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## A critical examination of the effectiveness of gratitude intervention on well-Being Outcomes: A within-person experimental daily diary approach

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### ABSTRACT

Given the rise in the global prevalence of stress and depressive symptoms, there is an increasing need to identify promising interventions that promote well-being. One potential intervention that has been widely discussed in the literature on improving well-being is the practice of gratitude. However, findings on its effectiveness have been marred by inconsistency and publication bias. Building upon past studies, the current study aims to revisit the effect of a gratitude contemplation intervention on multiple well-being outcomes by using a within-person experimental design with a daily diary approach. Multilevel modeling showed that the gratitude contemplation intervention had a significant within-person effect on multiple daily well-being outcomes including negative affect, perceived stress, anxiety, and depressive symptoms. Moreover, the results were robust across varying levels of personality traits. Our study provides another line of evidence to the literature supporting the benefits of gratitude contemplation intervention.

### KEYWORDS

Gratitude intervention; well-being; depressive symptoms; life satisfaction; anxiety daily diary; multilevel modeling

Achieving and maintaining a high level of well-being is not only a desirable end but is also a means to other good ends (Myers & Diener, 2018; Ryan & Deci, 2001; Tov & Diener, 2013). A myriad of studies has stressed the importance of well-being in predicting various positive outcomes, such as health and longevity (Chida & Steptoe, 2008; Diener et al., 2017), health behaviors (Hoyt et al., 2012; Kushlev et al., 2020), employment outcomes and job performance (Chia & Hartanto, 2021; Knapp et al., 2011), cognitive functioning (Comijs et al., 2004; Toh et al., 2020), and social relationships (Moore & Diener, 2019; Walker et al., 2013). Unfortunately, for many individuals, their well-being has taken a severe hit due to the current COVID-19 pandemic. Given the importance of well-being, it has therefore become imperative to look for promising interventions to promote well-being. One promising facilitator of well-being that has received growing attention is gratitude interventions. However, research findings on the effectiveness of such interventions have been marred by inconsistency and publication bias (Davis et al., 2016). In view of these limitations in the literature, the current study aims to build upon previous works by revisiting the effect of gratitude on multiple well-being outcomes using a within-person experimental design with a daily diary approach and multilevel modeling.

Gratitude has been defined as the positive experience of feeling thankful and appreciative when receiving something beneficial (Emmons, 2004). This can include feeling thankful when someone provides material or social support, or feeling appreciative towards nature or a higher power (Emmons & Shelton, 2002). State gratitude is typically characterized as a positive emotion felt in the moment, while trait gratitude is seen as a characteristic of individuals who are able to exhibit this emotion more frequently over a prolonged period of time (Hartanto et al., 2020; Rash et al., 2011; Wood et al., 2008). Feeling grateful allows an individual to focus more on the positives in their life, rather than to ruminate over what is lacking (Arnout & Almoied, 2021; Emmons & Crumpler, 2000). In line with the theory that gratitude plays a role in emphasizing positives, empirical research has shown various psychological, social, and physical benefits associated with gratitude. For instance, state gratitude has been found to elicit higher levels of optimism and life satisfaction, and lower levels of negative affect (Froh et al., 2008; Lambert et al., 2012; McGuire et al., 2020; Nezlek et al., 2019; L. Zhang et al., 2022). Furthermore, individuals higher in dispositional gratitude are more likely to experience positive outcomes, such as increased feelings of happiness and hope, strengthened interpersonal relations, and improved physical health (Bhullar et al., 2015; Green et al., 2019;

Hartanto et al., 2019, 2022; Murray & Hazelwood, 2011; Portocarrero et al., 2020; Watkins et al., 2003; Wood et al., 2010; Xiang & Yuan, 2021).

Several theoretical mechanisms have been proposed to underlie the positive effects of gratitude on well-being. Firstly, Fredrickson's (2001) *Broaden-and-Build Theory* posits that positive emotions, which could encompass feelings of gratitude, expand individuals' thought-action repertoires – individuals' set of actions that follow thoughts (Fredrickson & Branigan, 2005; Keeman et al., 2017). According to the theory, negative emotions narrow individuals' momentary thought-action repertoires. As a result, thoughts accompanied by negative emotions tend to be followed by a narrower set of action tendencies such as attack and flee. In contrast, positive emotions broaden individuals' momentary thought-action repertoires and encourages wider range of activities such as play, explore, savour, and integrate. In turn, the expansion of thought-action repertoires encourages grateful individuals to build coping strategies and hence greater resilience against stressors, mitigating the negative psychological effects of stressful events. Secondly, according to *Find-Remind-and-Bind Theory* (Algoe, 2012), practicing gratitude allows individuals to identify and appreciate partners in their lives whom they were not focusing on before, hence strengthening social bonds and building social support. The increased social support, based on the *stress-buffering hypothesis* (Gellert et al., 2018), may act as a protective measure against stress and other negative emotional states, allowing for improvements in well-being outcomes. Lastly, gratitude has been theorized to allow the individual to focus on the more positive aspects of their life as it increases the accessibility of positive experiences, bringing these positive experiences to the forefront of the individual's mind, leading to higher levels of positive affect and life satisfaction (Watkins et al., 2004, 2015).

Although there is a strong theoretical basis for gratitude to improve well-being, research finding on gratitude interventions on well-being outcomes has been mostly mixed. Some studies suggest that gratitude interventions are successful in improving well-being outcomes, such as life satisfaction, positive affect, and subjective happiness (Chan, 2013; Cunha et al., 2019; Rash et al., 2011). Furthermore, there has been some evidence suggesting that these interventions play a critical role in reducing psychopathological symptoms and negative emotions such as depressive mood and negative affect (Cheng et al., 2015; Killen & Macaskill, 2015), and in improving overall mental well-being (Bohlmeijer et al., 2020). However, there have been other studies that do not replicate these findings, with

their results showing null effects of gratitude interventions on well-being outcomes (e.g., Gavian, 2011; Ozimkowski, 2007; Peters et al., 2013; Smullen, 2012). In fact, recent meta-analyses have shown that the overall effect size of gratitude interventions on well-being was small (Cregg & Cheavens, 2020). This is further exacerbated by the lack of statistical power and existence of publication bias found in the existing studies (Davis et al., 2016).

In view of the mixed findings, the current study aimed to revisit the effectiveness of a gratitude intervention on multiple daily well-being outcomes, including positive affect, negative outcome, perceived stress, depressive symptoms, anxiety, and life satisfaction. To provide a more sensitive measure of well-being as well as address limitations related to statistical power, the current study further improved upon past gratitude intervention studies by utilizing a within-person experimental design with a daily diary approach (allowing for the use of multilevel modeling) and by specifically using the gratitude contemplation method (where individuals not only list the things that they are grateful for, but also contemplate and provide reasons as to *why* they are grateful for them; Locklear et al., 2021) as our intervention of choice. There are several advantages to this unique methodological approach. First, the within-person experimental approach addresses limitations of previous studies by increasing statistical power and minimizing error rates due to individual differences (Charness et al., 2012). Second, the daily diary study improves the ecological validity of the current study, minimizes memory distortion, and reduces measurement errors due to the daily repeated assessments of participants in their natural environment (Almeida, 2005; Mason et al., 2016). Third, multilevel modeling allows us to take into account the nested data structure in the daily diary design, is capable of analyzing incomplete data, and yields higher power than traditional ANOVA (Hair & Fávero, 2019; Quené et al., 2004). Lastly, the gratitude contemplation intervention is a highly effective manipulation tactic against a backdrop of other weaker strategies, given that past research has found that studies that used contemplation were more likely to be able to elicit feelings of gratitude as compared to studies that utilized other types of interventions (Davis et al., 2016; Rash et al., 2011).

Furthermore, we aimed to conduct several exploratory analyses to identify potential personality traits as moderators of the effect of gratitude intervention on well-being outcomes. The exploration is worthwhile as past literature has suggested that individuals with higher levels of dispositional or trait gratitude or those who place heavy emphasis on their positive life

experiences may be unable to benefit any further from additional gratitude intervention (McCullough et al., 2004). Indeed, there is some preliminary evidence that individuals with higher levels of trait gratitude are less likely to benefit after gratitude interventions as they are less likely to show improvements in well-being outcomes (Chan, 2013; Froh et al., 2008; Rash et al., 2011). The current study further explores several personality traits that are related to trait gratitude, such as trait positive affect and big five personality traits.

Lastly, our exploratory analysis also examines whether the effect of gratitude intervention can be extended beyond well-being outcomes. As previously mentioned, existing literature has proposed that gratitude may encourage individuals to expand their thought-action repertoires to build adaptive coping behaviors (Chang et al., 2022; Fredrickson, 2001; Xiang & Yuan, 2021). Moreover, practicing gratitude may allow individuals to identify and appreciate partners in their lives whom they were not focusing on before, hence strengthening social bonds and building social support (Algoe, 2012). Therefore, our additional analysis also aims to extend the effect of gratitude intervention to perceived social support and coping behaviors and examine whether these two constructs may mediate the effect of gratitude intervention on well-being outcomes.

Taken together, we hypothesized that gratitude interventions would improve well-being by increasing daily levels of positive affect and life satisfaction as well as decreasing daily levels of depressive symptoms, anxiety, perceived stress, and negative affect. Based on our daily diary within-person experimental approach, we

expected that participants would report higher levels of well-being – in terms of multiple indicators of well-being – on days when they practiced gratitude contemplation as compared to when they were in a neutral control condition.

## Method

### Participants

A total of 166 young adults participated in the current study. Three participants were excluded due to either inability to connect baseline and experimental data due to participant non-compliance, or because they had not provided data on both experimental and treatment conditions, resulting in a final sample of 163 participants (Table 1). All participants were recruited from a local university in Singapore in exchange for course credit. They were required to complete a baseline questionnaire, followed by surveys that were administered daily for 10 days. Given that multilevel modeling is robust against missing data at level 1, data from participants who did not complete the full daily survey (i.e., completed less than ten days of daily surveys) were still included in the study as long as they provided measures for both experimental and treatment conditions. There was no missing data at baseline, and a total of 1560 daily data observations ( $M = 9.57$  observations per participant, 95.71% completion rate) were collected during the daily diary sessions. All participants gave informed consent and data collection was approved by the local institutional review board [IRB-20-029-

**Table 1.** Summary of sample characteristics.

Variable	<i>M</i> ( <i>SD</i> )	Observed Range	Theoretical Range
<b>Demographics</b>			
Age (in years)	20.99 (1.71)	17–27	
Gender (% female)	80%		
Ethnicity (% Chinese)	80%		
Monthly household income <sup>a</sup>	4.93 (2.34)	1–9	1–9
Monthly personal income <sup>a</sup>	2.05 (1.25)	1–9	1–9
Subjective socioeconomic status <sup>b</sup>	6.12 (1.38)	1–10	1–10
<b>Dispositional Gratitude</b>			
GQ-6	33.26 (5.02)	16–42	6–42
GAC	11.31 (2.30)	3–15	3.00–15.00
<b>Dispositional Affect</b>			
Positive affect	14.71 (3.89)	5–23	5–25
Negative affect	11.79 (4.32)	5–25	5–25
<b>Personality</b>			
Extraversion	17.36 (5.13)	7–30	6–30
Agreeableness	21.49 (4.17)	11–29	6–30
Conscientiousness	18.10 (4.46)	9–29	6–30
Neuroticism	19.34 (5.30)	7–30	6–30
Openness to experience	21.39 (4.25)	8–30	6–30

*N* = 163.

<sup>a</sup>Monthly household and personal income were measured in SG\$2,500 intervals, from 1 = *less than \$2,500* to 10 = *more than or equal to \$20,000*.

<sup>b</sup>Subjective socioeconomic status was measured on a 10-point ladder scale (1 = *worst off in society*, 10 = *best off in society*) adapted from Adler et al. (2000).

A013-M1(921)]. The dataset in the current work has been made publicly available on ResearchBox (#737; <https://researchbox.org/737>).

## Measures

### Baseline

#### *Trait gratitude*

Trait gratitude was assessed by administering two separate scales. Gratitude was operationalized as experiences and expressions of gratitude and appreciation in life within the first scale, and as an emotion or mood measured via gratitude-related affect adjectives in the second scale.

Gratitude experiences were measured using the 6-item Gratitude Questionnaire-6 (McCullough et al., 2002). Participants were asked to indicate to what extent they agreed with various statements regarding gratitude experiences in daily life (e.g., 'I have so much in life to be thankful for') on a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*;  $\alpha = .76$ ).

Gratitude-related emotions were measured via the 3-item Gratitude Adjective Checklist (McCullough et al., 2002). Participants were asked to indicate how they generally felt with regard to the gratitude-related adjectives 'grateful', 'thankful' and 'appreciative' on a 5-point scale (1 = *not at all*, 5 = *extremely*;  $\alpha = 0.90$ ).

#### *Trait positive and negative affect*

Trait positive and negative affect were measured using the 10-item International Positive and Negative Affect Schedule-Short Form Scale (Thompson, 2007). Participants were asked to indicate how they generally felt over the past week on a 5-point scale (1 = *not at all*, 5 = *extremely*). Five items were used to assess positive affect (e.g., 'Inspired';  $\alpha = .81$ ) and another five item were used to assess negative affect (e.g., 'Upset';  $\alpha = .83$ ).

#### *Big five personality traits*

Big five personality traits were assessed using the 30-item shortened version of the Big Five Inventory (Soto & John, 2017). They were asked to indicate the extent to which thirty items applied to them using a 5-point scale (1 = *strongly disagree*, 5 = *strongly agree*). Participants were assessed on five factors, namely extraversion (e.g., tends to be quiet;  $\alpha = .83$ ), agreeableness (e.g., is compassionate, has a soft heart;  $\alpha = .76$ ), conscientiousness (e.g., tends to be disorganized;  $\alpha = .80$ ), neuroticism (e.g., worries a lot;  $\alpha = .85$ ), and openness (e.g., is fascinated by art, music, or literature;  $\alpha = .70$ ).

### *Trait coping behaviors*

Trait coping behaviors were measured using a shortened 32-item version of the COPE Inventory (Carver et al., 1989). Eight subscales, each containing four items, were selected from the original COPE Inventory for the current study by the authors to assess different aspects of coping behaviors by asking participants to indicate what they generally do when facing a stressful event. The factors assessed were positive reinterpretation (e.g., 'I try to grow as a person as a result of the experience';  $\alpha = .86$ ), mental disengagement (e.g., 'I turn to work or other substitute activities to take my mind off things';  $\alpha = .42$ ), focus on venting and emotions (e.g., 'I get upset, and am really aware of it';  $\alpha = .76$ ), active coping (e.g., 'I concentrate my efforts on doing something about it';  $\alpha = .77$ ), denial (e.g., 'I refuse to believe that it has happened';  $\alpha = .85$ ), behavioral disengagement (e.g., 'I just give up trying to reach my goal';  $\alpha = .82$ ), acceptance (e.g., 'I accept that this has happened and that it cannot be changed';  $\alpha = .74$ ), and substance use (e.g., 'I try to lose myself for a while by drinking alcohol or taking drugs';  $\alpha = .96$ ).

### *Daily*

#### *Daily state gratitude*

To ensure that the gratitude intervention was successful in inducing gratitude, a manipulation check was conducted using a 6-item modified version of the Gratitude Questionnaire-6 (McCullough et al., 2002) and a 3-item modified Gratitude Adjective Checklist (McCullough et al., 2002).

In the Gratitude Questionnaire-6, the instructions were changed from the original scale to state 'indicate the extent to which you agree with the statements *today*' so as to assess state, rather than trait, gratitude levels. Participants were asked to respond on a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*) to each item (e.g., 'Today, I have so much in life to be thankful for';  $\alpha_{\text{gratitude, ten-days}} = [.84, .90]$ ,  $\alpha_{\text{control, ten-days}} = [.86, .90]$ ).

The Gratitude Adjective Checklist was also modified such that participants were asked to report how they felt within that particular day with regard to gratitude-related affect adjectives ('grateful', 'thankful', 'appreciative') on a 5-point scale (1 = *not at all*, 5 = *extremely*;  $\alpha_{\text{gratitude, ten-days}} = [.95, .97]$ ,  $\alpha_{\text{control, ten-days}} = [.96, .98]$ ).

#### *Daily indebtedness*

Daily indebtedness was measured using a 3-item scale adapted from Yu (2017), with the instructions changed to direct participants to indicate their indebtedness levels on the day itself. Participants indicated the extent



to which they related to the adjectives assessing indebtedness (e.g., 'indebted', 'obligated', 'obliged') using a 5-point scale (1 = *not at all*, 5 = *extremely*;  $\alpha_{\text{gratitude, ten-days}} = [.84, .90]$ ,  $\alpha_{\text{control, ten-days}} = [.85, .94]$ ).

### **Daily stressor exposure**

Daily stressor exposure was measured using a 7-item scale from the Daily Inventory of Stressful Events (Almeida et al., 2002). Participants were asked to rate whether they experienced certain stressor events on the particular day (e.g., 'Did you have an argument or disagreement with anyone?', 'Did anything happen that you could have argued about but you decided to let pass in order to avoid a disagreement?') on a binary response scale (0 = *No*, 1 = *Yes*). In line with previous research on daily stressor exposure (Almeida et al., 2002), if at least one stressor event was experienced by the participant within the day, it was then categorized as a *stressor day*. If no stressor events were experienced on the day, it was categorized as a *non-stressor day*.

### **Daily positive and negative affect**

Daily positive and negative affect were measured using the 10-item International Positive and Negative Affect Schedule-Short Form Scale (Thompson, 2007). Participants were asked to indicate how they felt 'right now, at this present moment', regarding their positive (e.g., inspired;  $\alpha_{\text{gratitude, ten-days}} = [.83, .86]$ ,  $\alpha_{\text{control, ten-days}} = [.85, .88]$ ) and negative (e.g., upset;  $\alpha_{\text{gratitude, ten-days}} = [.81, .88]$ ,  $\alpha_{\text{control, ten-days}} = [.79, .83]$ ) affect on a 5-point scale (1 = *not at all*, 5 = *extremely*).

### **Daily perceived stress**

Daily perceived stress was measured using a 4-item modified version of the Perceived Stress Scale (Cohen et al., 1983) with all items changed to include the word 'today' and the instructions modified such that participants were directed to indicate their perceived levels of stress within the day. Participants were asked to report how they felt regarding their stress today (e.g., 'Today, have you felt that you were unable to control the important things in your life?') using on a 5-point scale (1 = *very slightly or not at all*, 5 = *extremely*;  $\alpha_{\text{gratitude, ten-days}} = [.65, .74]$ ,  $\alpha_{\text{control, ten-days}} = [.63, .75]$ ).

### **Daily depressive symptoms**

Daily depressive symptoms were measured by a 10-item modified version of the Centre for Epidemiologic Studies Depressive Scale (W. Zhang et al., 2012) with item wordings adapted to include the word 'today' and the instructions modified such that participants were directed to indicate experiencing depressive symptoms within

the day. Participants indicated how they felt today with regard to depressive symptoms (e.g., 'Today, I felt depressed') on a 4-point scale (1 = *rarely or none of the time*, 4 = *all the time*;  $\alpha_{\text{gratitude, ten-days}} = [.82, .86]$ ,  $\alpha_{\text{control, ten-days}} = [.81, .85]$ ).

### **Daily anxiety**

Daily anxiety was assessed using a 6-item shortened version of the State-Trait Anxiety Inventory (Marteau & Bekker, 1992). Participants responded to anxiety-related statements (e.g., 'I am tense', 'I feel upset') using a 4-point scale (1 = *not at all*, 4 = *very much*;  $\alpha_{\text{gratitude, ten-days}} = [.80, .85]$ ,  $\alpha_{\text{control, ten-days}} = [.78, .80]$ ).

### **Daily life satisfaction**

Participants' levels of daily life satisfaction were measured using the Satisfaction with Life Scale (Diener et al., 1985). The scale was modified to fit a daily time-frame by including the word 'today' in all items and directing participants to indicate life satisfaction levels for the particular day. Participants indicated their daily life satisfaction levels by responding to a 5-item scale (e.g., 'Today, in most ways my life is close to my ideal') on a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*;  $\alpha_{\text{gratitude, ten-days}} = [.92, .95]$ ,  $\alpha_{\text{control, ten-days}} = [.92, .94]$ ).

### **Daily perceived social support**

Daily perceived social support was assessed using three items describing perceptions of received social support ('Today, in general, I felt supported', 'Today, I feel that I can rely on my family and friend for support', 'Today, I feel that there is a family member or friend I could go to if I were just feeling down, without feeling funny about it later'). Participants responded to each item on a 5-point scale (1 = *not at all*, 5 = *extremely*;  $\alpha_{\text{gratitude, ten-days}} = [.91, .95]$ ,  $\alpha_{\text{control, ten-days}} = [.91, .95]$ ).

### **Daily loneliness**

Daily loneliness was measured using the Revised UCLA Loneliness Scale (Russell et al., 1980). Participants indicated the extent to which they experienced situations related to loneliness within the particular day by responding to 6 items (e.g., 'Today, I felt lonely') on a 5-point scale (1 = *not at all*, 5 = *extremely*;  $\alpha_{\text{gratitude, ten-days}} = [.93, .96]$ ,  $\alpha_{\text{control, ten-days}} = [.91, .96]$ ).

### **Daily coping behaviors**

Daily coping behaviors were measured using a 7-item scale from Sztachańska et al. (2019). Participants were asked to think about how they coped with stressful situations on the day itself in terms of a series of coping behaviors, rated on a 5-point scale (1 = *never*, 5 = *very often*). Each item measured a different aspect of coping

behaviors, namely being with other people ('I tried to be with other people'), focusing on physical symptoms ('I was focused on my physical symptoms'), thinking about better times ('I thought about the times when I felt better'), adopting a different perspective ('I approached the problem from different perspectives'), regretting what happened ('I regretted I couldn't change what had happened or what I felt as a consequence'), denial ('I told myself that it wasn't real'), and failure to cope due to anxiety ('I was anxious that I wouldn't cope with it'). Higher scores for each item indicated a higher likelihood of engaging in the specific coping behavior.

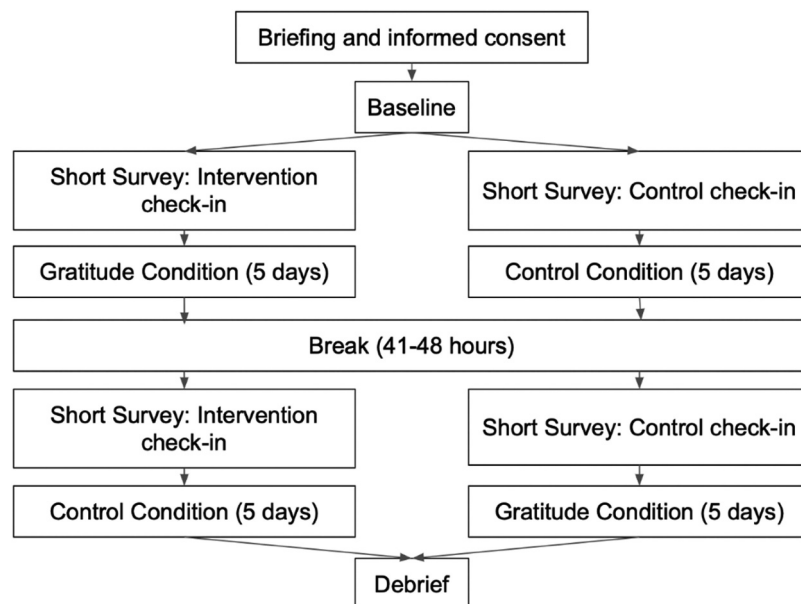
## Procedure

Data were collected over a period of two weeks, during which participants first completed a baseline survey and then a series of self-administered daily surveys for 6 consecutive days (1 day of short survey and 5 days full survey), following by a 41–48-hour washout period, and another series of self-administered daily surveys for 6 consecutive days (1 day of short survey and 5 days full survey); (Figure 1). The study adopted a within-subject experimental design in which all participants were exposed to both the gratitude intervention and daily events conditions. To rule out order effects, the conditions were counterbalanced such that, for the first week, half the participants were randomly assigned to the gratitude intervention condition while the other half were randomly assigned to the daily events (control) condition. To reduce possible carryover effects, participants were then given a break of

41–48 hours. In the second week, those that had been previously assigned to the gratitude intervention condition were assigned to the daily events condition, and vice versa.

During the baseline survey, participants answered baseline questionnaires assessing trait gratitude, trait positive and negative affect, personality, and the dispositional use of various coping behaviors. Each daily survey consisted of two sections, namely the manipulation check-in (i.e., the interventions; administered from Sunday to Friday of each week) and the measurement check-in (administered from Monday to Friday of each week). The measurement check-ins were administered immediately following the relevant manipulation check-ins on all days except on Sundays, when only the manipulation check-in was administered (so as to induce the relevant condition prior to Monday's measurement check-in).

During the manipulation check-in, participants were exposed to either the gratitude intervention condition or the daily events (control) condition. In the gratitude intervention condition, participants received the following instructions, adapted from Locklear et al. (2021) and Pillay et al. (2020): '*There are many things in our lives, both large and small, that we might be grateful for. Think back over the past day and write down in detail **three things** that you are grateful or thankful for **today**. Furthermore, please elaborate on **why you feel grateful or thankful** and provide contextual information where necessary. Try to think of new ideas that you have not focused on in the past*'. Participants in the daily events (control) condition received the following instructions: '*During the day, there*



**Figure 1.** Experimental flow. Note. Participants were randomly assigned each condition such that they completed both the gratitude and control condition once.

**Table 2.** Descriptive statistics of outcome measures.

Outcome	Gratitude			Control			Theoretical Range
	<i>M</i>	<i>SD</i>	Observed Range	<i>M</i>	<i>SD</i>	Observed Range	
<b>Manipulation check</b>							
Gratitude (GQ-6)	30.70	5.43	15.00–42.00	29.76	5.51	16.40–42.00	6.00–42.00
Gratitude (GAC)	10.87	2.42	5.00–15.00	10.13	2.60	4.00–15.00	3.00–15.00
Indebtedness	5.62	2.29	3.00–13.20	5.47	2.42	3.00–14.00	3.00–15.00
<b>Well-being</b>							
Positive affect	11.10	3.51	5.00–21.20	11.00	3.65	5.00–22.50	5.00–25.00
Negative affect	7.88	2.79	5.00–19.67	8.25	2.82	5.00–18.40	5.00–25.00
Perceived stress	10.81	2.37	4.20–16.60	11.31	2.51	4.75–18.40	4.00–20.00
Depression	19.14	4.29	11.20–31.80	19.67	4.08	11.20–30.20	4.00–40.00
Anxiety	14.04	2.95	7.75–22.00	14.51	2.89	7.20–21.80	6.00–24.00
Life satisfaction	21.63	5.95	7.00–34.80	21.42	5.92	7.00–33.80	5.00–35.00
Perceived social support	10.12	2.43	4.20–15.00	9.74	2.67	3.20–15.00	5.00–15.00
<b>Coping behavior</b>							
Being with other people	2.40	0.91	1.00–4.80	2.31	0.89	1.00–5.00	1.00–5.00
Focus on physical symptoms	1.95	1.80	1.00–4.20	2.01	0.81	1.00–4.20	1.00–5.00
Denial	1.40	0.60	1.00–4.00	1.38	0.64	1.00–4.20	1.00–5.00
Anxious could not cope	2.02	0.85	1.00–5.00	2.10	0.87	1.00–4.67	1.00–5.00
Think about better times	2.11	0.91	1.00–4.40	2.12	0.89	1.00–4.40	1.00–5.00
Regret what happened	1.94	0.81	1.00–4.33	2.05	0.90	1.00–5.00	1.00–5.00
Different perspective	2.37	0.94	1.00–4.80	2.32	0.92	1.00–5.00	1.00–5.00

*N* = 163. Values were computed by first calculating an average for each outcome for each condition per participant, such that there were 163 data points per condition.

are events, both large and small, that occur on a daily basis. Think back over the past day and write down in detail **three events** that occurred **today**. Please only write about the **objective** events that happened today.' (emphasis as shown).

During the measurement check-in, participants were asked to complete a series of self-reports assessing daily well-being (i.e., life satisfaction, positive affect, negative affect, perceived stress, depression, and anxiety), daily stressor exposure, daily perceived social support, daily loneliness, and daily use of coping strategies (refer to Table 2 for descriptives by condition).

## Analytic plan

The current study utilized multilevel modeling with day-level variables on Level 1 and participant-level variables on Level 2 to examine the effects of a gratitude intervention on the various well-being outcomes. Multilevel modeling is a more appropriate analytic method than traditional linear models (e.g., repeated measures ANOVA) as it considers multiple data points in a within-persons design (Field & Wright, 2011). This is also in line with recommendations from Probst (2010), who highlighted the importance of using multilevel modeling to mitigate limitations, such as inability to investigate effects occurring both within and across levels, in studies examining interventions that address well-being outcomes. Additionally, prior to testing wellbeing outcomes, we conducted a manipulation check as well as test for order effects. The manipulation check model is

similar to the model used to test wellbeing outcomes (describe below), with state gratitude and indebtedness serving as the outcome variables. The test for order effects included the addition of order (i.e., whether gratitude intervention was administered first or second) as a separate predictor variable to the model described below.

The general equation used to analyze all the well-being outcomes is as such, where *d* indicates the day of the intervention, and *i* represents each participant:

Level 1:

$$(Outcome)_{di} = B_{0i} + B_{1i}(\text{gratitudeintervention})_{di} + \varepsilon_{di}$$

Level 2:

$$B_{0i} = \gamma_{00} + \mu_{0i}$$

$$B_{1i} = \gamma_{10} + \mu_{1i}$$

In the above equation, the fixed parameter  $\gamma_{00}$  represents the intercept value indicating the average level of well-being across all participants for the control condition, while the random parameter  $\mu_{0i}$  represents the participant-level deviation from the aforementioned sample-level intercept for each participant *i*. Accordingly, the fixed parameter  $\gamma_{10}$  represents the average magnitude of the fixed effect of the gratitude intervention on well-being, while the random parameter  $\mu_{1i}$  represents each participant *i*'s deviation (i.e., the participant-specific effect of the gratitude intervention on well-being). Lastly,  $\varepsilon_{di}$  represents the residual (i.e., the difference between the daily predicted and observed levels of the outcome in question).



Following this, a moderation analysis was conducted, with the following equation used to analyze the moderators:

Level 1:

$$(Outcome)_{di} = B_{0i} + B_{1i}(gratitudeintervention)_{di} + \varepsilon_{di}$$

Level 2:

$$B_{0i} = \gamma_{00} + \gamma_{01}(moderator)_i + \mu_{0i}$$

$$B_{1i} = \gamma_{10} + \gamma_{11}(moderator)_i + \mu_{1i}$$

The fixed intercept  $\gamma_{11}$  in the above equation represents a change in the effect of gratitude intervention on well-being outcomes for every one-unit change in the respective moderator. Eight potential moderators (trait gratitude, positive affect, negative affect, extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience) that could theoretically influence the relationship between gratitude and well-being outcomes (Fagley, 2018; McCullough et al., 2004) were analyzed using the above equation. All moderators were centered around the grand mean, and random intercepts and slopes for all models were estimated using an unstructured covariance structure which allows random effects to vary and covary freely.

Lastly, an exploratory mediation analysis was conducted to examine if daily perceived social support and the daily utilization of regret as a coping mechanism could mediate the relationship between the gratitude intervention and the various well-being outcomes. Perceived daily social support was chosen as a potential mediator based on *Find-Remind-and-Bind Theory* (Algoe, 2012), which argues that practicing gratitude allows individuals to identify and appreciate partners in their lives whom they were not focusing on before, hence strengthening social bonds and building social support. The exploratory analyses on coping behaviours were based on existing literature that showed the benefits of gratitude in encouraging individuals to expand their thought-action repertoires to build adaptive coping behaviors (Chang et al., 2022; Fredrickson, 2001; Xiang & Yuan, 2021). The mediation analysis utilized a 1-1-1 mediation model with all constructs assessed at Level 1, and was conducted following the multilevel mediation analysis method developed by Yu et al. (2020) that allows taking into account third variable effects at different levels and different time points.

## Transparency & openness

The current study's design and its analysis plan were not pre-registered. The relevant materials, dataset, and R analytic code, as well as full summaries of the results,

have been made publicly available on ResearchBox (#737; <https://researchbox.org/737>). All analyses were conducted in R version 3.6.3 (R Core Team, 2020). Scale reliabilities were calculated using *psych* version 2.2.5 (Revelle, 2022). Multilevel modeling was conducted using *lme4* version 1.1–28 (Bates et al., 2015), and significance testing was carried out via *lmerTest* version 3.1–3 (Kuznetsova et al., 2017). Effect sizes were calculated in the form of standardized coefficients for fixed effects using *effectsize* version 0.6.0.1 (Ben-Shachar et al., 2020). Multilevel mediation analysis was conducted using *mlma* version 6.1–1 (Yu & Li, 2021).

## Results

### Manipulation check

To ensure that the gratitude intervention evoked feelings of gratitude, a manipulation check was performed by measuring participants' levels of state gratitude immediately after the intervention. Participants were found to have experienced significantly higher levels of gratitude during the gratitude intervention as compared to the daily events condition, both when measured in terms of the GQ-6 ( $\gamma_{10} = 0.93$ ,  $SE = 0.25$ ,  $\beta = .11$ , 95% CI = [.05, .17],  $p < .001$ ) and in terms of the GAC ( $\gamma_{10} = 0.75$ ,  $SE = 0.13$ ,  $\beta = .17$ , 95% CI = [.11, .23],  $p < .001$ ). A secondary manipulation check examining the construct divergence from daily levels of indebtedness revealed that there was no significant difference in indebtedness levels during the gratitude intervention as compared to the daily events condition ( $\gamma_{10} = 0.14$ ,  $SE = 0.11$ ,  $\beta = .04$ , 95% CI = [−.02, .11],  $p = .206$ ). This suggests that the gratitude intervention was successful in specifically eliciting feelings of gratitude.

### Order effects

Testing for order effects was carried out for each of the daily wellbeing indicators. Results indicated that there was no significant order effect on participant's daily positive affect, daily negative affect, perceived stress, anxiety, depressive symptoms, or life satisfaction (refer to Table 3).

### Daily Well-Being

We found that the gratitude intervention significantly lowered participant's levels of daily negative affect ( $\gamma_{10} = -0.38$ ,  $SE = 0.17$ ,  $\beta = -.07$ , 95% CI = [−.13, −.01],  $p = .027$ ), perceived stress ( $\gamma_{10} = -0.30$ ,  $SE = 0.16$ ,  $\beta = -.06$ , 95% CI = [−.12, .00],  $p = .058$ ), anxiety ( $\gamma_{10} = -0.46$ ,  $SE = 0.17$ ,  $\beta = -.08$ , 95% CI = [−.14, −.02],

**Table 3.** Order effects on daily wellbeing outcomes.

Outcome	$\beta$	95% CI	$\gamma_{10}$	(SE)	$p$
Positive affect	.10	[−.06, .26]	0.66	(0.53)	.220
Negative affect	.08	[−.08, .24]	0.38	(0.40)	.342
Perceived stress	.10	[−.06, .26]	0.41	(0.34)	.231
Depression	−.05	[−.11, .21]	0.37	(0.60)	.539
Anxiety	.06	[−.10, .23]	0.31	(0.42)	.462
Life satisfaction	−.02	[−.18, .14]	−0.20	(0.88)	.820

$p = .008$ ) and depressive symptoms ( $\gamma_{10} = -0.53$ ,  $SE = 0.26$ ,  $\beta = -0.07$ , 95% CI = [−.13, −.00],  $p = .040$ ) as compared to the daily events condition. In contrast, there was no significant relationship between the gratitude intervention and levels of daily positive affect ( $\gamma_{10} = 0.11$ ,  $SE = 0.16$ ,  $\beta = .02$ , 95% CI = [−.04, .08],  $p = .501$ ), and life satisfaction ( $\gamma_{10} = 0.17$ ,  $SE = 0.30$ ,  $\beta = .02$ , 95% CI = [−.04, .08],  $p = .579$ ).

### Exploratory analysis

The effect of the gratitude intervention on perceived social support and coping behaviors were also analyzed. Participants were found to have experienced significantly higher levels of daily perceived social support during the gratitude intervention ( $\gamma_{10} = 0.38$ ,  $SE = 0.11$ ,  $\beta = .10$ , 95% CI = [.04, .16],  $p < .001$ ) as compared to the daily events condition. This suggests that eliciting feelings of gratitude did increase feelings of daily perceived social support amongst the participants.

We also aimed to explore the effects of the gratitude intervention on participants' usage of daily coping strategies. We found that participants were significantly less likely to utilize the maladaptive coping strategies of regret ( $\gamma_{10} = -0.10$ ,  $SE = 0.05$ ,  $\beta = -0.06$ , 95% CI = [−.12, .00],

$p = .038$ ) following the gratitude intervention, as compared to the daily events condition. However, there was no significant relationship between the gratitude intervention and the utilization of coping strategies that involve being with other people ( $\gamma_{10} = 0.09$ ,  $SE = 0.06$ ,  $\beta = .05$ , 95% CI = [−.02, .11],  $p = .140$ ), focusing on physical symptoms ( $\gamma_{10} = -0.06$ ,  $SE = 0.05$ ,  $\beta = -0.04$ , 95% CI = [−.10, .02],  $p = .208$ ), denial ( $\gamma_{10} = 0.02$ ,  $SE = 0.04$ ,  $\beta = .02$ , 95% CI = [−.05, .08],  $p = .645$ ), becoming too anxious to cope ( $\gamma_{10} = -0.09$ ,  $SE = 0.05$ ,  $\beta = -0.05$ , 95% CI = [−.11, .01],  $p = .913$ ), thinking about better times ( $\gamma_{10} = -0.01$ ,  $SE = 0.06$ ,  $\beta = -0.06$ , 95% CI = [−.07, .07],  $p = .907$ ), and taking a different perspective ( $\gamma_{10} = 0.05$ ,  $SE = 0.05$ ,  $\beta = .03$ , 95% CI = [−.03, .10],  $p = .286$ ). Table 4 summarizes the results for these fixed effects.

### Exploratory Moderation Analyses

As a moderation analysis, the moderating role of trait gratitude, trait positive affect, trait negative affect, and the big five personality traits on the relationship between the gratitude intervention and various well-being outcomes was examined. Results from the moderation analyses were mostly non-significant and hence generally consistent across the different levels of

**Table 4.** Fixed effects on well-being, social, and coping outcomes.

Outcome	Gratitude Intervention (vs. Daily Events Condition)				
	$\beta$	95% CI	$\gamma_{10}$	(SE)	$p$
<b>Manipulation check</b>					
Gratitude (GQ-6)	.11	[.05, .17]	0.93	(0.25)	<.001
Gratitude (GAC)	.17	[.11, .23]	0.75	(0.13)	<.001
Indebtedness	.04	[−.02, .11]	0.14	(0.11)	.206
<b>Well-being</b>					
Positive affect	.02	[−.04, .08]	0.11	(0.16)	.501
Negative affect	−.07	[−.13, −.01]	−0.38	(0.17)	.027
Perceived stress	−.06	[−.12, .00]	−0.30	(0.16)	.058
Depression	−.07	[−.13, .00]	−0.53	(0.26)	.040
Anxiety	−.08	[−.14, −.02]	−0.46	(0.17)	.008
Life satisfaction	.02	[−.04, .08]	0.17	(0.30)	.579
Perceived social support	.10	[.04, .16]	0.38	(0.11)	<.001
<b>Coping behaviour</b>					
Being with other people	.05	[−.02, .11]	0.09	(0.06)	.140
Focus on physical symptoms	−.04	[−.10, .02]	−0.06	(0.05)	.208
Denial	.02	[−.05, .08]	0.02	(0.04)	.645
Anxious could not cope	−.05	[−.11, .01]	−0.09	(0.05)	.913
Think about better times	−.06	[−.07, .07]	−0.01	(0.06)	.907
Regret what happened	−.06	[−.12, .00]	−0.10	(0.05)	.038
Different perspective	.03	[−.03, .10]	0.05	(0.05)	.286

Note.  $N_{\text{participants}} = 163$ ,  $N_{\text{observations}} = 1560$ .  $\beta$  = effect size or standardized slope coefficient. 95% CI = 95% confidence interval of  $\beta$ .  $\gamma_{10}$  = unstandardized slope coefficient of gratitude condition. SE = standard error of  $\gamma_{10}$ .

**Table 5.** Cross-level interactions between trait moderators and well-being outcomes.

Moderators	Daily Positive Affect			Daily Negative Affect			Daily Perceived Stress			Daily Depression			Daily Anxiety			Daily Life Satisfaction		
	$\gamma_{11}$	(SE)	<i>p</i>	$\gamma_{11}$	(SE)	<i>p</i>	$\gamma_{11}$	(SE)	<i>p</i>	$\gamma_{11}$	(SE)	<i>p</i>	$\gamma_{11}$	(SE)	<i>p</i>	$\gamma_{11}$	(SE)	<i>p</i>
Trait Gratitude (GQ6)	−0.03	(0.03)	.426	−0.03	(0.03)	.305	−0.02	(0.03)	.634	−0.09	(0.05)	.094	−0.02	(0.03)	.559	0.11	(0.06)	.048
Trait Gratitude (GAC)	0.01	(0.07)	.841	−0.02	(0.07)	.781	−0.04	(0.07)	.523	−0.01	(0.11)	.926	−0.02	(0.08)	.744	0.20	(0.13)	.120
Trait PA	−0.08	(0.04)	.057	0.00	(0.04)	.921	0.01	(0.04)	.789	0.07	(0.07)	.292	0.01	(0.04)	.769	−0.05	(0.08)	.519
Trait NA	−0.02	(0.04)	.574	−0.02	(0.04)	.641	0.00	(0.04)	.988	0.08	(0.06)	.188	0.06	(0.04)	.123	−0.07	(0.07)	.282
Trait Extraversion	−0.03	(0.03)	.341	0.02	(0.03)	.488	−0.01	(0.03)	.715	0.03	(0.05)	.493	0.03	(0.03)	.454	−0.07	(0.06)	.243
Trait Agreeableness	0.03	(0.04)	.451	−0.04	(0.04)	.221	−0.05	(0.04)	.224	−0.07	(0.06)	.283	−0.02	(0.04)	.642	0.10	(0.07)	.133
Trait Conscientiousness	0.04	(0.04)	.222	0.01	(0.04)	.673	0.00	(0.04)	.983	−0.04	(0.06)	.505	−0.01	(0.03)	.850	0.00	(0.07)	.956
Trait Neuroticism	0.01	(0.03)	.829	0.00	(0.03)	.944	0.01	(0.03)	.806	0.01	(0.05)	.899	0.02	(0.03)	.490	−0.06	(0.06)	.257
Trait Openness	−0.09	(0.04)	.013	0.06	(0.04)	.150	0.02	(0.04)	.675	0.12	(0.06)	.043	0.03	(0.04)	.381	−0.06	(0.07)	.339

Note.  $N_{\text{participants}} = 163$ ,  $N_{\text{observations}} = 1560$ .  $\gamma_{11}$  = unstandardized slope coefficient of moderators. SE = standard error of  $\gamma_{11}$ .

moderators. This suggests that the moderators did not have a significant role in influencing the relationship between the gratitude intervention and various well-being outcomes. Table 5 summarizes these results.

### Exploratory mediation analyses

Lastly, given that we found significant effect of gratitude intervention on daily perceived social support ( $\gamma_{10} = 0.38$ ,  $SE = 0.11$ ,  $\beta = .10$ , 95% CI = [.04, .16],  $p < .001$ ) and utilization of regret as a coping strategy ( $\gamma_{10} = -0.10$ ,  $SE = 0.05$ ,  $\beta = -.06$ , 95% CI = [−.12, .00],  $p = .038$ ) in our exploratory analyses, we continued our exploratory mediation analyses and examined whether daily perceived social support and utilization of regret as a coping strategy mediated the relationship between the gratitude intervention and well-being outcomes. Neither daily perceived social support nor utilizing regret as a coping strategy mediated the relationship between the gratitude intervention and well-being outcomes (see Table 6), indicating that the effect of the gratitude intervention on well-being outcomes took place independently from the effect of the gratitude

intervention on daily perceived social support and utilization of regret as a coping strategy.

### Discussion

Although there is a strong theoretical basis for gratitude to improve well-being, research findings in the effect of gratitude interventions on well-being outcomes have been mixed. Therefore, to revisit and critically examine the effect of gratitude intervention on multiple well-being outcomes, we improved upon past gratitude intervention studies by conducting a within-person experimental design with a daily diary approach. Below, several important findings and their implications are discussed.

First, consistent with our hypothesis, we found that the gratitude contemplation intervention had a significant within-person effect on multiple well-being outcomes including daily negative affect, perceived stress, anxiety, and depressive symptoms. Specifically, when participants were told to practice gratitude contemplation, they experienced less negative affect, perceived stress, anxiety, and depressive symptoms as compared to when they were told to describe their daily events. This is in line with some existing studies that show evidence of gratitude interventions reducing negatively-valenced indicators of well-being such as anxiety, stress, and depressive symptoms (Cheng et al., 2015; Cunha et al., 2019; Killen & Macaskill, 2015). The significant findings on multiple well-being outcomes support the robustness of our results regarding the effectiveness of gratitude contemplation intervention on well-being in general. Although the previous studies did not find consistent effect of gratitude intervention, it is possible that the use of the within-person daily diary approach with a relatively large sample size and multilevel modeling allowed the current study to achieve relatively higher statistical power to detect the effect of the gratitude intervention on well-being outcomes. Additionally, similar to estimates from

**Table 6.** Results of multilevel mediation analysis.

Outcome	Indirect Effect	95% CI
<b>Mediator: Daily Perceived Social Support</b>		
Positive affect	−.0029	[−.0344, .0287]
Negative affect	.0022	[−.0247, .0292]
Perceived stress	.0043	[−.0446, .0532]
Depression	.0040	[−.0436, .0517]
Anxiety	.0050	[−.0525, .0626]
Life satisfaction	−.0052	[−.0644, .0541]
<b>Mediator: Using Regret as Coping Strategy</b>		
Positive affect	−.0003	[−.0065, .0059]
Negative affect	.0016	[−.0306, .0338]
Perceived stress	.0018	[−.0366, .0402]
Depression	.0019	[−.0376, .0414]
Anxiety	.0015	[−.0280, .0310]
Life satisfaction	−.0013	[−.0271, .0245]

Note. Values refer to the standardized indirect effect of the gratitude intervention onto each well-being outcome through the mediator.

recent meta-analyses on gratitude intervention (Cregg & Cheavens, 2020; Davis et al., 2016), we also found that the effect size of the gratitude intervention on well-being outcomes was mostly small. Nevertheless, as the gratitude contemplation intervention is convenient, easily administered, and effectively free, which indicates a low barrier to entry, the significant within-person and cumulative effect of gratitude contemplation intervention on well-being may still be a worthwhile consideration despite its effect size and the intervention may have strong practical uses.

Nonetheless, contradictory to our hypothesis, we did not find any within-person effect of gratitude intervention on positively-valenced indicators of well-being, such as positive affect and life satisfaction. In other words, our participants did not experience any significant increase in positive affect and life satisfaction when they were told to practice gratitude contemplation as compared to when they were told to write about their daily events. Two possible explanations may account for the lack of effect on positively-valenced indicators of well-being. First, given that positive and negative affect are not bipolar opposites of each another (Diener & Emmons, 1984), it is plausible that gratitude intervention might be more effective in alleviating negatively-valenced indicators of well-being than improving positively-valenced indicators of well-being. This is consistent with several recent studies that have shown negative affect to be more responsive to positive interventions or dispositions than is positive affect (Chan, 2013; Hill et al., 2018; Majeed et al., 2021). Due to negativity bias (Baumeister et al., 2001), we speculate that negatively-valenced indicators of well-being could be more salient and malleable in response to external factors such as gratitude intervention. Thus, a longer termed intervention might be required for any gratitude intervention to elicit similar significant improvements in positive affect and life satisfaction (Sin & Lyubomirsky, 2009). Second, cultural context may also contribute to the lack of within-person effect of gratitude intervention on positive affect and life satisfaction. Most of the previous studies on the effects of gratitude interventions on positive affect and life satisfaction have mostly focused on a Western sample. This is problematic because studies have shown cross-cultural differences between individuals in individualistic and collectivist cultures in their expression and experience of positive affect. For instance, a common measure of life satisfaction – the Satisfaction with Life Scale – was shown to be not validated in Chinese participants as they viewed it as promoting self-enhancement, which frowned upon in collectivist culture (Oishi, 2006). Similarly, individuals from collectivist cultures tend to report lower positive

affect but not negative affect as compared to individuals from individualistic cultures (Milbury et al., 2017). Taken together, it is possible that the gratitude contemplation intervention may not benefit positive affect and life satisfaction in collectivist cultures as it is viewed as promoting self-enhancement. This could explain why a study with a Japanese sample by Otsuka et al. (2012) did not find any effect of gratitude intervention on well-being when well-being was measured by positively-valenced indicators such as positive affect, subjective happiness, and life satisfaction. Alternatively, it is also plausible that the effect of gratitude intervention on positively-valenced indicators of well-being is specific to self-transcendent positive emotions such as awe, admiration, and elevation (Stellar et al., 2017; Yaden et al., 2017). Given the lack of measures related to self-transcendent positive emotions in the current study, it will be important for future studies to consider self-transcendent positive emotion as another outcome of gratitude intervention

Interestingly – and positively – the current study found that our gratitude contemplation intervention increased feeling of gratefulness but not indebtedness. The result is inconsistent with several past works that have shown evidence that gratitude interventions elicit feelings of indebtedness, especially in collectivist cultures (Layous et al., 2017; Shin et al., 2020). The lack of indebtedness observed might be unique to the use of gratitude contemplation intervention in the current study, which requires individuals not only to list the things that they are grateful for, but to also contemplate and provide reasons as to *why* they are grateful for them (Locklear et al., 2021). Given that most of the previous works studying the relation between gratitude and indebtedness have relied on either behaviorally-expressed gratitude or on purely recalling grateful experience without further contemplation (e.g., Layous et al., 2017; Oishi et al., 2019; Shin et al., 2020), the reasoning and elaboration of grateful experiences in the current gratitude contemplation intervention may help individuals to process the grateful experiences without inducing a sense of indebtedness.

Our exploratory analyses revealed several interesting preliminary findings. Firstly, we found that the gratitude intervention may not only improve well-being but also increase perceived social support and reduce the experience of regret. These findings suggest that the effect of the gratitude intervention can be extended beyond well-being outcomes. However, perceived social support and the experience of regret did not mediate the effect of gratitude on well-being indicators, suggesting that the two constructs were unlikely to be involved in the mechanisms underlying the

significant within-person effect of gratitude on daily negative affect, perceived stress, anxiety, and depressive symptoms found in the current study. Secondly, we did not find a robust moderator in any of our exploratory moderation analyses. These findings suggest that the effect of the gratitude intervention on well-being outcomes was consistent across varying levels of personality traits such as trait gratitude, positive affect, negative affect, and the big five personalities (i.e., extraversion, agreeableness, conscientiousness, neuroticism, and openness). The lack of significant moderator may imply that our gratitude contemplation intervention is easily generalizable across individuals regardless of their individual differences. This serves to further strengthen the benefits of gratitude interventions as exercises that can be easily implemented across various populations.

Despite the promising results of the gratitude intervention, several limitations of the current study are noteworthy. One limitation is related to the lack of a follow-up measure to test the long-term effect of the gratitude intervention. It is plausible that the benefits observed in the current study might be temporary and cease when the gratitude contemplation exercise is discontinued. Future studies should consider collecting follow-up measures to examine the long-term effect of such gratitude interventions. Moreover, given that the current study was conducted with a sample of generally healthy young adults, the generalizability of the findings across age groups might be limited. Further research should aim to conduct a study similar in nature in other populations such as older adults and those with clinical disorders to ascertain the generalizability of the current findings. Furthermore, given the use of within-subject experimental design with a large sample size, the procedure of the current study may not only increase statistical power but may also increase the possibility of Type 1 errors. Thus, caution should be exercised in evaluating the findings of the current study. Moreover, our exploratory mediation analyses used a cross-sectional analytic design which is inconsistent with the assumption of temporal sequencing in a mediation process and often leads to misleading and biased estimates than more appropriate longitudinal models (O’Laughlin et al., 2018). Thus, caution should also be exercised in interpreting the exploratory cross-sectional mediation models. Lastly, it is plausible that the non-significant mediations found in our exploratory mediation analyses could be driven by the relatively short duration of our gratitude intervention. As a result, the intervention may not have sufficient time to allow changes in the coping strategies to start improving well-being. Therefore, future experimental studies should consider to incorporate a longer gratitude intervention to examine the mediating factors.

In conclusion, the current study aimed to test gratitude contemplation as a promising intervention to promote well-being. We provide another line of evidence to the literature supporting the benefits of a gratitude intervention on multiple negatively-valenced well-being outcomes such as daily negative affect, perceived stress, anxiety, and depressive symptoms. Due to the low cost, easy administration, and convenience of such a gratitude contemplation exercise, the gratitude intervention may have significant clinical implications for practitioners and the general public.

## Disclosure statement

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## Data availability statement

The data described in this article are publicly available on ResearchBox (#737; <https://researchbox.org/737>).

## Open scholarship



This article has earned the Center for Open Science badges for Open Data and Open Materials through Open Practices Disclosure. The data and materials are openly accessible at <https://researchbox.org/737>.

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