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Trait mindfulness is associated with enhanced daily affectivity and cognition independent of daily stressors exposure: Insights from large-scale daily diary studies in the US and Singapore

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ABSTRACT

Trait mindfulness has been linked to various adaptive outcomes, including attenuated affective and cognitive responses to laboratory-induced stress. However, the role of trait mindfulness as a resilience factor against daily stressors exposures is less established. Across 2 studies, multilevel analysis was used to examine the relationships between trait mindfulness and daily affect and cognition, as well as affective and cognitive reactivity to and recovery from everyday stressor exposure. Trait mindfulness was significantly associated with higher daily positive affect in both studies, lower negative affect and cognitive failure, and lower cognitive reactivity to daily stressor exposure in Study 2. However, trait mindfulness did not attenuate cognitive reactivity in Study 1, nor affective reactivity to daily stressor exposure and affective and cognitive recovery from previous-day stressor exposure in both studies. Overall, results suggest that the mechanisms underlying the affective and cognitive buffering effect of trait mindfulness are not stress specific.

Trait mindfulness refers to an individual's dispositional tendency to focus on the present moment and remain non-judgmental towards their thoughts and feelings (Brown & Ryan, 2003). According to numerous cross-sectional studies, individuals with higher levels of trait mindfulness report better psychological functioning (Ford et al., 2018; Rehman et al., 2023), including higher levels of life satisfaction (Kong et al., 2014; Wang & Kong, 2020) and positive affect (Brown & Ryan, 2003; McLaughlin et al., 2019), as well as lower levels of anxiety (Carpenter et al., 2019; Prieto-Fidalgo et al., 2022) and depressive symptoms (Barnhofer et al., 2011; Lee & Zelman, 2019). The robust associations between trait mindfulness and various adaptive outcomes suggest that trait mindfulness may serve as a resilience factor following exposure to daily stressors.

Daily stressors are minor issues that occur in everyday life (e.g., missing work deadlines; Almeida et al., 2002). Daily stressor exposure may affect emotional and cognitive outcomes, including lower levels of daily positive affect (Majeed et al., 2021; Ng et al., 2022), daily self-esteem (Chua et al., 2023), and cognitive performance (Sliwinski et al., 2006), as well as higher levels of daily negative affect (Dixon & Overall, 2016; Ng et al., 2022) and daily memory recall issues (Neupert et al., 2008). Individuals exposed to daily stressors in the long term are more likely to experience chronic physical ailments, affective disorders, or cognitive health deterioration in the long term (Charles et al., 2013; Piazza et al., 2013; Stawski et al., 2011).

Researchers have proposed that mindful individuals may cope better with daily stressor exposure because they react less to stressors and recover from stressors more quickly (Creswell & Lindsay, 2014; Teper et al., 2013). Stress reactivity describes the initial reaction (i.e., physiological, emotional, or psychological) to a stressor exposure incident. Conversely, stress recovery occurs when the initial reaction to a stressor encounter returns to baseline (Cho et al., 2017). Emotional and cognitive reactivity to stressors may be attenuated among individuals with high trait mindfulness as they are more likely to pay attention to their internal affective and cognitive states, allowing them to swiftly notice changes in their thoughts and emotions and successfully regulate any unpleasant thoughts and feelings that may arise as a result of stressor exposure (Teper et al., 2013). Additionally, individuals with high levels of trait mindfulness may report faster recovery after a stressor experience because they can remain impartial towards their inner experiences and are less likely to get caught up in negative experiences, thereby shortening the duration of any negative emotion or cognition experienced following stressor encounters (Fogarty et al., 2015). To

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summarize, individuals with higher levels of trait mindfulness may be more resilient to stressor experiences due to lower levels of affective and cognitive reactivity and faster affective and cognitive recovery.

There is preliminary evidence from empirical studies on stress and mindfulness that trait mindfulness fosters resilience against *chronic*, *acute*, and *daily* stressor exposure. Trait mindfulness is associated with outcomes that assist adaptation to challenging situations, including higher emotional regulation proficiency, decreased likelihood of ruminating, and lower levels of perceived life strain (e.g., Garland et al., 2011; Marks et al., 2010; Mesmer-Magnus et al., 2017). Using experimental studies, researchers also found that mindfulness attenuates reactivity to and recovery from laboratory stressors (e.g., Brown et al., 2012; Crosswell et al., 2017). Lastly, Ciesla et al. (2012) and Dixon and Overall (2016) demonstrated that mindfulness may attenuate affective reactivity to daily stressor exposure in naturalistic settings. Overall, there is some empirical support for the stress-buffering effects of trait mindfulness.

However, researchers suggesting that trait mindfulness enhances affective resilience against acute stressors (e.g., Brown et al., 2012; Garland et al., 2011) frequently overlook the inherent assumptions underlying the stress-buffering effects of trait mindfulness. Specifically, they often assume that the improved affective outcomes of individuals with higher levels of trait mindfulness after stressor exposure served as evidence that trait mindfulness reduces reactivity to stress. However, given that individuals with higher levels of trait mindfulness consistently report higher levels of baseline well-being than individuals with lower levels of trait mindfulness (Ford et al., 2018), it is possible that the higher levels of well-being after stressor exposure is due to their elevated baseline well-being rather than reduced stress reactivity. Therefore, to better understand the influence of trait mindfulness on individuals' stress trajectory, it is crucial to evaluate whether trait mindfulness leads to lower levels of reactivity after stressor exposure or if "attenuated reactivity" is simply a result of higher overall well-being.

Secondly, researchers often claim that trait mindfulness has a stress-buffering effect despite only examining how trait mindfulness reduces affective reactivity to stress (Ciesla et al., 2012; Dixon & Overall, 2016). This bias towards stress response and affective outcomes ignores the role of trait mindfulness in stress recovery and cognitive outcomes. While trait mindfulness may accelerate emotional recovery following a negative experience in experimental studies (e.g., Britton et al., 2012; Crosswell et al., 2017; Keng & Tan, 2018), such results might not generalize to naturalistic settings. Furthermore, trait mindfulness is linked to better cognition (e.g., Neupert et al., 2008), less rumination after negative events (Ciesla et al., 2012) and better disengagement from negative emotional stimuli (Cho et al., 2017; Greenberg & Meiran, 2014), implying that trait mindfulness may influence cognitive reactivity and recovery following stressor exposure. Despite this indirect evidence, it is necessary to examine how trait mindfulness directly influences stress recovery and cognitive outcomes following stressor exposure to broaden the supporting empirical evidence for the proposed theoretical framework.

Firstly, to determine whether trait mindfulness indeed leads to better outcomes after stress exposure or if it merely reflects higher baseline well-being, we examined the main effects of trait mindfulness on top of investigating the attenuating effect of trait mindfulness on reactivity to stressor exposure. We hypothesized that trait mindfulness has a significant cross-sectional relationship with daily affect and cognition, and will also attenuate affective and cognitive reactivity from daily stressor exposure.

H1. Trait mindfulness has a positive relationship with (a) daily positive affect and a negative relationship with (b) daily negative affect and (c) daily cognitive failure.

H2. Trait mindfulness attenuates (a) positive affective reactivity, (b) negative affective reactivity and (c) cognitive reactivity to daily stressor exposure.

Secondly, to address the bias towards stress reactivity in previous research, we investigated the impact of trait mindfulness on stress recovery, focusing on both affective and cognitive outcomes. We hypothesized that trait mindfulness will attenuate affective and cognitive recovery from daily stressor exposure.

H3. Trait mindfulness strengthens (a) positive affective recovery, (b) negative affectivity reactivity and (c) cognitive recovery from daily stressor exposure.

Unlike previous studies which relied on small sample sizes of around 100 to examine the stress-buffering effects of trait mindfulness (Ciesla et al., 2012; Dixon & Overall, 2016), we will use a sample size larger than 250 in the current study. According to research on statistical power in multilevel modeling, the number of groups (i.e., participants) is more important than the number of observations within groups (i.e., number of days of daily dairy survey) for reliable level 2 estimates (Maas & Hox, 2005). Moreover, other researchers have suggested that small cross-level interaction effects are difficult to detect with fewer than 200 groups (Arend & Schäfer, 2019) and that correlations are more stable when $N = 250$ (Schonbrodt & Perugini, 2013). Thus, small sample sizes may result in underpowered studies where true relationships are not detected due to high levels of noise in the data (see Button et al., 2013), and/or may lead to unstable estimates that are imprecise and fluctuate widely across samples (see Schonbrodt & Perugini, 2013). Hence, our research will examine the 3 hypotheses using a large sample size to provide stronger and more reliable conclusions regarding the stress-buffering effects of trait mindfulness.

1. General approach

1.1. Study design

Both studies were daily diary studies. After providing informed consent, participants completed a baseline survey and reported their daily experiences via phone interviews (Study 1) or online surveys (Study 2). We excluded participants with missing baseline data or less than two days of data for the daily dairy study (i.e., the minimum number of data points required to calculate the slope of daily stressor exposure by participant). We obtained approval for Study 2's data collection from the Institutional Review Board at the first author's university. We elaborated each study's details in later sections.

1.2. Measures

1.2.1. Trait mindfulness

In Study 1, we measured trait mindfulness using a 9-item scale (Langer & Moldoveanu, 2000), assessing the frequency of mindfulness-related practices (e.g., "more engaged in the present moment") on a 5-point scale (1 = *strongly-agree*, 5 = *strongly disagree*). We measured trait mindfulness using the 15-item Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) rated on a 6-point scale (1 = *almost never*, 6 = *almost always*) in Study 2. We reverse-coded and summed (Study 1) or averaged (Study 2) scores on the scale, such that higher scores represent higher levels of trait mindfulness ($\alpha_{Study\ 1} = 0.95$; $\alpha_{Study\ 2} = 0.91$).

1.2.2. Demographics

We measured and used participants' demographics (e.g., age, race, sex, objective socioeconomic status and subjective socioeconomic status) as covariates for both studies. We measured objective socioeconomic status using participants' annual personal income (top coded at $300,000; Study 1) or their monthly household income on a 6-point scale (1 = *Less than $2000*, 2 = *$2000–$5999*, 3 = *$6000–$9999*, 4 = *$10,000–$14,999*, 5 = *$15,000–$19,999*, 6 = *More than $20,000*; Study 2). We assessed subjective socioeconomic status using Adler et al.'s (2000) 10-rung ladder scale (1 = *lowest subjective socioeconomic status*, 10 = *highest subjective socioeconomic status*) for both studies. We measured participants' marital status and their educational level (1 = *no school/some grade school (1–6)*, 12 = *PH.D., ED.D., MD, DDS, LLB, LLD, JD, or other professional degree*) in Study 1 only as participants in Study 2 were undergraduates.

We included these demographic covariates as researchers have previously shown their influence on the outcome variables of positive affect, negative affect and cognitive failure. For example, older (Chen et al., 2018), male (Wani & Dar, 2017) and married (Khodarahimi, 2015) individuals with higher subjective socioeconomic status (Kim et al., 2020) often experience higher levels of positive affect and lower levels of negative affect; while race (Zsembik & Peek, 2001), income (Aguila & Casanova, 2020) and education level (Banks et al., 2014) may influence cognitive functioning.

1.2.3. Daily stressor exposure

We employed Almeida et al.'s (2002) Daily Inventory of Stressful Events to assess daily exposure to stressors for both studies. Participants were presented with seven categories of stressors (e.g., work/education stressors, home stressors, etc.) and indicated whether they had encountered any stressor for each category for that day (0 = *No exposure to stressor*, 1 = *Exposure to stressor*).

1.2.4. Daily positive and negative affect

We used Mroczek and Kolarz's (1998) 27-item Daily Distress Scale to assess daily positive and negative affect in both studies. Participants reported the frequency of experiencing 13 positive emotions (e.g., "in good spirits") and 14 negative emotions (e.g., "frustrated") that day using a 5-point scale (0 = *none of the time*, 4 = *all of the time*). The mean scores across the 13 positive affect items and the 14 negative affect items represented participants' positive affect (Study 1: $\alpha_{within} = 0.71$, $\alpha_{between} = 0.96$; Study 2: $\alpha_{within} = 0.90$, $\alpha_{between} = 0.90$) and negative affect (Study 1: $\alpha_{within} = 0.70$, $\alpha_{between} = 0.89$; Study 2: $\alpha_{within} = 0.85$, $\alpha_{between} = 0.87$) respectively.

1.2.5. Daily cognitive failure

We assessed daily cognitive failure using Sunderland et al.'s (1983) 9-item scale in Study 1. Participants indicated whether they had experienced nine different instances of memory errors that day (e.g., Forget an appointment; 0 = *No*, 1 = *Yes*). We measured daily cognitive failure using Lange and Süß's (2014) 13-item Cognitive Failure in Everyday Life scale in Study 2. Participants rated the frequency of experiencing 13 different cognitive errors during the day (e.g., "Did you misplace something, at any point of time today?") on a 4-point scale (0 = Never, 3 = Several times). We summed (Study 1) or averaged (Study 2; $\alpha_{within} = 0.67$, $\alpha_{between} = 0.91$) ratings across the scale items to determine participants' daily cognitive failure.

1.3. Analytic plan

For both studies, we employed multilevel modeling to investigate (1) the main effect of trait mindfulness on daily affect and daily cognitive failure, (2) the moderating role of trait mindfulness in affective and cognitive reactivity to daily stressor exposure and (3) the moderating role of trait mindfulness in affective and cognitive recovery from previous-day stressor exposure. We conducted multilevel modeling given the hierarchical structure of the dataset, where day-level observations were nested within participants. We developed separate multilevel equations to analyze each outcome (i.e., daily positive affect, daily negative affect and daily cognitive failure) individually for each of the three investigations. We did not include day of daily diary survey as a covariate for all models since its effects were unlikely to differ by participants.

1.3.1. Data pre-processing

We preprocessed data similarly in Studies 1 and 2. Firstly, we created a new Level 1 variable (i.e., daily stressor exposure) indicating whether participants had a stressor exposure day or non-stressor exposure day (−0.5 = *Non-stressor exposure day*, 0.5 = *Stressor exposure day*). In line with prior studies (e.g., Almeida et al., 2002; Majeed et al., 2021), participants had a stressor exposure day if they encountered at least one type of stressor that day and a non-stressor exposure day if they did not encounter any of the seven stressor types. We then calculated the mean number of stressor exposure days (i.e., average stressor exposure) for each participant at Level 2. Next, we created another Level 1 variable (i.e., previous-day stressor exposure) indicating whether participants experienced stressor exposure on the previous day (−0.5 = *No previous-day stressor exposure*, 0.5 = *Previous-day stressor exposure*). We effect-coded categorical Level 2 covariates (i.e., race where −0.5 = *White*, 0.5 = *Non-White*; sex where −0.5 = *Male*, 0.5 = *Female*; marital status where −0.5 = *Married*, 0.5 = *Non-Married*) and grand mean centered continuous Level 2 covariates (i.e., age, objective socioeconomic status and subjective socioeconomic status). Lastly, we applied a square-root transformation to daily negative affect scores to reduce skewness in the scores distribution.

1.3.2. Main effect of trait mindfulness

For both studies, we included trait mindfulness in the level 2 equation to examine the main effect of trait mindfulness on daily affect and daily cognitive failure. We added demographic covariates at level 2 for the adjusted model. To investigate the relationship between trait mindfulness and daily cognitive failure in Study 1, we conducted poison multilevel modeling since items assessing daily cognitive failure in Study 1 appears to be independent and function more as a checklist of whether participants experience any of the various instances of memory lapses. Responses to the items would thus more likely to follow a Poisson distribution. For the remaining outcomes (i.e., daily affect in Study 1 and 2 and daily cognitive failure in Study 2), we conducted analyses using linear multilevel models. The equations for the adjusted models are provided in the supplementary material. $\gamma_{0,1}$, representing the difference in level of outcome due to different levels of trait mindfulness, was the parameter of interest.

1.3.3. Reactivity to daily stressor exposure

Before analyzing reactivity to daily stressor exposure and recovery from previous-day stressor exposure, we compared the model fit of the unadjusted moderation model with versus without covariance between the slope and intercept of daily stressor exposure by participant for each outcome. Details on the analysis and model fit results are available in Researchbox #1953. To examine the moderating role of trait mindfulness in affective and cognitive reactivity, we included daily stressor exposure in the level 1 equation and included average stressor exposure and the cross-level interaction between trait mindfulness and daily stressor exposure at level 2. In the adjusted model, we included demographic covariates and the cross-level interaction between each demographic covariate and daily stressor exposure at level 2 to control for their respective effects on reactivity to daily stressor exposure (Yzerbyt et al., 2004). Of note, we used Poisson multilevel modeling when examining cognitive failure as an outcome in Study 1 and linear multilevel modeling for the remaining outcomes. Furthermore, we did not exclude random effects for models with a singular fit (i.e., the unadjusted model examining cognitive reactivity to daily stressor exposure) as the resulting model would be theoretically inaccurate. We provided the adjusted model equations for examining the moderating role of trait mindfulness in affective and cognitive reactivity to daily stressors in the supplementary material. $\gamma_{1,1}$, representing the difference in the influence of current-day stressor exposure on the outcome level as a function of trait mindfulness, was the parameter of interest. We conducted simple slopes and Johnson-Neyman analyses if the cross-level interaction between current-day stressor exposure and trait mindfulness was significant.

1.3.4. Recovery from previous-day stressor exposure

We used Ong and Leger (2022) and Smyth et al.'s (2023) recommended procedure to analyze affective and cognitive recovery from daily stressors. Specifically, since we operationalized affective/cognitive recovery as the relationship between previous-day stressor exposure and level of outcome (i.e., affect/cognitive failure) in the current-day when the current day was a non-stressor exposure day, we filtered the original dataset to include only data for current non-stressor exposure days. Then, we conducted multilevel analyses using the modified dataset.

We specified multilevel equations and conducted analyses in the same manner as when examining reactivity to daily stressor exposure, but replaced daily stressor exposure variable with previous-day stressor exposure. Similarly, we did not exclude random effects for models with a singular fit (i.e., both unadjusted and adjusted models examining cognitive recovery from previous-day stressor exposure in Study 1) which would result in a theoretically inaccurate model. We provided the equations for the adjusted model in the supplementary material. γ1,1 representing the difference in the influence of previous-day stressor exposure on the outcome level as a function of trait mindfulness was the parameter of interest.

1.3.5. Sensitivity analysis

We tested the robustness of Study 1's results by examining whether findings would remain consistent across different combinations of items from the mindfulness scale using Steegen et al.'s (2016) leave-one-out multiverse analysis. We performed the analysis for the unadjusted and adjusted models of the three separate investigations.

1.3.6. Internal meta-analysis

We conducted an internal meta-analysis to consolidate the results across the two studies for each investigation (i.e., main effects of trait mindfulness, reactivity to daily stressor exposure, recovery from previous-day stressor exposure) using their respective parameters of interest (i.e., $\gamma_{0,2}$, $\gamma_{1,1}$, $\gamma_{1,1}$). For each investigation, we performed three random-effects meta-analyses on the parameter of interest to specify three separate outcomes (i.e., daily positive and negative affect, and daily cognitive failure). We used standardized coefficients and standard error of the parameters of interest from each study's adjusted model to perform the meta-analyses.

1.4. Transparency and openness

We did not pre-register the design and analytical plan of the present investigation. We analyzed data using R version 4.0.5 (R Core Team, 2023). We uploaded data for Study 2 and R code and supplementary materials for Study 1 and 2 to Researchbox #1953 (https://researchbox.org/1953). Data and information regarding the scales used in Study 1 can be downloaded from ICPSR (https://www.icpsr.umich.edu/web/pages/).

We computed reliability of participant-level measures using the R package psych version 2.3.3 (Revelle, 2022) and calculated reliability of day-level measures using Bonito et al. (2012) and Nezlek's (2017) approach coupled with Majeed et al.'s (2023) custom R function. We divided the random intercept variance by the sum of the random intercept variance and residual variance of null models with only a random intercept to compute ICCs.

We used the R packages lme4 version 1.1–32 (Bates et al., 2015), lmerTest version 3.1–3 (Kuznetsova et al., 2017) and effectsize version 0.8.3 (Ben-Shachar et al., 2020) for the building and significance testing of multilevel models, and generating effect sizes, respectively. We used standardized regression coefficients from all models in Study 2 and for affect models in Study 1, and partially standardized regression coefficients (i.e., predictors standardized but criterion unstandardized) from cognitive models in Study 1 to represent effect sizes. We employed an online calculator (Preacher et al., 2023; http://www.quantpsy.org/interact/hlm2.htm) to generate the R code for creating simple slopes and Johnson-Neyman plots. Lastly, we utilized metafor version 4.2–0 (Viechtbauer, 2010) to conduct internal meta-analysis.

2. Study 1

2.1. Method

2.1.1. Participants and design

We utilized data from the baseline survey and the 8-day daily diary survey of the MIDUS Refresher 1 project (Ryff et al., 2016; Ryff & Almeida, 2018) and the MIDUS 3 project (Ryff et al., 2019; Ryff & Almeida, 2022). The MIDUS Refresher 1 project's baseline survey and daily diary survey were conducted from 2011 to 2014 and 2012 to 2014 respectively, while those for the MIDUS 3 project were conducted from 2013 to 2014 and 2017 to 2019 respectively. Excluding participants with missing baseline data or insufficient daily data points left data from 1641 participants (55 % Female, 88 % White, $M_{Age} = 56.08$) for the final analyses (Table 1). Participant completion rates for the daily survey were 93.78 % ($M = 7.50$ days per participant).

2.2. Results

2.2.1. Main effect of trait mindfulness

The relationship between trait mindfulness and daily positive affect was large and significant (unadjusted: $\gamma_{0,1} = 0.19$, $SE = 0.02$, $\beta = 0.17$, 95 % CI = [0.13, 0.21], $p < .001$; adjusted: $\gamma_{0,1} = 0.15$, $SE = 0.02$, $\beta = 0.13$, 95 % CI = [0.09, 0.18], $p < .001$), suggesting that participants with higher levels of trait mindfulness experience higher levels of daily positive affect. Trait mindfulness was a significant predictor of daily negative affect in the unadjusted model ($\gamma_{0,1} = -0.02$, $SE = 0.01$, $\beta = -0.04$, 95 % CI = [−0.08, 0.00], $p = .035$) but not in the adjusted model ($\gamma_{0,1} = -0.01$, $SE = 0.01$, $\beta = -0.02$, 95 % CI = [−0.06, 0.02], $p = .296$). Furthermore, the relationship between trait mindfulness and daily cognitive failure was not significant (unadjusted: $\gamma_{0,1} = 0.02$, $SE = 0.04$, $\beta = 0.01$, 95 % CI = [−0.04, 0.07], $p = .628$; adjusted: $\gamma_{0,1} = 0.01$, $SE = 0.04$, $\beta = 0.01$, 95 % CI = [−0.05, 0.07], $p = .721$). We summarized the results in Table 2.

2.2.2. Reactivity to daily stressor exposure

Trait mindfulness did not attenuate affective and cognitive reactivity to daily stressor exposure (Table 3). The cross-level interaction between trait mindfulness and daily stressor exposure on current-day positive affect (unadjusted: $\gamma_{1,1} = 0.003$, $SE = 0.01$, $\beta = 0.001$, 95 % CI = [−0.01, 0.01], $p = .835$; adjusted: $\gamma_{1,1} = 0.005$, $SE = 0.01$, $\beta = 0.002$, 95 % CI = [−0.01, 0.01], $p = .725$), current-day negative affect (unadjusted: $\gamma_{1,1} = -0.003$, $SE = 0.01$, $\beta = -0.003$, 95 % CI = [−0.02, 0.01], $p = .663$; adjusted: $\gamma_{1,1} = -0.003$, $SE = 0.01$, $\beta = -0.003$, 95 % CI = [−0.02, 0.01], $p = .687$) and current-day level of cognitive failure (unadjusted: $\gamma_{1,1} = -0.002$, $SE = 0.04$, $\beta = -0.001$, 95 % CI = [−0.03, 0.02], $p = .961$; adjusted: $\gamma_{1,1} = 0.01$, $SE = 0.04$, $\beta = 0.004$, 95 % CI = [−0.02, 0.03], $p = .786$) were not significant.

2.2.3. Recovery from previous-day stressor exposure

Trait mindfulness did not influence affective or cognitive recovery from previous-day stressor exposure (Table 4). The cross-level interaction between trait mindfulness and previous-day stressor exposure was not significant for all three outcomes: current-day positive affect (unadjusted: $\gamma_{1,1} = 0.01$, $SE = 0.02$, $\beta = 0.003$, 95 % CI = [−0.01, 0.02], $p = .616$; adjusted: $\gamma_{1,1} = -0.001$, $SE = 0.02$, $\beta = -0.001$, 95 % CI = [−0.01, 0.01], $p = .934$), current-day negative affect (unadjusted: $\gamma_{1,1} = 0.001$, $SE = 0.01$, $\beta = 0.001$, 95 % CI = [−0.02, 0.02], $p = .930$; adjusted: $\gamma_{1,1} = 0.005$, $SE = 0.01$, $\beta = 0.01$, 95 % CI = [−0.01, 0.03], $p = .563$) and current-day level of cognitive failure (unadjusted: $\gamma_{1,1} = 0.01$, $SE = 0.06$, $\beta = 0.002$, 95 % CI = [−0.04, 0.04], $p = .912$; adjusted: $\gamma_{1,1} = -0.01$, $SE = 0.06$, $\beta = -0.002$, 95 % CI = [−0.04, 0.04], $p = .930$).

Table 1
Summary of descriptive statistics for Study 1.

Variable	*N*	*M*	*SD*	Observed range	Theoretical range	ICC
Participant level						
Sex (% Female)	1641	55 %				
Race (% White)	1641	88 %				
Marital status (% Married)	1641	67 %				
Age (in years)	1641	56.08	13.39	25–90		
Personal income (in hundred thousands)	1641	0.56	0.55	0–3	0–3	
Education level	1641	7.97	2.40	1–12	1–12	
Subjective socioeconomic status	1641	6.42	1.82	1–10	1–10	
Trait mindfulness	1641	33.64	7.06	9–45	1–45	
Day level						
Daily stressor exposure	12,311	40 %				0.25
Daily positive affect	12,311	2.61	0.80	0–4	0–4	0.77
Daily negative affect (square-root transformed)	12,311	0.30	0.31	0–1.85	0–2	0.50
Daily cognitive failure	12,311	0.69	1.07	0–8	0–8	0.22

Note. *N* refers to the number of participants for participant-level variables. For day-level variables, *N* refers to the number of observations.

Table 2
Summary of results for main effects of trait mindfulness (adjusted model) for Study 1.

	Positive affect		Negative affect		Cognitive failure	
	Std. Coeff.	Coeff. (*SE*)	Std. Coeff.	Coeff. (*SE*)	Std. Coeff.	Coeff. (*SE*)
Fixed effects						
Intercept, $\gamma_{0,0}$	0.003	2.57 (0.03)***	0.01	0.30 (0.01)***	−0.81	−0.82 (0.04)***
Trait mindfulness, $\gamma_{0,2}$	0.13	0.15 (0.02)***	−0.02	−0.01 (0.01)	0.01	0.01 (0.04)
Covariates						
Age, $\gamma_{0,3}$	0.13	0.08 (0.01)***	−0.14	−0.03 (0.004)***	−0.01	−0.01 (0.02)
Race, $\gamma_{0,4}$	−0.02	−0.05 (0.05)	−0.01	−0.01 (0.02)	−0.0004	−0.001 (0.09)
Sex, $\gamma_{0,5}$	−0.01	−0.01 (0.04)	0.03	0.02 (0.01)	0.09	0.18 (0.06)**
Personal income, $\gamma_{0,6}$	0.04	0.05 (0.03)	−0.02	−0.01 (0.01)	0.01	0.02 (0.06)
Subjective socioeconomic status, $\gamma_{0,7}$	0.22	0.10 (0.01)***	−0.10	−0.02 (0.003)***	−0.04	−0.02 (0.02)
Marital status, $\gamma_{0,8}$	−0.06	−0.10 (0.04)**	0.06	0.04 (0.01)**	−0.01	−0.02 (0.06)
Education level, $\gamma_{0,9}$	−0.10	−0.03 (0.01)***	0.05	0.01 (0.003)*	0.11	0.05 (0.01)***
Random effects						
Intercept, $\mu_{0,i}$		0.41 (0.64)		0.04 (0.21)		0.93 (0.96)
Residual, $\varepsilon_{d,i}$		0.15 (0.38)		0.05 (0.22)		

Note. $N_{participant} = 1641$ and $N_{observation} = 12,311$. Std. Coeff (β) are interpreted as follows: small ($\beta < 0.2$), medium ($0.2 \geq \beta \leq 0.5$), and large ($\beta > 0.5$).
*** $p < .001$.
** $p < .01$.
* $p < .05$.

2.2.4. Sensitivity analysis

Our findings were generally consistent across all 511 different permutations of assessing trait mindfulness for all three different investigations. We included summary plots of all sensitivity analyses in Researchbox #1953.

For the main effects of trait mindfulness, trait mindfulness had a large, significant and positive association with daily positive affect for all permutations in the unadjusted and adjusted models. Trait mindfulness was significantly and negatively associated with daily negative affect for 65.36 % of permutations in the unadjusted model (Fig. 1) and estimates ranged from small (main finding) to large. However, the association between trait mindfulness and daily negative affect in the adjusted model was negative (99.99 % of permutations) and not significant (all permutations), while estimates were similar in magnitude to the main findings. Lastly, trait mindfulness had a positive (unadjusted: 98.63 % of permutations; adjusted: 97.26 % of permutations) and non-significant relationship (unadjusted: all permutations; adjusted: all permutations) with daily cognitive failure, and estimates were similar in magnitude to the main findings.

For interaction effects, a positive interaction implied that as the level of trait mindfulness increases, the relationship between the independent variable and the outcome variable becomes more positive or less negative, whereas a negative interaction implied that this relationship becomes less positive or more negative. Estimates from the interaction between trait mindfulness and daily stressor exposure on daily positive affect were positive (unadjusted: 97.85 % of permutations; adjusted: 98.24 % of permutations), not significant (unadjusted: all permutations; adjusted: all permutations), and similar to main findings. Similarly, the interaction estimates for daily negative affect were negative (unadjusted: 58.12 % of permutations; adjusted: 53.62 % of permutations), not significant (unadjusted: all permutations; adjusted: all permutations) and similar to main findings. When daily cognitive failure was specified as the outcome, the interaction estimates were positive (unadjusted: 54.60 % of permutations; adjusted: 89.82 % of permutations), not significant (unadjusted: all permutations; adjusted: all permutations) and similar to main findings.

Lastly, estimates from the interaction between trait mindfulness and previous-day stressor exposure on daily positive affect were positive (unadjusted: 97.46 % of permutations; adjusted: 62.62 % of permutations), not significant (unadjusted: all permutations; adjusted: all permutations), and similar to main findings. For daily negative affect, the interaction estimates were negative, (unadjusted: 9.34 % of permutations; adjusted: 53.62 % of permutations), not significant (unadjusted: all permutations; adjusted: all permutations), and similar to main findings. The interaction estimates between trait mindfulness and previous-day stressor exposure on daily cognitive failure in unadjusted and adjusted models were positive (unadjusted: 54.60 % of permutations; adjusted: 53.62 % of permutations), not significant (unadjusted: all permutations; adjusted: 99.80 % of permutations) and similar to main findings.

Table 3
Summary of results for reactivity to daily stressor exposure (adjusted model) for Study 1.

	Positive affect		Negative affect		Cognitive failure	
	Std. Coeff.	Coeff. (*SE*)	Std. Coeff.	Coeff. (*SE*)	Std. Coeff.	Coeff. (*SE*)
Fixed effects						
Intercept, $\gamma_{0,0}$	0.01	2.49 (0.03)***	0.0002	0.36 (0.01)***	−0.84	−0.62 (0.04)***
Daily stressor exposure, $\gamma_{1,0}$	−0.07	−0.09 (0.01)***	0.28	0.19 (0.01)***	0.18	0.46 (0.05)***
Average stressor exposure, $\gamma_{0,1}$	−0.20	−0.61 (0.06)***	0.23	0.27 (0.02)***	0.39	1.46 (0.10)***
Trait mindfulness, $\gamma_{0,2}$	0.15	0.16 (0.02)***	−0.04	−0.02 (0.01)*	−0.01	−0.02 (0.04)
Daily stressor exposure × Trait mindfulness, $\gamma_{1,1}$	0.002	0.005 (0.01)	−0.003	−0.003 (0.01)	0.004	0.01 (0.04)
Covariates						
Age, $\gamma_{0,3}$	0.09	0.06 (0.01)***	−0.07	−0.02 (0.004)***	0.07	0.05 (0.02)*
Race, $\gamma_{0,4}$	−0.04	−0.09 (0.05)	0.01	0.01 (0.02)	0.03	0.10 (0.08)
Sex, $\gamma_{0,5}$	0.01	0.01 (0.03)	−0.001	0.001 (0.01)	0.06	0.11 (0.05)
Annual personal income, $\gamma_{0,6}$	0.04	0.05 (0.03)	−0.02	−0.01 (0.01)	0.02	0.02 (0.05)
Subjective socioeconomic status, $\gamma_{0,7}$	0.22	0.10 (0.01)***	−0.09	−0.02 (0.003)***	−0.03	−0.02 (0.01)
Marital status, $\gamma_{0,8}$	−0.07	−0.12 (0.03)***	0.07	0.05 (0.01)***	0.001	0.01 (0.06)
Education level, $\gamma_{0,9}$	−0.06	−0.02 (0.01)**	−0.01	−0.002 (0.002)	0.04	0.02 (0.01)
Daily stressor exposure × Age, $\gamma_{1,2}$	0.01	0.01 (0.01)*	−0.02	−0.01 (0.004)*	−0.02	−0.04 (0.02)
Daily stressor exposure × Race, $\gamma_{1,3}$	0.01	0.05 (0.03)	0.01	0.02 (0.02)	0.03	0.17 (0.08)*
Daily stressor exposure × Sex, $\gamma_{1,4}$	−0.02	−0.07 (0.02)***	0.01	0.01 (0.01)	−0.01	−0.03 (0.06)
Daily stressor exposure × Annual personal income, $\gamma_{1,5}$	−0.001	−0.004 (0.02)	0.01	0.01 (0.01)	−0.03	−0.11 (0.05)*
Daily stressor exposure × Subjective socioeconomic status, $\gamma_{1,6}$	0.001	0.001 (0.01)	−0.004	−0.001 (0.003)	−0.01	−0.01 (0.01)
Daily stressor exposure × Marital status, $\gamma_{1,7}$	0.004	0.01 (0.02)	0.02	0.03 (0.01)**	0.02	0.09 (0.06)
Daily stressor exposure × Education level, $\gamma_{1,8}$	−0.01	−0.005 (0.004)	−0.01	−0.003 (0.002)	0.004	0.003 (0.01)
Random effects						
Intercept, $\mu_{0,i}$		0.38 (0.61)		0.03 (0.18)		0.71 (0.84)
Daily stressor exposure, $\mu_{1,i}$		0.02 (0.14)		0.01 (0.10)		0.03 (0.16)
Residual, $\varepsilon_{d,i}$		0.14 (0.38)		0.04 (0.20)		

Note. $N_{participant}$ = 1641 and $N_{observation}$ = 12,311. Std. Coeff (β) are interpreted as follows: small (β < 0.2), medium (0.2 ≥ β ≤ 0.5), and large (β > 0.5).
*** $p < .001$.
** $p < .01$.
* $p < .05$.

Table 4
Summary of results for recovery from previous-day stressor exposure (adjusted model) for Study 1.

	Positive affect		Negative affect		Cognitive failure	
	Std. Coeff.	Coeff. (*SE*)	Std. Coeff.	Coeff. (*SE*)	Std. Coeff.	Coeff. (*SE*)
Fixed effects						
Intercept, $\gamma_{0,0}$	0.01	2.53 (0.03)***	0.002	0.25 (0.01)***	−1.26	−0.89 (0.06)***
Previous-day stressor exposure, $\gamma_{1,0}$	0.003	0.005 (0.02)	0.02	0.03 (0.01)**	0.04	0.08 (0.08)
Average stressor exposure, $\gamma_{0,1}$	−0.17	−0.60 (0.07)***	0.22	0.26 (0.02)***	0.38	1.75 (0.15)***
Trait mindfulness, $\gamma_{0,2}$	0.14	0.16 (0.02)***	−0.04	−0.01 (0.01)	−0.02	−0.03 (0.05)
Previous-day stressor exposure × Trait mindfulness, $\gamma_{1,1}$	−0.001	−0.001 (0.02)	0.01	0.005 (0.01)	−0.002	−0.01 (0.06)
Covariates						
Age, $\gamma_{0,3}$	0.09	0.05 (0.01)***	−0.08	−0.02 (0.004)***	0.13	0.09 (0.02)***
Race, $\gamma_{0,4}$	−0.05	−0.10 (0.05)*	0.002	0.01 (0.02)	0.01	0.02 (0.10)
Sex, $\gamma_{0,5}$	0.04	0.06 (0.04)	−0.002	−0.01 (0.01)	0.07	0.14 (0.07)*
Annual personal income, $\gamma_{0,6}$	0.04	0.06 (0.03)	−0.02	−0.01 (0.01)	0.06	0.10 (0.06)
Subjective socioeconomic status, $\gamma_{0,7}$	0.22	0.09 (0.01)***	−0.11	−0.02 (0.003)***	−0.02	−0.01 (0.02)
Marital status, $\gamma_{0,8}$	−0.07	−0.12 (0.04)***	0.07	0.04 (0.01)***	−0.03	−0.04 (0.07)
Education level, $\gamma_{0,9}$	−0.06	−0.02 (0.01)**	−0.002	0.001 (0.002)	0.05	0.02 (0.01)
Previous-day stressor exposure × Age, $\gamma_{1,2}$	0.004	0.01 (0.01)	−0.01	−0.01 (0.004)	−0.01	−0.02 (0.03)
Previous-day stressor exposure × Race, $\gamma_{1,3}$	0.01	0.03 (0.04)	0.01	0.02 (0.02)	−0.01	−0.05 (0.13)
Previous-day stressor exposure × Sex, $\gamma_{1,4}$	0.01	0.03 (0.02)	−0.02	−0.02 (0.01)*	0.003	0.01 (0.09)
Previous-day stressor exposure × Annual personal income, $\gamma_{1,5}$	0.0001	0.0003 (0.02)	−0.02	−0.02 (0.01)	−0.01	−0.03 (0.08)
Previous-day stressor exposure × Subjective socioeconomic status, $\gamma_{1,6}$	0.01	0.01 (0.01)	−0.02	−0.005 (0.003)	0.001	0.001 (0.02)
Previous-day stressor exposure × Marital status, $\gamma_{1,7}$	−0.01	−0.04 (0.03)	0.02	0.03 (0.01)*	0.03	0.15 (0.09)
Previous-day stressor exposure × Education level, $\gamma_{1,8}$	−0.01	−0.01 (0.01)	0.02	0.004 (0.003)	−0.001	−0.001 (0.02)
Random effects						
Intercept, $\mu_{0,i}$		0.40 (0.63)		0.03 (0.18)		0.84 (0.92)
Previous-day stressor exposure, $\mu_{1,i}$		0.01 (0.09)		0.004 (0.06)		0.02 (0.14)
Residual, $\varepsilon_{d,i}$		0.12 (0.35)		0.03 (0.17)		

Note. $N_{participant}$ = 1583 and $N_{observation}$ = 6706. Std. Coeff (β) are interpreted as follows: small (β < 0.2), medium (0.2 ≥ β ≤ 0.5), and large (β > 0.5).
*** $p < .001$.
** $p < .01$.
* $p < .05$.

2.3. Interim discussion

We found that trait mindfulness had a large and significant association with daily positive affect but not negative affect or cognitive failure. These findings were mostly inconsistent with our hypotheses and findings by previous researchers that trait mindfulness has a significant negative relationship with negative affect (Giluk, 2009; McLaughlin et al., 2019) as well as cognitive failure (Jankowski & Bąk,

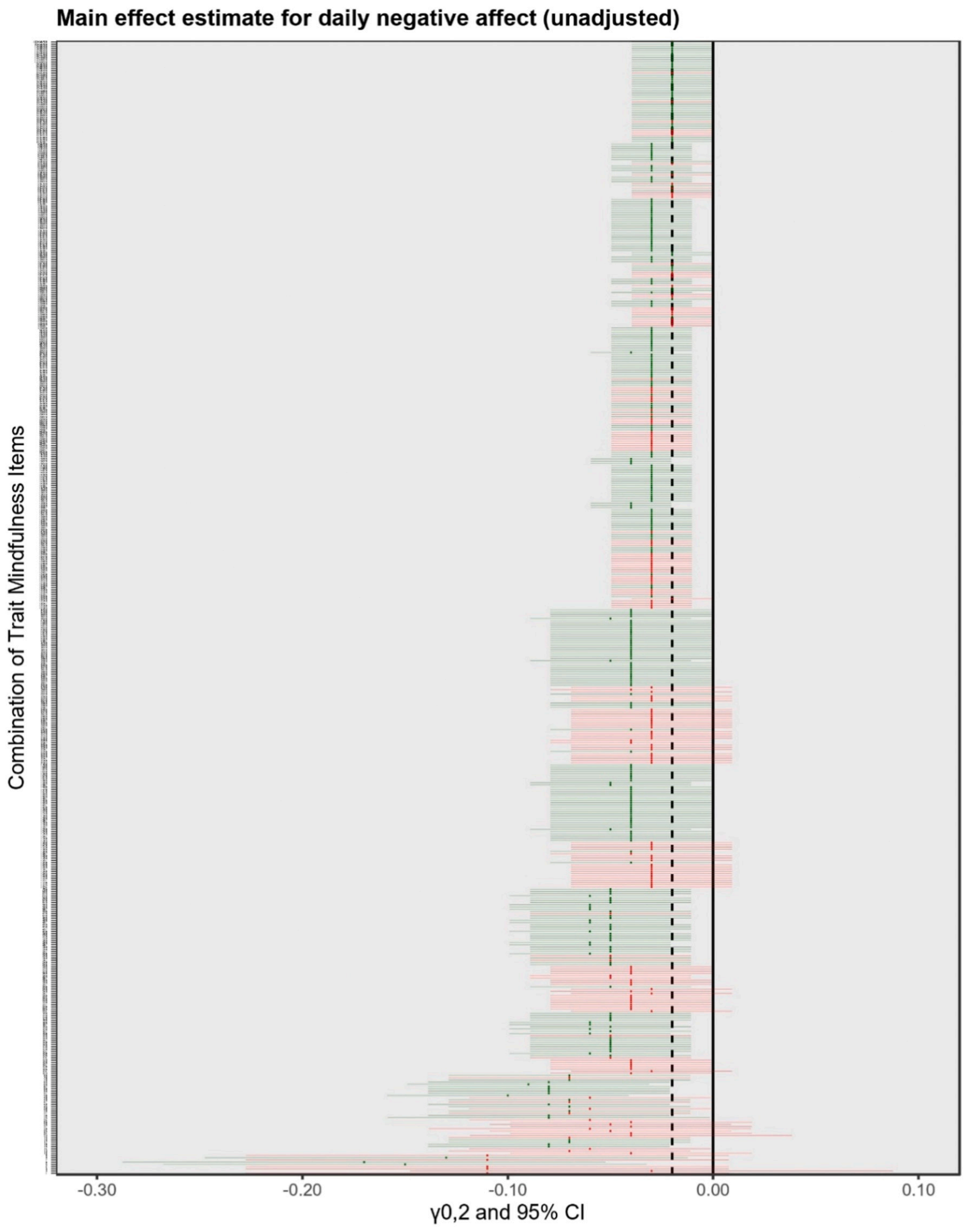

Fig. 1. Summary of leave-one-out multiverse analysis for the main effect of trait mindfulness on daily negative affect in the unadjusted model.
Note. Circles indicate unstandardized point estimates while its whiskers indicate 95 % CI. Green circles indicate that estimates are significant at $p < .05$ and red circles indicate non-significance of point estimates. The vertical black dashed line indicates the value of the estimate for all items in the trait mindfulness scale.

2019; Kondracki et al., 2023). It is possible that the low between-person variability in negative affect (ICC = 0.50) and cognitive failure (ICC = 0.22), compared to positive affect (ICC = 0.77), resulted in insignificant associations between trait mindfulness and negative affect and cognitive failure.

We found no significant relationship between trait mindfulness and affective or cognitive reactivity to daily stressors and affective or cognitive recovery from previous-day stressor exposure despite previous researchers demonstrating that trait mindfulness attenuates affective reactivity and recovery from acute stressor exposure (Brown et al., 2012; Crosswell et al., 2017). The way trait mindfulness was assessed might explain why the pattern of results evidenced in prior studies was not replicated in Study 1. The MIDUS authors developed the mindfulness scale based on Langer and Moldoveanu's (2000) conceptualization of mindfulness and included it as part of the "subjective religiosity" component of the MIDUS survey. Consequently, the scale included items like "Because of your religion or spirituality, do you try to be more engaged in the present moment?" and "…more aware of different ways to solve problems?". Previous researchers have demonstrated the scale's good internal reliability (Sesker et al., 2016) and test-retest reliability (Kim et al., 2021). Furthermore, the scale is positively associated with well-being, optimism and problem-solving coping, and negatively associated with aggression and neuroticism (Kim et al., 2021; Sesker et al., 2016), consistent with prior mindfulness research. Despite the reliability and validity of the scale, the scale's development within the "subjective religiosity" framework might influence responses from non-religious participants. Since researchers typically conceptualize mindfulness as a general present-moment awareness in a non-religious context, we used a well-established scale to assess trait mindfulness (i.e., Mindful Attention Awareness Scale; Brown & Ryan, 2003) in Study 2. Comparing the pattern of results from Study 1 to findings from Study 2 may elucidate Study 1's null findings.

3. Study 2

3.1. Method

3.1.1. Participants and design

Across two independent waves (Wave 1: 261 participants; Wave 2: 253 participants), 514 undergraduates (75 % Female, 80 % Chinese, $M_{Age} = 22.24$) from Singapore took part in a daily dairy study as part of a larger study exploring everyday life events (Chen et al., 2024; Goh, Chia, Majeed, Chen, & Hartanto, 2023; Ng, Lua, Majeed, & Hartanto, 2022) We excluded 2 participants due to insufficient day-level data points leaving data from 512 participants. Daily surveys had 97.60 % completion rates (*M* = 6.83 days per participant). We provided descriptive statistics in Table 5.

3.2. Results

3.2.1. Main effect of trait mindfulness

Trait mindfulness had a large and significant influence on daily positive affect (unadjusted: $\gamma_{0,1} = 0.22$, $SE = 0.04$, $\beta = 0.20$, 95 % CI = [0.14, 0.27], $p < .001$; adjusted: $\gamma_{0,1} = 0.19$, $SE = 0.04$, $\beta = 0.18$, 95 % CI = [0.11, 0.25], $p < .001$), daily negative affect (unadjusted: $\gamma_{0,1} = -0.16$, $SE = 0.02$, $\beta = -0.33$, 95 % CI = [−0.39, −0.27], $p < .001$; adjusted: $\gamma_{0,1} = -0.15$, $SE = 0.02$, $\beta = -0.31$, 95 % CI = [−0.37, −0.25], $p < .001$) and daily cognitive failure (unadjusted: $\gamma_{0,1} = -0.15$, $SE = 0.02$, $\beta = -0.27$, 95 % CI = [−0.34, −0.21], $p < .001$; adjusted: $\gamma_{0,1} = -0.14$, $SE = 0.02$, $\beta = -0.26$, 95 % CI = [−0.33, −0.19], $p < .001$), suggesting that participants with higher levels of trait mindfulness experienced higher levels of daily positive affect and lower levels of daily negative affect and daily cognitive failure (Table 6).

Table 5
Summary of descriptive statistics for Study 2.

Variable	*N*	*M*	*SD*	Observed range	Theoretical range	ICC
Participant level						
Sex (% female)	512	75 %				
Race (% Chinese)	512	80 %				
Age (in years)	512	22.24	1.68	19–30		
Monthly household income	512	3.02	1.44	1–6	1–6	
Subjective socioeconomic status	512	6.16	1.32	2–10	1–10	
Trait mindfulness	512	3.86	0.88	1–5.93	1–6	
Day level						
Daily stressor exposure	3498	33 %				0.35
Daily positive affect	3498	1.93	0.93	0–4	0–4	0.58
Daily negative affect (square-root transformed)	3498	0.61	0.43	0–2	0–2	0.52
Daily cognitive failure	3498	0.37	0.48	0–3	0–3	0.59

Note. *N* refers to the number of participants for participant-level variables and number of observations for day-level variables.

3.2.2. Reactivity to daily stressor exposure

Trait mindfulness did not influence positive or negative affective reactivity to daily stressor exposure (Table 7). There was no significant cross-level interaction between trait mindfulness and daily stressor exposure on current-day positive affect levels (unadjusted: $\gamma_{1,1} = 0.01$, $SE = 0.03$, $\beta = 0.01$, 95 % CI = [−0.02, 0.03], $p = .724$; adjusted: $\gamma_{1,1} = 0.01$, $SE = 0.03$, $\beta = 0.003$, 95 % CI = [−0.03, 0.03], $p = .862$) and current-day negative affect levels (unadjusted; $\gamma_{1,1} = 0.01$, $SE = 0.02$, $\beta = 0.01$, 95 % CI = [−0.02, 0.04], $p = .703$; adjusted: $\gamma_{1,1} = 0.01$, $SE = 0.02$, $\beta = 0.01$, 95 % CI = [−0.02, 0.04], $p = .447$).

In contrast, trait mindfulness influenced cognitive reactivity to daily stressor exposure. The cross-level interaction between trait mindfulness and daily stressor exposure on current-day degree of cognitive failure was small and significant (unadjusted model: $\gamma_{1,1} = -0.05$, $SE = 0.02$, $\beta = -0.04$, 95 % CI = [−0.08, −0.01], $p = .007$; adjusted model: $\gamma_{1,1} = -0.05$, $SE = 0.02$, $\beta = -0.04$, 95 % CI = [−0.07, −0.01], $p = .016$), suggesting that participants with lower levels of trait mindfulness experienced a stronger positive effect of daily stressor exposure on cognitive failure. Simple slopes analyses (Fig. 2, Panel A) illustrated that the increase in level of cognitive failure on stressor exposure days compared to non-stressor exposure days reached statistical significance for participants with higher levels of trait mindfulness (1 *SD* above the mean) in both the unadjusted model ($b = 0.10$, $SE = 0.02$, 95 % CI = [0.06, 0.15], $p < .001$) and adjusted model ($b = 0.10$, $SE = 0.03$, 95 % CI = [0.04, 0.15], $p < .001$). Similarly, participants with lower levels of trait mindfulness (1 *SD* below the mean) reported a significant increase in levels of cognitive failure on stressor exposure days compared to non-stressor exposure days (unadjusted: $b = 0.19$, $SE = 0.02$, 95 % CI = [0.15, 0.24], $p < .001$; adjusted: $b = 0.18$, $SE = 0.03$, 95 % CI = [0.12, 0.23], $p < .001$). Using Johnson-Neyman analysis, we found that daily stressor exposure was significantly associated with higher levels of daily cognitive failure when mean-centered trait mindfulness scores were <1.44 (Fig. 2, Panel B).

3.2.3. Recovery from previous-day stressor exposure

Trait mindfulness did not influence affective and cognitive recovery from previous-day stressor exposure (Table 8). There was no significant cross-level interaction between trait mindfulness and previous-day stressor exposure on current-day positive affect (unadjusted: $\gamma_{1,1} = -0.002$, $SE = 0.04$, $\beta = -0.001$, 95 % CI = [−0.03, 0.03], $p = .963$; adjusted: $\gamma_{1,1} = -0.01$, $SE = 0.04$, $\beta = -0.005$, 95 % CI = [−0.04, 0.03], $p = .776$), current-day negative affect (unadjusted model: $\gamma_{1,1} = -0.01$, $SE = 0.02$, $\beta = -0.01$, 95 % CI = [−0.04, 0.03], $p = .721$; adjusted: $\gamma_{1,1} = -0.01$, $SE = 0.02$, $\beta = -0.01$, 95 % CI = [−0.04, 0.03], $p = .618$) and current-day cognitive failure (unadjusted: $\gamma_{1,1} = 0.02$, $SE = 0.02$, $\beta = 0.02$, 95 % CI = [−0.02, 0.06], $p = .332$; adjusted: $\gamma_{1,1} = 0.02$, $SE = 0.02$, $\beta = 0.02$, 95 % CI = [−0.02, 0.06], $p = .344$).

3.3. Interim discussion

We conducted Study 2 to determine whether the trait mindfulness measure used in Study 1 might account for Study 1's null results. In Study 2, trait mindfulness had a large and significant association with daily positive affect, daily negative affect and daily cognitive failure. These results diverged from Study 1's findings and were consistent with findings from previous cross-sectional studies on trait mindfulness, positive affect, negative affect and everyday cognitive failure (e.g., Chadwick et al., 2008; Jankowski & Bąk, 2019; McLaughlin et al., 2019).

Table 6
Summary of results for main effects of trait mindfulness (adjusted model) for Study 2.

	Positive affect		Negative affect		Cognitive failure	
	Std. Coeff.	Coeff. (*SE*)	Std. Coeff.	Coeff. (*SE*)	Std. Coeff.	Coeff. (*SE*)
Fixed effects						
Intercept, $\gamma_{0,0}$	0.0003	1.96 (0.04)***	0.004	0.61 (0.02)***	0.01	0.37 (0.02)***
Trait mindfulness, $\gamma_{0,2}$	0.18	0.19 (0.04)***	−0.31	−0.15 (0.02)***	−0.26	−0.14 (0.02)***
Covariates						
Age, $\gamma_{0,3}$	−0.002	−0.001 (0.02)	−0.05	−0.01 (0.01)	−0.01	−0.004 (0.01)
Race, $\gamma_{0,4}$	−0.01	−0.02 (0.08)	0.03	0.03 (0.03)	0.02	0.02 (0.04)
Sex, $\gamma_{0,5}$	−0.07	−0.15 (0.08)	0.06	0.06 (0.03)	0.04	0.04 (0.04)
Monthly household income, $\gamma_{0,6}$	0.05	0.03 (0.02)	0.02	0.005 (0.01)	0.04	0.01 (0.01)
Subjective socioeconomic status, $\gamma_{0,7}$	0.12	0.09 (0.03)***	−0.12	−0.04 (0.01)***	−0.09	−0.03 (0.01)*
Random effects						
Intercept, $\mu_{0,i}$		0.44 (0.66)		0.07 (0.27)		0.12 (0.34)
Residual, $\varepsilon_{d,i}$		0.36 (0.60)		0.09 (0.30)		0.09 (0.31)

Note. $N_{\text{participant}} = 512$ and $N_{\text{observation}} = 3498$. Std. Coeff (β) are interpreted as follows: small ($\beta < 0.2$), medium ($0.2 \geq \beta \leq 0.5$), and large ($\beta > 0.5$).
*** $p < .001$.
* $p < .05$.

Table 7
Summary of results for reactivity to daily stressor exposure (adjusted model) for Study 2.

	Positive affect		Negative affect		Cognitive failure	
	Std. Coeff.	Coeff. (*SE*)	Std. Coeff.	Coeff. (*SE*)	Std. Coeff.	Coeff. (*SE*)
Fixed effects						
Intercept, $\gamma_{0,0}$	0.01	1.88 (0.04)***	0.001	0.67 (0.02)***	−0.00001	0.46 (0.02)***
Daily stressor exposure, $\gamma_{1,0}$	−0.10	−0.17 (0.04)***	0.25	0.21 (0.02)***	0.15	0.14 (0.02)***
Average stressor exposure, $\gamma_{0,1}$	−0.11	−0.36 (0.11)**	0.15	0.23 (0.05)***	0.23	0.40 (0.05)***
Trait mindfulness, $\gamma_{0,2}$	0.15	0.16 (0.03)***	−0.27	−0.13 (0.01)***	−0.21	−0.12 (0.02)***
Daily stressor exposure × Trait mindfulness, $\gamma_{1,1}$	0.003	0.01 (0.03)	0.01	0.01 (0.02)	−0.04	−0.05 (0.02)*
Covariates						
Age, $\gamma_{0,3}$	−0.01	−0.01 (0.02)	−0.04	−0.01 (0.01)	0.002	0.0003 (0.01)
Race, $\gamma_{0,4}$	0.02	0.04 (0.08)	−0.02	−0.02 (0.03)	−0.03	−0.04 (0.04)
Sex, $\gamma_{0,5}$	−0.05	−0.12 (0.08)	0.02	0.04 (0.03)	−0.01	−0.005 (0.04)
Monthly household income, $\gamma_{0,6}$	0.05	0.03 (0.02)	0.01	0.002 (0.01)	0.04	0.01 (0.01)
Subjective socioeconomic status, $\gamma_{0,7}$	0.11	0.08 (0.02)**	−0.11	−0.04 (0.01)***	−0.07	−0.03 (0.01)*
Daily stressor exposure × Age, $\gamma_{1,2}$	−0.02	−0.02 (0.02)	0.02	0.01 (0.01)	−0.002	−0.001 (0.01)
Daily stressor exposure × Race, $\gamma_{1,3}$	−0.0005	−0.002 (0.07)	0.01	0.02 (0.03)	−0.004	−0.01 (0,04)
stressor exposure × Sex, $\gamma_{1,4}$	−0.02	−0.10 (0.08)	0.05	0.10 (0.04)**	0.01	0.03 (0.04)
Daily stressor exposure × Monthly household income, $\gamma_{1,5}$	0.002	0.003 (0.02)	−0.02	−0.01 (0.01)	−0.0004	−0.0003 (0.01)
Daily stressor exposure × Subjective socioeconomic status, $\gamma_{1,6}$	0.002	0.003 (0.02)	−0.003	−0.002 (0.01)	−0.02	−0.02 (0.01)
Random effects						
Intercept, $\mu_{0,i}$		0.38 (0.62)		0.06 (0.24)		0.10 (0.31)
Daily stressor exposure, $\mu_{1,i}$		0.09 (0.30)		0.02 (0.14)		0.04 (0.20)
Residual, $\varepsilon_{d,i}$		0.34 (0.58)		0.08 (0.28)		0.08 (0.29)

Note. $N_{\text{participant}} = 512$ and $N_{\text{observation}} = 3498$. Std. Coeff (β) are interpreted as follows: small ($\beta < 0.2$), medium ($0.2 \geq \beta \leq 0.5$), and large ($\beta > 0.5$).
*** $p < .001$.
** $p < .01$.
* $p < .05$.

Therefore, the null findings in Study 1 could be due to how trait mindfulness was assessed.

Similar to Study 1, we found that trait mindfulness did not attenuate affective reactivity to daily stressor exposure and affective and cognitive recovery from previous-day stressor exposure in Study 2. Previous researchers have documented conflicting findings regarding the relationship between trait mindfulness and affective reactivity to daily stressor exposure (An et al., 2019; Dixon & Overall, 2016). Additionally, few researchers have examined the association between trait mindfulness, cognitive reactivity to stressor exposure and affective and cognitive recovery from stressor exposure in naturalistic settings. Combining results of Studies 1 and 2, it is plausible that trait mindfulness does not attenuate affective reactivity nor affective and cognitive recovery from everyday stressor exposure. We will elaborate on other plausible explanations in the General discussion section.

Interestingly, ICCs for daily measures were generally higher in Study 2 than in Study 1, possibly because different participant samples were used in Study 1 (midlife adults) and 2 (undergraduates) often have more structured routines (e.g., class and socializing schedules). These consistent daily experiences may reduce within-person variability in daily outcomes. Conversely, midlife adults typically face a broader range of daily responsibilities and stressors (e.g., work, family, and financial concerns; Chen et al., 2018) possibly creating greater variability in daily outcomes. Overall, differences in study context stability may explain the higher ICCs in Study 2.

4. Internal meta-analysis

The meta-analytic estimate for the main effect of trait mindfulness ($\gamma_{0,2}$) was large and significant only for daily positive affect (daily positive affect: $\gamma_{0,2} = 0.15$, $SE = 0.02$, 95 % CI = [0.11, 0.19], $z = 7.21$, $p < .001$; daily negative affect: $\gamma_{0,2} = -0.16$, $SE = 0.14$, 95 % CI = [−0.45, 0.12], $z = -1.13$, $p = .260$; daily cognitive failure: $\gamma_{0,2} = -0.12$, $SE = 0.14$, 95 % CI = [−0.39, 0.14], $z = -0.92$, $p = .358$).

The meta-analytic estimate for reactivity to daily stressor exposure ($\gamma_{1,1}$) was not significant for daily positive affect ($\gamma_{1,1} = 0.002$, $SE = 0.01$, 95 % CI = [−0.01, 0.01], $z = 0.39$, $p = .698$), daily negative affect ($\gamma_{1,1} = -0.0001$, $SE = 0.01$, 95 % CI = [−0.01, 0.01], $z = -0.02$, $p =$

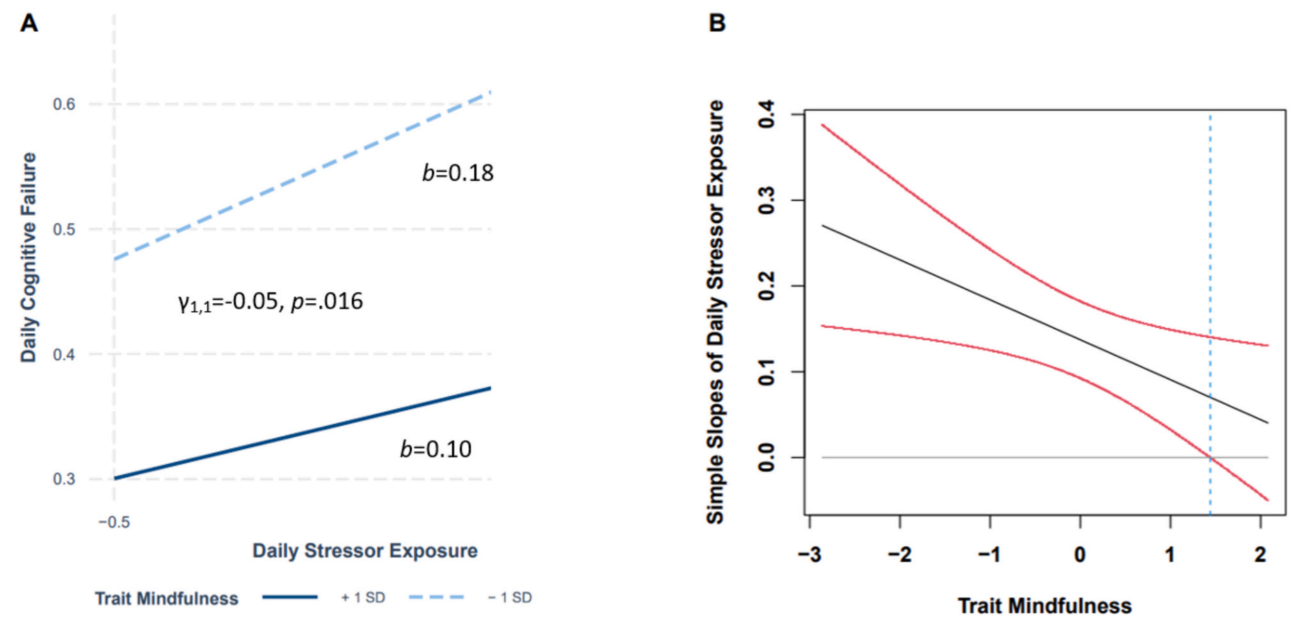

Fig. 2. Simple slope plot of cross-level interaction between daily stressor exposure and trait mindfulness on daily cognitive failure (panel a) and Johnson-Neyman plot depicting region of significance (panel b) in the adjusted model.
Note. Trait mindfulness was grand-mean centered.

Table 8
Summary of results for recovery from previous-day stressor exposure (adjusted model) for Study 2.

	Positive affect		Negative affect		Cognitive failure	
	Std. Coeff.	Coeff. (*SE*)	Std. Coeff.	Coeff. (*SE*)	Std. Coeff.	Coeff. (*SE*)
Fixed effects						
Intercept, $\gamma_{0,0}$	0.004	1.98 (0.06)***	−0.001	0.57 (0.02)***	0.002	0.37 (0.02)***
Previous-day stressor exposure, $\gamma_{1,0}$	0.02	0.09 (0.05)	0.01	0.01 (0.02)	0.02	0.01 (0.02)
Average stressor exposure, $\gamma_{0,1}$	−0.07	−0.32 (0.15)*	0.14	0.28 (0.06)***	0.20	0.37 (0.06)***
Trait mindfulness, $\gamma_{0,2}$	0.17	0.17 (0.04)***	−0.30	−0.14 (0.02)***	−0.23	−0.09 (0.02)***
Previous-day stressor exposure × Trait mindfulness, $\gamma_{1,1}$	−0.005	−0.01 (0.04)	−0.01	−0.01 (0.02)	0.02	0.02 (0.02)
Covariates						
Age, $\gamma_{0,3}$	0.01	0.005 (0.02)	−0.06	−0.01 (0.01)	0.01	−0.0004 (0.01)
Race, $\gamma_{0,4}$	0.02	0.07 (0.09)	−0.04	−0.04 (0.03)	−0.03	−0.03 (0.04)
Sex, $\gamma_{0,5}$	−0.03	−0.09 (0.09)	−0.02	−0.01 (0.04)	−0.02	−0.01 (0.04)
Monthly household income, $\gamma_{0,6}$	0.04	0.04 (0.03)	0.03	0.01 (0.01)	0.05	0.01 (0.01)
Subjective socioeconomic status, $\gamma_{0,7}$	0.11	0.07 (0.03)**	−0.12	−0.03 (0.01)**	−0.07	−0.02 (0.01)
Previous-day stressor exposure × Age, $\gamma_{1,2}$	−0.005	−0.01 (0.02)	0.01	0.01 (0.01)	−0.02	−0.01 (0.01)
Previous-day stressor exposure × Race, $\gamma_{1,3}$	0.01	0.07 (0.09)	0.01	0.02 (0.04)	0.002	0.004 (0.04)
Previous-day stressor exposure × Sex, $\gamma_{1,4}$	−0.03	−0.13 (0.09)	0.01	0.01 (0.04)	0.01	0.02 (0.05)
Previous-day stressor exposure × Monthly household income, $\gamma_{1,5}$	0.04	0.06 (0.03)*	0.01	0.004 (0.01)	0.002	0.001 (0.01)
Previous-day stressor exposure × Subjective socioeconomic status, $\gamma_{1,6}$	−0.02	−0.03 (0.03)	0.03	0.02 (0.01)	0.02	0.01 (0.01)
Random effects						
Intercept, $\mu_{0,i}$		0.46 (0.68)		0.06 (0.25)		0.08 (0.28)
Previous-day stressor exposure, $\mu_{1,i}$		0.05 (0.22)		0.00 (0.00)		0.04 (0.20)
Residual, $\varepsilon_{d,i}$		0.31 (0.56)		0.07 (0.27)		0.06 (0.23)

Note. $N_{participant}$ = 494 and $N_{observation}$ = 2128. Std. Coeff (β) are interpreted as follows: small (β < 0.2), medium (0.2 ≥ β ≤ 0.5), and large (β > 0.5).
*** $p < .001$.
** $p < .01$.
* $p < .05$.

.987) and daily cognitive failure ($\gamma_{1,1}$ = −0.02, *SE* = 0.02, 95 % CI = [−0.06, 0.03], z = −0.78, *p* = .433). Similarly, the meta-analytic estimate for recovery from previous-day stressor exposure ($\gamma_{1,1}$) was not significant for daily positive affect ($\gamma_{1,1}$ = −0.001, *SE* = 0.01, 95 % CI = [−0.01, 0.01], z = −0.19, *p* = .852), daily negative affect ($\gamma_{1,1}$ = 0.002, *SE* = 0.01, 95 % CI = [−0.02, 0.02], z = 0.24, *p* = .812) and daily cognitive failure ($\gamma_{1,1}$ = 0.01, *SE* = 0.01, 95 % CI = [−0.02, 0.04], z = 0.61, *p* = .542). Fig. 3 illustrates forest plots depicting meta-analytic estimates for each investigation.

5. General discussion

Researchers studying trait mindfulness often made various assumptions when examining its stress-buffering role: (1) individuals with higher levels of mindfulness often report higher well-being following stressor exposure because of lower stress reactivity, rather than higher baseline affective well-being, and (2) investigating how trait mindfulness influence *affective reactivity* to stressor exposure alone provides sufficient empirical support for its stress-buffering role. To address these assumptions, we examined the relationships between trait mindfulness and daily affect and cognition, affective and cognitive reactivity to

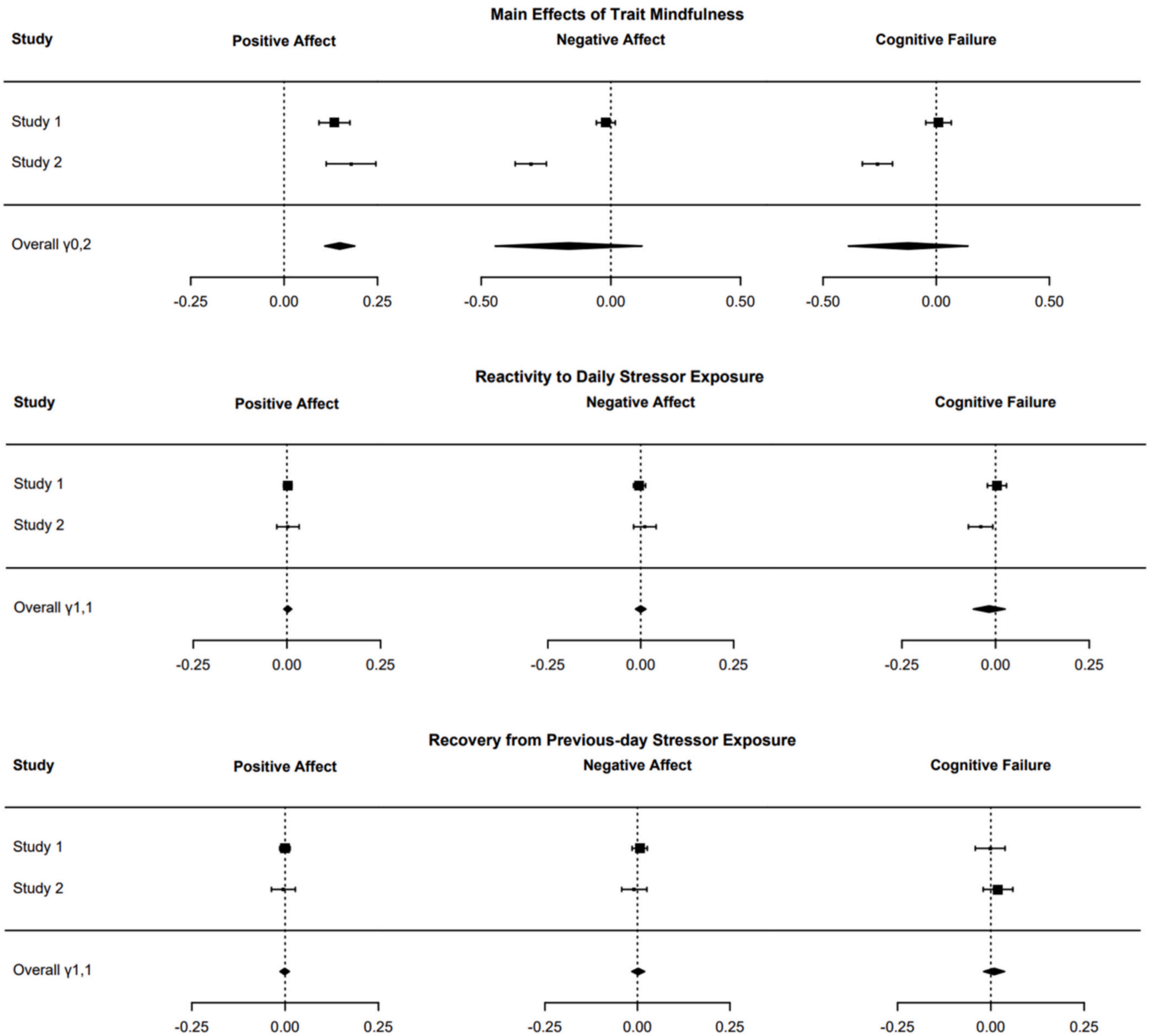

Fig. 3. Forest plots depicting meta-analytic estimates.
Note. The magnitude of the effect size and sample size is reflected by the dimensions of the boxes and whiskers of the boxes represent its corresponding 95 % confidence interval. Pooled effect sizes and its corresponding 95 % confidence interval are represented by the diamonds and the width of the diamonds, respectively.

stressor exposure and affective and cognitive recovery from previous-day stressor exposure across two studies. We found a large and significant association between trait mindfulness and daily positive affect in Study 1. Using a more established trait mindfulness measure, we found a large and significant relationship between trait mindfulness and daily affect and daily cognitive failure, and a small but significant relationship with cognitive reactivity to daily stressor exposure in Study 2. However, the null results between trait mindfulness and affective reactivity to daily stressor exposure and affective and cognitive recovery following previous-day stressor exposure remained. Overall, trait mindfulness may improve psychological functioning (i.e., higher daily positive affect, lower daily negative affect and cognitive failure) independent of daily stressor exposure.

Firstly, trait mindfulness significantly attenuated cognitive reactivity to daily stressor exposure in Study 2, where individuals with lower levels of trait mindfulness experienced a larger increase in the degree of cognitive failure from a non-stressor exposure day to a stressor exposure day compared to individuals with higher levels of trait mindfulness. Individuals with higher levels of trait mindfulness might be less likely to experience cognitive failure following stressor exposure because these individuals remain focused in the present moment and do not deplete cognitive resources by engaging in preservative cognition (e.g., rumination) after a stressor event (Alleva et al., 2014; Raes & Williams, 2010). As no researcher has examined the influence of trait mindfulness on cognitive reactivity to stressor exposure in naturalistic settings, evidence that trait mindfulness strengthens individuals' resilience against the cognitive consequences of daily stressor exposure is preliminary. Nevertheless, researchers should further examine whether higher levels of rumination could potentially explain the influence of daily stress exposure on daily cognitive failure.

Next, trait mindfulness did not attenuate affective reactivity to daily stressor exposure in Study 2. This is in line with findings from previous research on trait mindfulness and affective reactivity to daily stressors (e.g., An et al., 2019; Szoke, 2021) but not others (e.g., Ciesla et al., 2012; Dixon & Overall, 2016). Given the large sample size employed, the non-significant influence of trait mindfulness on affective reactivity to daily stressor exposure suggests that trait mindfulness does not strengthen individuals' affective resilience towards daily stressor exposure. However, the null findings may also be attributed to the facet of mindfulness assessed. We employed the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) in Study 2, which placed more emphasis on the cognitive dimension of trait mindfulness because it measured the extent to which an individual act with awareness. In contrast, other trait mindfulness scales (e.g., Five Factor Mindfulness Questionnaires) place more focus on the affective dimensions of trait mindfulness, including non-reactivity and non-judgment to inner experiences. Previous researchers found that trait mindfulness significantly attenuated negative affective reactivity to daily stressors when trait mindfulness was assessed using the dimensions of non-judging or non-reactivity to inner experience but not when trait mindfulness was assessed using the 'acting with awareness' dimension (Blanke et al., 2018; Feldman et al., 2016). Combined with the current finding that trait mindfulness buffered cognitive but not affective reactivity to daily stressor exposure, it would be premature to conclude that individuals with high levels of trait mindfulness are as vulnerable to affective consequences of exposure to daily stressors as individuals with low levels of trait mindfulness. A more likely conclusion is that the 'act with awareness' facet of trait mindfulness does not buffer affective reactivity to daily stressor exposure. Another possible explanation is that individuals with higher levels of mindfulness have better emotional regulation (Mesmer-Magnus et al., 2017) and problem solving coping (Sesker et al., 2016) skill set which can influence daily affect (Ashkanasy & Kay, 2023) thus limiting the impact of mindfulness on affective reactivity to daily stressor exposure. This is likely given that participants with higher levels of trait mindfulness also have higher levels of positive affect and lower levels of negative affects at baseline, suggesting that participants might be less prone to emotional fluctuations.

Lastly, we found that trait mindfulness did not influence the relationship between previous-day stressor exposure and current-day level of affect and cognitive failure despite the considerable number of researchers demonstrating that higher levels of mindfulness facilitate affective recovery from stressor exposure in laboratory studies (e.g., Crosswell et al., 2017; Keng & Tan, 2018; Paz et al., 2017). Thus, it is likely that experimental and naturalistic stressors have different recovery trajectories. Another possible explanation for the conflicting findings is that previous laboratory studies accounted for individual differences in stress awareness, whereas this study did not. We assessed daily stressor exposure via participants' self-report, assuming that participants are similar in terms of their ability to (1) be self-aware and accurately report their daily stressor exposure, (2) observe changes in their inner thoughts and feelings without any self-judgment and (3) experience similar levels of stressor exposure. However, individual differences in stress awareness and perception exist (DeMarree & Naragon-Gainey, 2022; Duggan et al., 2024). For instance, individuals with prior meditation practice are better at being aware and remain non-reactive towards their inner affect and cognition (Baer, 2019) while individuals with higher levels of trait mindfulness experience lower perceived stress (McBride et al., 2022). As we did not assess and control for such individual confounds (e.g., past meditation practice), the reliance on self-report stress measurement may have obscured the potential influence of trait mindfulness in the stress recovery process.

6. Conclusion

Overall, the results point to an important understanding of trait mindfulness. The fact that trait mindfulness had significant main effects but insignificant interaction effects with daily stressor exposure and previous-day stressor exposure on daily affect and cognition indicates that the emotional and cognitive benefits conferred by higher levels of trait mindfulness are not limited to stressful situations. Indeed, mindful individuals are aware of their inner experiences and pay attention to them without judgment, most of the time, not just during stressful situations, thus allowing them to reap the benefits of being non-reactive to present moment awareness even in non-stressful contexts. For example, individuals with higher levels of mindfulness are better at emotional regulation (Mesmer-Magnus et al., 2017) and hence, would also be better at regulating negative affect arising from both stressful (e.g., missing a deadline) and non-stressful situations (e.g., physical discomfort from sleep deprivation or being in an environment that is too hot). Overall, individuals with higher trait mindfulness are more likely to mindfully attend to different types of people and situations in daily life and therefore, report improvement in daily affect and cognition regardless of external stressors.

There are some limitations to the current study. Firstly, the correlational nature of the study prevents us from drawing causal conclusions regarding the relationship between trait mindfulness and cognitive reactivity to daily stressor exposure. Secondly, findings in the current study might not generalize to different cultural contexts. While we employed different samples in Study 1 (US midlife adults) and 2 (Singapore undergraduates), the lack of direct comparison precludes conclusion that the culture or age group do not attenuate effects of trait mindfulness on stress reactivity and recovery. Future researchers should compare individuals from different cultural contexts within the same age range (e.g., undergraduates) to clarify whether culture may attenuate the effects of mindfulness. Given the cultural differences in emotional expression, it is likely that trait mindfulness may have differential attenuating effects across cultures.

Thirdly, the use of same data collection method (i.e., self-report) for all variables may inflate the observed relationships between trait mindfulness and affective and cognitive outcomes since some of the shared variance may arise from using the same measurement method rather than the underlying relationship between the variables. To overcome this issue, future researchers could ask participants' peer and family members to report on participants' affective and cognitive states. This approach may also improve the accuracy of outcome assessments since participants may lack awareness of their cognitive failures (e.g., forgetting tasks) and emotional states. Future researchers can also make use of behavioral measures such as executive functions assessments as objective indicators of participants' cognitive performance.

Lastly, despite our substantial efforts to minimize endogeneity bias, the complexity of real-world data and methodological limitations make it difficult to eliminate its influence. Specifically, we have taken measures to address potential sources of endogeneity bias (e.g., omitted confounding variables, non-representative samples, measurement error, and common method variance (CMV)), such as including a comprehensive list of demographic covariates that previous research has identified as influencing affect and cognition to address the issue of confounding variables and including data from two different cultural groups and age ranges—midlife adults from the United States in Study 1 and undergraduates from Singapore in Study 2 to improve sample representativeness. While we used self-report measures throughout the study, we did not correct for CMV following research indicating that the inflationary effects of CMV may offset the attenuating effects of measurement error (Lance et al., 2010). As CMV and other sources of endogeneity bias may not be fully addressed, there exists a certain level of endogeneity bias in our research.

Despite these shortfalls, we examined the role of trait mindfulness in affective and cognitive reactivity to and affective and cognitive recovery from everyday stressors using substantial and diverse samples across 2 different studies. Our results demonstrated that trait mindfulness promotes better daily affect and cognition regardless of everyday stressor exposure. While trait mindfulness was not associated with affective reactivity to and recovery from daily stressors, our study identified important boundary conditions surrounding the benefits of trait mindfulness and showed that the mechanisms underlying the affective and cognitive buffering effect of trait mindfulness are not stress-specific.

CRediT authorship contribution statement

Yi Jing Chua: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Andree Hartanto:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization. **Nadyanna M. Majeed:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

I have shared the link to my data/code in the main manuscript

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