy et al., 2023; Monroy & Keltner, 2023), we hypothesize that awe has both long-term effects on well-being and short-term effects on daily well-being.

H2. Awe can shape individuals' attention bias. Due to a lack of research on awe and attention bias in the past, the exact relationship between awe and attention bias cannot be definitively determined. However, according to the broaden-and-build theory of positive emotions (Fredrickson, 2001) and the theory of mood-congruent bias (Voelkle et al., 2014), awe may enhance a positive attention bias, but its impact on negative attention bias is not clear.

H3. Attention bias, especially positive attention bias, can mediate the effect of awe on protecting well-being. According to the cognitive theory (Beck, 2008; Leung et al., 2022), which proposes that attention biases are important variables that influence emotional disorders, the promoting effect of awe on well-being may be explained by attention bias.

STUDY 1

Methods

Participants

We recruited participants from three universities in China and encouraged them to invite their classmates, friends, or family to take part in the study via the snowball sampling method, a cost-effective technique capable of attaining high response rate (Naderifar et al., 2017). After they completed three waves of surveys, they were eligible to receive ¥40 (approximately $5.76). To guarantee data validity, we informed the participants that they would get paid only after we verified the quality of the questionnaires.

China implemented the relaxed COVID-19 policies in December 2022, and all data were collected from December 2022 to February 2023. Participants completed surveys online, with the interval between two adjacent surveys spaced 1 month. The Monte Carlo Power Analysis for Indirect Effects Application was utilized to determine the required number of samples (Schoemann et al., 2017). A minimum of 280 participants were essential to reach a power of .80. There were 633, 545, and 549 participants who completed the questionnaires at Wave 1, Wave 2, and Wave 3, respectively, and 528 participants completed all three waves. We excluded the data of one participant due to the scores on the dependent variable surpassing three standard deviations (SD) and removed another three participants' data who were under 18 years of age. Therefore, the valid data for analysis comprised 524 participants, among whom 365 were female (69.7%), and 361 participants (68.9%) came from rural geographical areas. The participants' age ranged from 18 to 72 years, with an average of 21.21 $\pm$ 3.38 years. Educational levels ranged from junior middle school or below to graduate.

Measures

Dispositional awe scale (DPES-awe)

We measured awe by the awe sub-scale from the Dispositional Positive Emotion Scale (Shiota et al., 2006). There were six items, such as 'I often feel awe'. Participants respond to each item using a 7-Likert scale (1, *strongly disagree*; 7, *strongly agree*). The higher score indicates higher levels of awe. Cronbach's alpha coefficients of this scale in the study were .83 (Wave 1), .84 (Wave 2) and .85 (Wave 3).

Attention Bias Questionnaire (ABQ)

We used the positive/negative attentional bias scale to assess individuals' attentional bias (Noguchi et al., 2006). The scale consists of 30 items, including positive attention bias (e.g. 'I pay attention to positive characteristics of myself', with 19 items) and negative attention bias (e.g. 'I can't forget the times I have performed poorly at something', with 11 items) dimensions. Participants should respond to each item on a 5-point Likert scale (1, *strongly disagree*; 5, *strongly agree*). Higher scores indicate that individuals' attention bias leans more towards positive or negative information. In this study, Cronbach's alpha coefficients for positive attention bias were .92 (Wave 1), .92 (Wave 2), and .94 (Wave 3). The Cronbach's alpha coefficients for negative attention bias were .84 (Wave 1), .86 (Wave 2), and .86 (Wave 3).

The satisfaction with Life Scale (SWLS)

The SWLS was adopted to measure participants' global life satisfaction (Diener et al., 1985). It is a unidimensional scale, including five items (e.g. 'In most ways my life is close to my ideal'). Participants rated their agreement to each item on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The higher score indicates greater satisfaction with one's life. In this study, Cronbach's alpha coefficients for positive attention bias were .88 (Wave 1), .87 (Wave 2), and .88 (Wave 3).

The Peace of Mind Scale (PMS)

The PMS was used to measure individuals' inner peace (Lee et al., 2012). PMS is a one-dimensional scale with seven items (such as 'I feel comfortable and at ease inside'). Participants should answer each question on a 5-point scale (1, *never*; 5 *always*). A higher score indicates a higher level of inner peace. In this study, the Cronbach's alpha coefficient was .88 in all three waves.

Positive and Negative Affect Schedule (PANAS)

The PANAS, developed by Watson et al. (1988), was utilized in this study to assess positive and negative affect. The PANAS comprises two 10-item mood sub-scales, one for measuring positive affect (e.g. 'interested') and the other for measuring negative affect (e.g. 'sad'). Participants responded to each item on a 5-point scale, ranging from 1 (*almost none*) to 5 (*extremely many*). Higher scores indicate a greater level of positive or negative affect experienced by individuals. In this study, Cronbach's alpha coefficients for positive affect sub-scales were .92 (Wave 1), .93 (Wave 2), and .94 (Wave 3). Meanwhile, those for negative affect sub-scales were .91 (Wave 1), .91 (Wave 2), and .92 (Wave 3).

Depression and Anxiety Scales

Previous research shown that COVID-19 led to an increase in depression and anxiety among individuals (Goldrick-Rab et al., 2022; Xiong et al., 2020). Therefore, depression and anxiety were measured using the sub-scales of depression and anxiety in the Symptom Checklist-90 (SCL-90), a comprehensive self-report inventory designed to assess psychopathology in both clinical and nonclinical populations (Derogatis et al., 1976). The depression scale covers a wide range of symptoms associated with clinical depression, including dysphoric mood and feelings of hopelessness. The anxiety scale includes symptoms and behaviors commonly associated with anxiety, such as nervousness and panic attacks. There are 13 items for depression and 10 items for anxiety, with participants rating each item on a 5-point scale ranging from 0 (*not at all*) to 4 (*extremely*). A higher score on the scale indicates higher levels of depression and anxiety. The Cronbach's alphas for the depression and anxiety scales range from .92 to .93 and .91 to .92, respectively.

Gratitude questionnaires

We measured gratitude, which is considered to be an emotional state resulting from the perception that one has benefited from the costly, intentional, voluntary action of another person (McCullough et al., 2002). Like awe, gratitude is self-transcendent and strongly linked to well-being (Emmons & McCullough, 2003; Stellar et al., 2017). Furthermore, stimuli that trigger the experience of awe may also trigger feelings of gratitude (Bussing et al., 2021). Therefore, when examining the relationship between awe and well-being, it is necessary to control for the influence of gratitude.

We also collected demographic information as the controlled variables, including age, gender (coded as: 1 = male, 2 = female), education level (coded as: 1 = junior middle school or below, 5 = graduate), the number of times participants had contacted COVID-19 (coded as 0, *never*; 1, *once*; 2, *twice*; 3, *more than three times*) and the severity (1, *not at all severe*; 7, *extremely severe*; $M = 3.46$, $SD = 1.49$) in Wave 3.

Statistical analysis

We conducted descriptive statistics analysis and correlational analysis using SPSS 26.0 and carried out cross-lagged structural equation analysis in AMOS 23.0 (SPSS Inc., Chicago, IL, USA). The Cross-Lagged Panel Model (CLPM) is a statistical technique widely applied in longitudinal research to explore the dynamic relationships between variables over time (Cole & Maxwell, 2003). It focuses on the synchronous correlation, autoregressive effects, and cross-lagged effects across different time points. Specifically, it examines how the previous level of a variable influences its current level (autoregressive effect) and how it affects the current level of another variable (cross-lagged effect) (Fang & Wen, 2023; Lüdtke & Robitzsch, 2021). There are several advantages to using the CLPM. First, it allows researchers to examine the predictive effects of one variable on another while controlling for correlations between variables at the same time point and the stability of variables over time. Secondly, the CLPM can capture dynamic relationships between variables. Thirdly, the CLPM can clearly distinguish the sequence of variable measurement and fulfill the premise of causality inference, permitting the inference of causality between variables to a certain extent (Fang & Wen, 2023). Therefore, the CLPM is a powerful tool for establishing causality among variables, which aligns with the research objectives of the present study, exploring the influence of awe on well-being and the mediation role of attention bias between them.

Results

Common method variance

All the data in this study were collected through self-report, so it is necessary to consider the possibility of common method bias (CMB). We conducted Harman's one-factor method to detect CMB (Podsakoff et al., 2012). All measured items were included in the analysis using principal component analysis. Results showed that the total explanatory ratios were between 26.70% and 30.12% in three waves, less than the criterion of 40% (Podsakoff et al., 2012). It is suggested that CMB is not a major issue in this study.

Descriptive statistics for variables

The mean and standard deviation of the variables for three waves were displayed in Table 1. In order to evaluate if these variables experienced changes over time, we conducted repeated measures analysis of variance (ANOVA) and post hoc multiple comparisons with the Bonferroni correction (Bland & Altman, 1995).

TABLE 1 Descriptive statistics and Pearson correlations of means across three waves.

Variable	Wave 1	Wave 2	Wave 3	*F*-test	Awe	PAB	NAB	NA	PA	LS	POM	DEP	ANX
Awe	$5.07 \pm .94^{a}$	$5.04 \pm .95^{a}$	$5.03 \pm .93^{a}$	$F = .11$; $p = .289$; $\eta^2 = 0$	1								
PAB	$3.79 \pm .56^{a}$	$3.75 \pm .57^{ab}$	$3.73 \pm .57^{b}$	$F = 4.23$; $p = .015$; $\eta^2 = .01$	$.62^{***}$	1							
NAB	$3.28 \pm .65^{a}$	$3.25 \pm .63^{a}$	$3.22 \pm .67^{a}$	$F = 2.85$; $p = .058$; $\eta^2 = .01$	$-.16^{***}$	$-.15^{***}$	1						
PA	$2.85 \pm .86^{a}$	$2.90 \pm .88^{a}$	$2.89 \pm .87^{a}$	$F = 1.56$; $p = .21$; $\eta^2 = 0$	$-.12^{**}$	$-.37^{***}$	$.53^{***}$	1					
NA	$2.24 \pm .79^{a}$	$2.14 \pm .80^{b}$	$2.20 \pm .76^{ab}$	$F = 6.32$; $p = .002$; $\eta^2 = .01$	$.47^{***}$	$.48^{***}$	$-.35^{***}$	$-.08$	1				
LS	4.10 ± 1.18^{a}	4.11 ± 1.23^{a}	4.19 ± 1.14^{a}	$F = 2.67$; $p = .069$; $\eta^2 = .01$	$.47^{***}$	$.49^{***}$	$-.43^{***}$	$-.32^{***}$	$.66^{***}$	1			
POM	$3.46 \pm .72^{a}$	$3.42 \pm .71^{a}$	$3.40 \pm .70^{a}$	$F = .04$; $p = .95$; $\eta^2 < .001$	$.48^{***}$	$.64^{***}$	$-.52^{***}$	$-.60^{***}$	$.58^{***}$	$.71^{***}$	1		
DEP	26.47 ± 10.37^{a}	25.99 ± 10.75^{a}	26.58 ± 10.98^{a}	$F = 1.77$; $p = .17$; $\eta^2 = 0$	$-.25^{***}$	$-.45^{***}$	$.53^{***}$	$.80^{***}$	$-.26^{***}$	$-.44^{***}$	$-.69^{***}$	1	
ANX	19.93 ± 8.01^{a}	18.95 ± 7.99^{b}	19.72 ± 8.14^{a}	$F = 7.71$; $p < .001$; $\eta^2 = .01$	$-.18^{***}$	$-.39^{***}$	$.48^{***}$	$.83^{***}$	$-.12^{**}$	$-.32^{***}$	$-.61^{***}$	$.93^{***}$	1

Note: The superscript letters a, b and c represent post hoc comparisons of variables to determine whether there is a significant difference. Different letters indicate significant differences between different waves.

Abbreviations: ANX, Anxiety; DEP, Depression; LS, Life satisfaction; NA, Negative affect; NAB, Negative attention bias; PA, Positive affect; PAB, Positive attention bias; POM, Peace of mind.

The results of the ANOVA analysis revealed that positive attention bias in Wave 1 was higher compared to Wave 3 ($p = .032$, 95% CI [.004, .11]), negative affect in Wave 1 was found to be higher than in Wave 2 ($p = .002$, 95% CI [.03, .18]), and anxiety in Wave 2 was lower than in Wave 1 ($p = .001$, 95% CI [−1.62, −.34]) and Wave 3 ($p = .007$, 95% CI [−1.39, −.17]). All other variables showed no significant changes over time ($ps > .058$).

In addition, we calculated the means of each variable across the three waves and conducted correlation analysis. The results indicated that the pairwise correlations among the variables were significant (see Table 1).

Pearson correlations for variables

We performed a correlational analysis between variables at different time points. Both the correlations using the different time points and the means demonstrated that dispositional awe is positively correlated with positive attention bias, life satisfaction, positive affection and peace of mind. Conversely, it has also been found to have a negative association with negative attention bias, negative affection, anxiety, and depression, except for the correlation between awe in Wave 1 and negative affect. Table 2 shows the Pearson correlations between variables at different time points.

The longitudinal model of dispositional awe, attention bias and well-being

We performed two separate cross-lagged structural equation models (SEM) using AMOS 26.0 to examine the influence of dispositional awe on positive and negative well-being indexes and the mediating role of attention bias in the relationships. In these models, the dependent variables were considered as latent variables. The positive well-being indexes included positive affect, life satisfaction and peace of mind, and the negative well-being indexes consisted of negative affect, depression and anxiety. All the variables were standardized. To evaluate the significance of the indirect effects, we employed a parametric bootstrap procedure with 5000 replications to calculate the 95% bias-corrected CI based on parameters and standard errors. Fit indices such as χ^2 statistic and approximate fit indices were used to evaluate the models' goodness of fit.

The longitudinal model for the positive well-being indexes

The model (see Figure 1) included dispositional awe as the independent variable, with positive and negative attention bias serving as mediators, and positive indexes of well-being as the outcome variable. Control variables comprised age, gender, geographical area, education level, number of contacts with the virus, severity and gratitude. The model fit was deemed acceptable, as evidenced by $\chi^2/df = 1089.27/244 = 4.46$, $p < .001$, $CFI = .89$, $IFI = .89$, $GFI = .87$, $RMSEM = .08$.

The results indicate that the total effect of dispositional awe in Wave 1 significantly predicted positive well-being indexes in Wave 3 (total effect = .09, 95% CI = [.03, .16], $p = .004$) and positive attention bias (a = .17; 95% CI = [.09, .25], $p < .001$), but did not predict negative attention bias (c = −.05; 95% CI = [−.12, .02], $p = .129$) in Wave 2. Positive attention bias (b = .16; 95% CI = [.05, .28], $p = .007$) and negative attention bias (d = −.14; 95% CI = [−.22, −.05], $p = .002$) in Wave 2 were significantly linked with positive well-being indexes in Wave 3. The indirect effect of dispositional awe on positive well-being indexes was significant through the increased positive attention bias (mediation effect = a * b = .03; 95% CI = [.01, .06], $p = .004$, PM = 33.33%). However, the mediation effect of negative attention bias was not significant (mediation effect = c *

TABLE 2 Pearson correlations between variables for three waves.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1 DW_wave1	1												
2 PATT_wave1	.41***	1											
3 NATT_wave1	−.08	.01	1										
4 PA_wave1	.35***	.39***	.22***	1									
5 NA_wave1	0	−.26***	.48***	−.04	1								
6 SWLS_wave1	.29***	.32***	−.31***	.58***	−.24***	1							
7 PM_wave1	.29***	.52***	−.45***	.44***	−.54***	.55***	1						
8 DEP_wave2	−.15***	−.36***	.50***	−.18***	.72***	−.33***	−.63***	1					
9 ANX_wave2	−.10*	−.31***	.45***	−.08	.75***	−.23***	−.56***	.90***	1				
10 DW_wave2	.60***	.45***	−.16***	.27***	−.15***	.34***	.40***	−.20***	−.18***	1			
11 PATT_wave2	.41****	.68***	−.16***	.38***	−.25***	.39***	.50***	−.37***	−.30***	.56***	1		
12 NATT_wave2	−.10*	−.17***	.63***	−.28***	.42***	−.31***	−.40***	.42***	.37***	−.12**	−.06	1	
13 PA_wave2	.37***	.30***	−.22***	.62***	−.09*	.49***	.41***	−.22***	−.12**	.39***	.42***	−.29***	1
14 NA_wave2	−.04	−.28***	.38***	−.07	.62***	−.19***	−.45***	.59***	.60***	−.11*	−.29***	.40***	.02
15 SWLS_wave2	.34***	.32***	−.34***	.45***	−.27***	.63***	.52***	−.38***	−.28***	.40***	.46***	−.36***	.58***
16 PM_wave2	.35***	.47***	−.39***	.44***	−.41***	.52***	.72***	−.55***	−.47***	.43***	.58***	−.43***	.53***
17 DEP_wave2	−.15****	−.31***	.42***	−.17***	.58***	−.33***	−.54***	.74***	.67***	−.20***	−.38***	.44***	−.21***
18 ANX_wave2	−.10*	−.29***	.37***	−.08	.59***	−.21***	−.48***	.70***	.71***	−.13***	−.31***	.38***	−.05
19 DW_wave3	.64***	.48***	−.10*	.32***	−.10*	.37***	.35***	−.20***	−.14**	.70***	.56***	−.12**	.38***
20 PATT_wave3	.39***	.60***	−.16***	.34***	−.23***	.38***	.44***	−.31***	−.25***	.45***	70***	−.19***	.38***
21 NATT_wave3	−.13**	−.14****	.62***	−.28***	.39***	−.32***	−.38***	.42***	.38***	−.17***	−.17***	.66***	−.26***
22 PA_wave3	.37***	.29***	−.24***	.61***	−.08	.47***	.40***	−.20***	−.11*	.35***	.38***	−.32***	.72***
23 NA_wave3	−.04	−.26***	.38***	−.10*	.61***	−.26***	−.45***	.60***	.59***	−.13**	−.31***	.37***	−.10*
24 SWL_wave3	.34***	.29***	−.26***	.46***	−.22***	.63***	.46***	−.30***	−.24***	.37***	.39***	−.33***	.49***
25 PM_wave3	.32***	.43***	−.38***	.41***	−.42***	.52***	.65***	−.53***	−.46***	.39***	.53***	−.43***	.47***

TABLE 2 (Continued)

	1	2	3	4	5	6	7	8	9	10	11	12	13
26 DEP_wave3	−.20***	−.33***	.39***	−.20***	.55***	−.31***	−.56***	.73***	.68***	−.22***	−.41***	.40***	
27 ANX_wave3	−.15***	−.28***	.37***	−.12*	.57***	−.24***	−.50***	.70***	.71***	−.16***	−.35***	.36***	−.12***

Note: 1—Dispositional awe_wave1; 2—Positive attention_wave1; 3—Negative attention_wave1; 4—Positive affect_wave1; 5—Negative affect_wave1; 6—Life satisfaction_wave1; 7—Peace of mind_wave1; 8—Depression_wave2; 9—Anxiety_wave2; 10—Dispositional awe_wave2; 11—Positive attention_wave2; 12—Negative attention_wave2; 13—Positive affect_wave2; 14—Negative affect_wave2; 15—Life satisfaction_wave2; 16—Peace of mind_wave2; 17—Depression_wave2; 18—Anxiety_wave2; 19—Dispositional awe_wave3; 20—Positive attention_wave3; 21—Negative attention_wave3; 22—Positive affect_wave3; 23—Negative affect_wave3; 24—Life satisfaction_wave3; 25—Peace of mind_wave3; 26—Depression_wave3; 27—Anxiety_wave3.
Abbreviation: SWLS, satisfaction with Life Scale.
*$p < .05$,
**$p < .01$,
***$p < .001$.

TABLE 2 (Continued)

	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1 DW_wave1														
2 PATT_wave1														
3 NATT_wave1														
4 PA_wave1														
5 NA_wave1														
6 SWLS_wave1														
7 PM_wave1														
8 DEP_wave2														
9 ANX_wave2														
10 DW_wave2														
11 PATT_wave2														

TABLE 2 (Continued)

	14	15	16	17	18	19	20	21	22	23	24	25	26	27
12 NATT_wave2														
13 PA_wave2														
14 NA_wave2	1													
15 SWLS_wave2	−.23***	1												
16 PM_wave2	−.51***	.66***	1											
17 DEP_wave2	.71***	−.42***	−.58***	1										
18 ANX_wave2	.73***	−.28***	−.49***	.89***	1									
19 DW_wave3	−.10*	.39***	.43***	−.21***	−.14***	1								
20 PATT_wave3	−.33***	.39***	.52***	−.36***	−.32***	.57***	1							
21 NATT_wave3	.32***	−.36***	−.37***	.38***	.33***	−.14***	−.02	1						
22 PA_wave3	−.06	.49***	.48***	−.19***	−.08	.44***	.46***	−.28***	1					
23 NA_wave3	.65***	−.30***	−.45***	.61***	.59***	−.12**	−.29***	.43***	−.01	1				
24 SWL_wave3	−.22***	.70***	.56***	−.36***	−.22***	.44***	.44***	−.34***	.57***	−.26***	1			
25 PM_wave3	−.42***	.56***	.72***	−.52***	−.44***	.44***	.56***	−.42***	.53***	−.53***	.66***	1		
26 DEP_wave3	.64***	−.38***	−.57***	.77***	.73***	−.25***	−.42***	.41***	−.25***	.73***	−.37***	−.59***	1	
27 ANX_wave3	.65***	−.31***	−.50***	.72***	.74***	−.18***	−.35***	.40***	−.11*	.76***	−.26***	−.53***	.92***	1

Note: 1—Dispositional awe_wave1; 2—Positive attention_wave1; 3—Negative attention_wave1; 4—Positive affect_wave1; 5—Negative affect_wave1; 6—Life satisfaction_wave1; 7—Peace of mind_wave1; 8—Depression_wave2; 9—Anxiety_wave2; 10—Dispositional awe_wave2; 11—Positive attention_wave2; 12—Negative attention_wave2; 13—Positive affect_wave2; 14—Negative affect_wave2; 15—Life satisfaction_wave2; 16—Peace of mind_wave2; 17—Depression_wave2; 18—Anxiety_wave2; 19—Dispositional awe_wave3; 20—Positive attention_wave3; 21—Negative attention_wave3; 22—Positive affect_wave3; 23—Negative affect_wave3; 24—Life satisfaction_wave3; 25—Peace of mind_wave3; 26—Depression_wave3; 27—Anxiety_wave3.
Abbreviation: SWLS, satisfaction with Life Scale.
*$p < .05$,**$p < .01$,***$p < .001$.

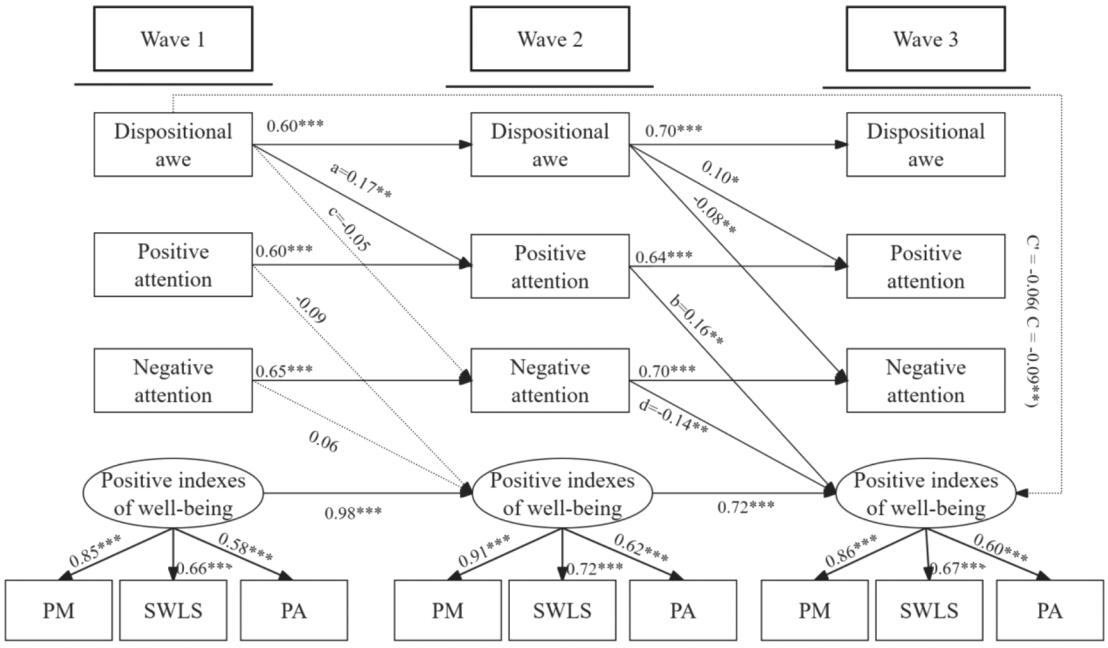

FIGURE 1 The cross-lagged panel mediation model for the effect of dispositional awe on positive well-being indexes. Positive well-being treated as a latent variable in the models. Path coefficients were standardized. Dashed lines represent insignificant paths. The influence of controlled variables on the outcome variable was found to be insignificant, with *ps* > .199, except for gender (β = −.08, p = .02, 95% CI [−.14, −.01]; dummy code: 1 = female, 2 = male). Residuals were not displayed in the figure. Paths a and c demonstrate the influence of awe on positive and negative attention bias, respectively. Paths b and d illustrate the impact of positive and negative attention bias on the positive indicators of well-being, respectively.

d = .01; 95% CI = [−.001, .02], p = .091). Additionally, the direct path from dispositional awe in Wave 1 to positive well-being indexes in Wave 3 was not significant, β = −.06, 95% CI = [−.01, .12], p = .087. These results suggest that dispositional awe can increase positive attention bias and enhance individuals' positive affect, life satisfaction and peace of mind.

The longitudinal model for the negative well-being indexes

Using a similar analysis procedure, we investigated the mediating effects of attention bias between feelings of awe and negative indexes of well-being. The model's fit was deemed satisfactory, $\chi^2/df = 908.07/244 = 3.72$, *CFI* = .93, *IFI* = .93, *GFI* = .88, *RMSEM* = .07. The cross-lagged panel model is presented in Figure 2.

Results indicate that the total and direct effects of dispositional awe in Wave 1 on the negative well-being indexes in Wave 3 were not significant (total effect = −.05, 95% CI [−.09, .02], p = .177; direct effect = −.02, 95% CI [−.08, .04], p = .547). Positive attention bias in Wave 2 positively correlated with the negative well-being indexes in Wave 3 (b = −.11; 95% CI = [−.19, −.02], p = .015). The indirect effect of awe on the dependent variable was significantly mediated by increased positive attention bias (mediation effect = a * b = −.02; 95% CI = [−.04, −.004], p = .009). However, the mediation effect of negative attention bias was found to be insignificant (mediation effect = c * d = −.002; 95% CI [−.01, .001], p = .169). These findings suggest that awe may indirectly reduce negative well-being indexes, such as depression, anxiety and negative affect by enhancing individuals' positive attention bias.

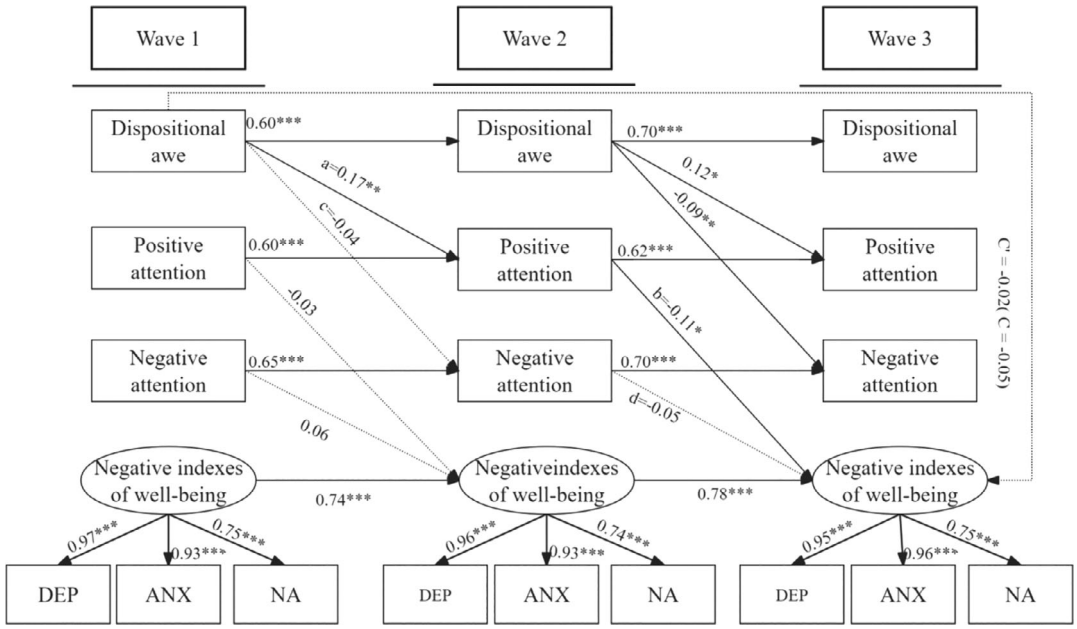

FIGURE 2 Cross-lagged panel mediation model for the effect of dispositional awe on negative well-being indexes. All the explicit variables were normalized. Path coefficients were standardized, and dashed lines denoted insignificant paths. The effects of all controlled variables on the dependent variable in Wave 3 were insignificant, *ps* > .186. Residuals were not shown. Paths a and c demonstrate the influence of awe on positive and negative attention bias, respectively. Paths b and d illustrate the impact of positive and negative attention bias on the negative indicators of well-being, respectively.

In this longitudinal study, we examined the impact of awe on individuals' well-being during a public health emergency and delved into the underlying mechanisms through the lens of attention bias. The findings revealed a positive correlation between awe and positive affect, life satisfaction and peace of mind, as well as a negative correlation with depression and anxiety. Furthermore, the results suggested that while positive attention bias does play a mediating role in the relationship between awe and well-being (awe → positive attention bias → well-being), negative attention bias does not (awe → negative attention bias → well-being), partially providing support for H2 and H3 as seen in the results of Study 1. Although longitudinal studies have yielded insights into the long-term effects of awe on well-being, we chose to utilize a daily diary study method to explore the impact of awe on daily well-being. This approach not only helps mitigate memory bias but also enhances the ecological validity of the research (Bolger et al., 2003).

STUDY 2

Methods

Participants

The sample size is determined based on previous diary studies on awe and mental health (Bai et al., 2021; Sturm et al., 2022). Recruiting advertisements were posted on the campus

networks of two universities in China. A total of 187 participants took part in the experiment, with 183 completing 14-day survey. We only analyzed data from participants who completed the survey. There were 126 females (68.85%). The average age of participants was 20.80 years ($SD = 1.16$), ranging from 19 to 24 years. Prior to the formal investigation, participants were provided with informed consent forms. They were told the duration, compensation for the experiment and their right to withdraw from the experiment at any time without incurring any costs.

Materials and procedure

The purpose of Study 2 is to explore the effect of trait-like awe on daily well-being and the mediation role of attention bias between them. Therefore, we measured the trait-like variables once time at the first day, including dispositional awe (Cronbach's alpha coefficients was .84), positive attention bias (Cronbach's alpha coefficient = .92), negative attention bias (Cronbach's alpha coefficient = .88) and gratitude (Cronbach's alpha coefficients = .75) as the same as in Study 1. On contrast, the indexes of well-being, including life satisfaction, positive and negative emotions, and the peace of mind, were evaluated over a consecutive 14-day period.

Life satisfaction

We used similar methods to measure daily stress as in the article by Bai et al. (2021) to measure daily life satisfaction, asking participants, 'To what extent are you satisfied with your life today?' Participants should indicate their level of satisfaction on an 11-point scale, with options ranging from 1 (*not at all*) to 11 (*extremely*). A higher score reflects a higher degree of satisfaction with one's life.

Positive and negative emotions

The daily positive and negative emotions were assessed by 15 affect items as follows: happy, grateful, contented, peaceful, joyful, moved, distressed, sad, tired, stressed, nervous, afraid, hopeless, alone, and angry (Emmons & McCullough, 2003). Participants were required to rate the extent to experience each feeling during the day on a 11-point scale, with 1 meaning 'not at all' and 11 meaning 'extremely'. Higher scores indicate a higher level of positive or negative affect experienced by individuals in their daily lives. The Cronbach's alpha coefficients for the positive and negative affect sub-scales were found to be between 0.80–0.89 and 0.89–0.95 over a period of 14 days, respectively.

The peace of mind

The peace of mind in this study was similar to Study 1, with the only difference being that it starts with the word 'Today' in the present study, the Cronbach's alpha coefficients ranged from 0.79 to 0.89 over a period of 14 days.

Additionally, we collected additional information as the controlled variables, including age, gender (coding as 1 = male, 2 = female), and region (coding as 1 = rule, 2 = city).

Data analysis

Since the daily measure of well-being consisted of multiple data points nested within individuals and within each day, meaning that participants (level 2, $N = 183$) completed the daily

questionnaires (level 1, $N = 2562$) during the same 2-week period, violating the assumptions of independence between subjects and days. Therefore, the data were treated as a two-level structure. Firstly, we used HLM 7 to construct a null model to calculate the means, within- and between-variances, as well as the intra-class correlation coefficient (ICC). Secondly, we conducted intercepts as outcomes model to test whether awe could predict daily well-being in Mplus 7. Finally, as the independent variable (awe) and the mediators (positive and negative attention bias) were on the second level, and the dependent variable (well-being) was on the first level, we adopted the 2-2-1 model and used MSEM to conduct the mediation effect of attention bias in Mplus 7 (Fang & Wen, 2023). To determine the significance of the mediation effect, a parametric bootstrap procedure with 5000 replications was still utilized in this study.

Results

Descriptive and correlation analysis

We initially computed the means of the daily measurement variables, which included life satisfaction, peace of mind, and positive and negative affect, and then proceeded to conduct descriptive and correlation analyses for the main variables, as presented in Table 3. The outcomes demonstrated that dispositional awe, gratitude, and positive attention bias exhibited positive correlations with the mean measurements of life satisfaction, peace of mind, and positive affect. The results for negative attention bias were found to be negatively correlated with peace of mind and negative affect. In addition, awe was positively correlated with positive attention bias but was not correlated with negative attention bias. Similar results emerged when analyzing the correlations between trait variables and the well-being measurements of each day.

TABLE 3 The descriptive and correlation analyses for the main variables.

	$M \pm SD$	1	2	3	4	5	6	7
1. Awe	5.00 ± 1.03	1						
2. Positive attention bias	3.75 ± .51	.25***	1					
3.Negative attention bias	3.31 ± .65	−.02	.36***	1				
4.Peace of mind	3.63 ± .51	.31***	.42***	−.20***	1			
5.Life satisfaction	6.37 ± 1.39	.33***	.43***	−.08	.72***	1		
6. Positive affect	5.42 ± 1.55	.43***	.36***	−.11	.63***	.83***	1	
7. Negative affect	2.41 ± 1.49	−.11	−.22***	.23***	−.53***	−.39***	−.16*	1

Note: The table did not show the correlations between trait variables and daily measurements. The correlations between awe and daily peace of mind, positive affect, life satisfaction and negative affect ranged from .15 to .31 ($p < .037$), .28 to .39 ($p < .001$), .15 to .28 ($p < .047$) and −.04 to −.15 ($p < .037$), respectively. The correlations between positive attention bias and daily peace of mind, positive affect, life satisfaction and negative affect ranged from .14 to .43 ($p < .051$), .22 to .36 ($p < .003$), .07 to .38 ($p < .348$) and −.09 to −.36 ($p < .251$), respectively. The correlations between negative attention bias and daily peace of mind, positive affect, life satisfaction and negative affect ranged from −.08 to −.28 ($p < .248$), −.06 to −.14 ($p < .448$), .01 to −.15 ($p < .893$) and −.08 to −.26 ($p < .279$), respectively.

*$p < .05$, **$p < .01$, and ***$p < .001$.

Null model

The null model does not include any predictor variables and the equations, which are shown as follows:

$$\text{Level} - 1 : y_{ij} = \beta_{0j} + \gamma_{ij}.$$

$$\text{Level} - 2 : \beta_{0j} = \beta_{00} + u_{0j}.$$

In these models, i represents days, and j represents individuals. β0j represents the between-person variance, and γ_{ij} represents the within-person variance. The ICC values for well-being indexes ranged from 0.44 to 0.62. This suggests that a minimum of 44% of the variance is attributed to individual differences. When the ICC exceeds 0.06, multilevel models are recommended (Fang & Wen, 2023).

Intercepts as outcomes model

We conducted the intercepts as outcomes model using the following formulations:

$$\text{Level} - 1 : yij = \beta_{0j} + \gamma_{ij}.$$

$$\text{Level} - 2 : \beta_{0j} = \beta_{00} + \beta_{01}(\text{awe}) + \beta_{02}(\text{gender}) + \beta_{03}(\text{restrict}) + \beta_{04}(\text{age}) + \beta_{05}(\text{gratitude}) + u_{0j}.$$

We performed this model independently for the positive and negative well-being indexes. Positive well-being indexes were considered as the latent variable, including positive affect, life satisfaction, and peace of mind. Results indicated that awe could predict daily positive well-being indexes, after controlling gender, restrict, age, and gratitude, $\beta_{01} = .40$, $p < .001$, 95%CI [.21, .60]. However, awe failed to predict daily negative affect, $\beta_{01} = -.07$, $p = .543$, 95% CI [−.27, .14].

The mediation effect of attention bias

We constructed separate MSEM models for the positive and negative well-being indexes (see Figure 3). The results indicated significant mediation effects of awe on daily well-being, both for positive indexes and negative affect, through positive attention bias (positive well-being: mediation effect = .12, $p = .001$, 95% CI = [.05, .18]; negative affect: mediation effect = −.08, $p = .007$, 95% CI = [−.14, −.02]). However, the mediation effects through negative attention bias were not significant (positive well-being: mediation effect = .01, $p = .762$, 95% CI = [−.03, .05]; negative affect: mediation effect = −.01, $p = .762$, 95% CI = [−.06, .04]). These results partially support H2 and H3, suggesting that individuals with higher levels of dispositional awe tend to demonstrate higher levels of positive attention bias and experience greater daily well-being, and positive attention bias can interpret this relationship.

In the present study, we investigate the connection between awe and daily well-being, as well as the mechanisms that underlie the association through the perspective of attention bias.

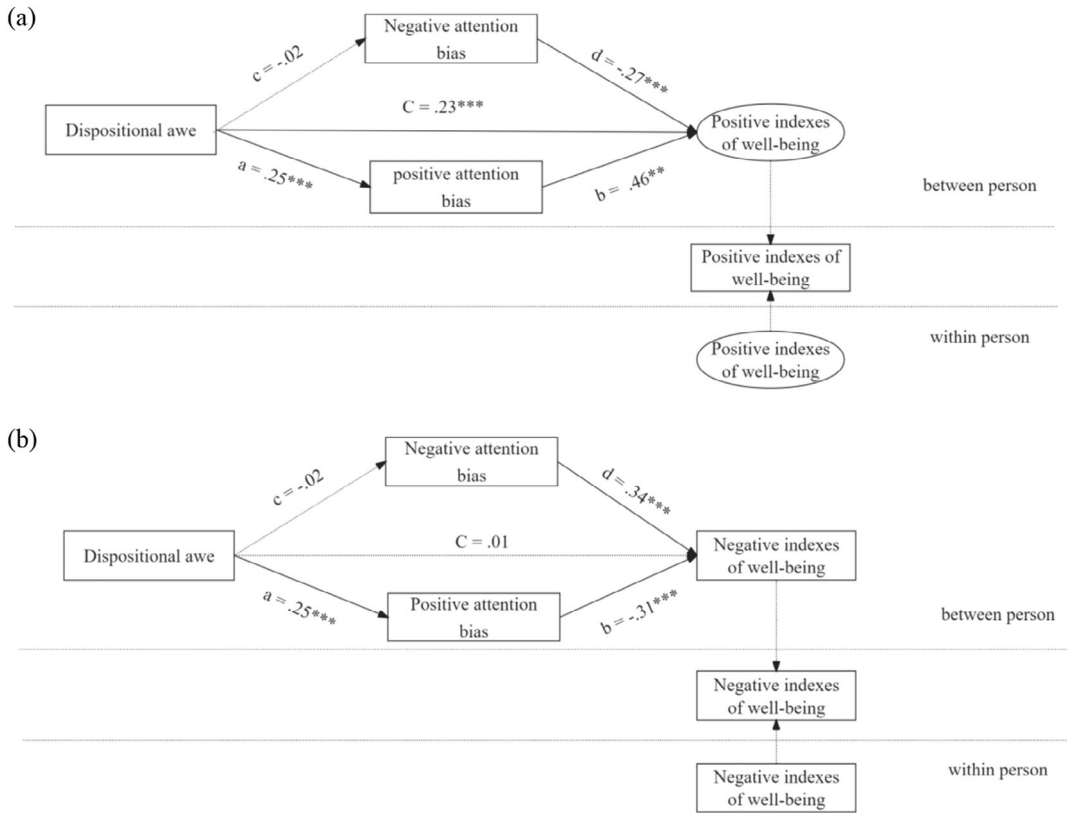

FIGURE 3 The Multilevel Structural Equation Model (MSEM) illustrates the mediation effect of attention bias on the relationship between dispositional awe and well-being. Figure 3a,b, respectively, depicts the mediation effects in relation to both positive and negative indicators of well-being. Path coefficients were standardized. Paths a and c demonstrate the influence of awe on positive and negative attention bias, respectively. Paths b and d illustrate the impact of positive and negative attention bias on the negative indicators of well-being, respectively.

These results partially support H2 and H3, showing that individuals with greater levels of dispositional awe demonstrate higher levels of positive attention bias and daily well-being. Moreover, positive attention bias, but not negative attention bias, serves as a mediator in this relationship.

GENERAL DISCUSSIONS

Previous studies have explored the impact of awe on well-being, showing that it can enhance positive emotions, life satisfaction and reduce negative feelings, stress, and social pain (Bai et al., 2021; Gordon et al., 2017; Luo et al., 2021; Rankin et al., 2020; Rudd et al., 2012). This study took longitudinal and daily dairy approaches to investigate how awe can protect well-being during challenging times and the mechanisms underlying this relationship. Our findings align with prior research, revealing that awe can boost positive emotions, life satisfaction and peace of mind, and decrease levels of depression and anxiety. What's more, we discovered that positive attention bias mediated the connection between awe and well-being. These results remained robust even after adjusting for variables such as age, gender, region and gratitude.

Regarding H1, we examined the protective influence of awe on well-being by adopting a perspective focused on self-transcendent positive emotion. It is discovered that awe can greatly improve peace of mind, life satisfaction and positive emotions, while simultaneously diminishing feelings of depression and anxiety during emergency or in daily life. The findings are in line with the undoing theory of positive emotions (Fredrickson et al., 2000), which suggests that positive emotions can help individuals recover from negative emotions caused by difficult situations. The profound experience, inspired by awe, can enable individuals to seek something profoundly important and contemplate the meaning of life from a broader perspective (Bai et al., 2017; Bonner & Friedman, 2011; Jiang et al., 2024; Luo et al., 2023), which can promote individuals' openness and tolerance for uncertainty (Rankin et al., 2020). Therefore, awe could be regarded as a factor of resilience. Individuals tending to experience awe in daily life are more likely to seek self-growth, which helps them find reconciliation with life's difficulties to promote well-being and reduce anxiety and depression, effectively offsetting the negative impacts of challenges (Bussing et al., 2021). Recent studies have showed that individuals who feel awe and gratitude are more likely to reflect life, experience more positive changes and perceive lower burden during COVID-19 epidemic (Bussing et al., 2021; Monroy et al., 2023), providing support to the current findings.

Concerning about H2, we examined the impact of awe on attention bias and discovered that awe was predictive of a positive attention bias, while no such prediction was observed for a negative attention bias. This is the first examination of the relationship between awe and attention bias, demonstrating that awe can promote individuals' positive attention bias. This finding supports the broaden-and-build theory of positive emotions (Fredrickson et al., 2000) and the theory of mood-congruent bias (Voelkle et al., 2014). The valence of most awe experiences in daily life is positive (Gordon et al., 2017). Awe primarily enhances an individual's attention to positive information without influencing the processing of negative information (Voelkle et al., 2014). Awe is associated with aesthetic response (Bonner & Friedman, 2011; Keltner & Haidt, 2003), allowing individuals to acknowledge the good and positive aspects of the world and appreciate its beauty (Buessing et al., 2014; Lovoll & Saether, 2022). While awe may not necessarily act as a buffer against adverse events in life, it can provide a positive reframing and help individuals perceive positive aspects of life even during difficult times (Buessing et al., 2014; Bussing et al., 2021). Consequently, frequent experiences of awe in daily life broaden individuals' cognitive resources and improve their ability to process information with a positive outlook, thus shaping their attention bias to be more positive.

Nevertheless, we did not find a significant influence of awe on negative attention. This finding provides valuable insights into the specific nature of the relationship between awe and attention bias, shedding light on the varied impacts that awe may have on different aspects of attention. Awe is commonly considered to be a positive emotion (Gordon et al., 2017; Van Cappellen & Rimé, 2014), which enhances automatic information processing for stimuli with a similar valence, allocating more attention resources to positive information. However, it may have little effect on information with negative valence. An increase in attention towards positive stimuli does not always mean a decrease in attention towards negative stimuli. Both positive and negative attention biases can coexist. In Study 2, we found that positive attention bias was positively correlated with negative attention bias. Several studies indicate that individuals may give equal attention to both positive and negative information, such as high seekers with high experiences (Zhang & Xu, 2014) or positive-disposed individuals (Chen & Yan, 2018). This suggests that positive and negative attention bias may be two separate dimensions. Additionally, Chinese culture, with its yin-yang philosophy and dialectical thinking, emphasizes the

importance of considering both sides of an issue (Peng & Nisbet, 1999; Yang, 2023), which could also diminish the impact of awe on negative attention.

In relation to H3, findings revealed that in both Study 1 and Study 2, positive attention bias acted as a mediator in the relationship between awe and well-being. However, the mediating effect of negative attention bias was not significant. Attention bias plays a crucial role in mental health and well-being (Beck, 2008; Gawęda et al., 2015; Jopling et al., 2021; Mobini et al., 2014; Sonoda, 2007; Vinograd et al., 2020). For instance, previous studies have shown that a weak positive attention bias and a high negative attention bias are correlated with higher levels of depressive and anxiety symptoms, stress, lower life satisfaction and reduced positive affect (Nishiguchi & Tanno, 2023; Phillips et al., 2017; Scrimin et al., 2016). Conversely, training individuals with depression or dysthymia to focus on positive stimuli has been found to enhance their positive emotions, life satisfaction and decrease depression levels (Stone et al., 2022; Vazquez et al., 2018). Therefore, awe can enhance well-being through the augmentation of positive attention bias. Although negative attention bias can be a predictor of well-being, awe does not exert an influence on it. Hence, awe serves to safeguard well-being by elevating positive attention bias rather than by diminishing negative attention bias.

Additionally, this study yielded an intriguing finding: The correlation between positive and negative attention biases was not significant in Study 1, whereas in Study 2, a positive correlation was observed. The reasons behind this result may be complex. While previous studies have generally indicated a negative or no correlation between positive and negative attention biases (Noguchi et al., 2006), there have been suggestions that both biases may be either high or low simultaneously (Chen & Yan, 2018; Nie & Chen, 2012; Zhang & Xu, 2014), resulting in a positive correlation (Lv et al., 2016). One possible explanation is that positive and negative attention biases are not on a single continuum but rather represent two distinct dimensions, similar to positive and negative affect (Luo & Huang, 2016). Additionally, Study 1 included a more diverse sample with a wider age range, whereas Study 2 focused on college students. It is common for college students to exhibit a bias towards attending to both positive and negative stimuli (Nie & Chen, 2012), which could explain the positive correlation found in Study 2. Nevertheless, further research is needed to better understand the relationship between them. Specifically, future studies should aim to identify the moderating factors that influence this relationship.

The present study holds potential theoretical and practical implications. On one hand, the findings offer new insights into the relationship between awe and well-being. The existing studies have already revealed the promoting effect of awe on well-being (Bai et al., 2021; Jiang et al., 2024; Rudd et al., 2012). This study further reveals the mechanism of this influence, showing that awe increases an individual's positive attention bias, thereby enhancing their well-being in emergency and daily life. Therefore, this research expands upon existing studies and enriches our understanding of the positive effects of awe on well-being. On the other hand, this study also has practical significance for protecting well-being. In daily life or in times of adversity, individuals should cultivate awe, which can aid them in appreciating the positive changes it brings and maintain a positive outlook on the world. Schneider (2009) pointed out that awe is the ability to stay moved in day-to-day life, which can provide individuals with insight and the fortitude to navigate challenging situations. Therefore, cultivating the feeling of awe is worth advocating. Previous research has found that activities such as listening to music, experiencing the beauty of nature, enjoying works of art, visiting magnificent architecture, reading touching stories and even learning from adverse events can help evoke feelings of awe (Anderson et al., 2018; Luo et al., 2021; Monroy & Keltner, 2023; Schneider, 2009; Yang, 2023; Yuan et al., 2024).

This present study has several limitations that require further attention. Firstly, although we adopted longitudinal and daily diary approaches to better examine the relationship between awe and well-being in the current work, causal relationships could not be directly inferred (Luo et al., 2023). Future research should use experimental studies to induce the state of awe and examine its influence on attention bias and well-being. Previous studies have used various methods to elicit the experience of awe, such as watching videos (e.g. planet earth and great person) and pictures, listening to beautiful songs, appreciating famous art or looking up at atypically tall trees (Piff et al., 2015; Prade & Saroglou, 2023; Yuan et al., 2024). By utilizing these methods, we can directly establish the causal relationship between awe and attention bias. Secondly, data were collected through self-report methods in both studies. Self-reports are subject to bias and may be influenced by social approval (Adams et al., 2005). Therefore, in the future, objective data should be utilized to validate the results of this study. For example, employing eye-tracking technology to measure the direction of initial gaze and total fixation time on positive and negative information can objectively assess whether awe genuinely promotes a positive attention bias. Event-related potentials (ERPs) and functional magnetic resonance imaging (fMRI) can also be utilized to explore the brain mechanisms underlying the effects of awe on information processing and well-being, advancing our comprehension of their natural relationship. In addition, Study 1 utilized a snowball sampling method, which may introduce bias in sample composition if the initial participants are not representative of the target population (Pongener & Das, 2021). Referrals may share similar characteristics, potentially resulting in a lack of diversity in the sample (Rocha et al., 2017). Therefore, future research can utilize other online platforms to gather data, thus broadening the diversity of the sample. Thirdly, because mental health data were not collected, further research is needed to determine whether the findings can be generalized to a psychopathological population, such as those with anxiety or depressive disorders. Awe has been shown to have influence on mental and behavioral changes, as evidenced in the book 'Awakening to Awe' by Schneider (2009). Schneider found positive transformations in various groups brought by the experience of awe. Therefore, it is valuable to investigate awe's capacity to heal and transform in clinical populations. Lastly, due to constraints imposed by COVID-19 and the transit time of the virus, the duration of the longitudinal study in Study 1 was relatively short, lasting only 2 months. Further studies are necessary to investigate the long-term effects of awe on well-being.

CONCLUSIONS

Current findings suggest that awe can serve as an effective buffer for protecting well-being in crisis and daily life. This is supported by the increase in positive affect, life satisfaction, peace of mind and the decrease in depression and anxiety. Additionally, it was found that positive attention bias, rather than negative attention bias, plays a mediating role in the relationship between awe and well-being. This is an era that lacks awe (Schneider, 2009), which could lead to extreme individualism and egotism, increasing the risk to well-being and mental health (Barragan et al., 2021; Sobirova, 2020). Therefore, it is necessary to cultivate the experience of awe. In the field of education, teachers could help students experience awe through subject teaching or by incorporating curriculum focused on psychological health. In the field of psychotherapy, psychotherapists should not only focus on symptom remission but also on promoting personal growth by triggering self-transcendent emotions such as awe. For example, transpersonal psychotherapy, an approach used to explore the placement of the self in a broader context and to promote

expansion of consciousness and spiritual integration through personal transcendence, emphasizes the significant role of awe (Bonner & Edward, 2016; Luo et al., 2021). Overall, these results highlight the importance of cultivating experiences of awe as a valuable strategy for maintaining well-being and positive information procession in this era with uncertainty and challenges.

CONFLICT OF INTEREST STATEMENT

We have no conflicts of interest to disclose.

DATA AVAILABILITY STATEMENT

All data and analysis code have been made publicly available via The Open Science Framework repository, named data and script about 'awe, attention bias, and well-being' and can be accessed at https://osf.io/rfyt5/.

ETHICS STATEMENT

The present study was approved by the Academic Committee of Neijiang Normal University. All participants provided informed consents before completing the questionnaires and were paid after completing the whole questionnaires.

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