

Better emotion regulation mediates gratitude and increased stress in undergraduate students across a university semester

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Abstract

It is well established that university students are vulnerable to poor mental health. Although increased gratitude has been shown to reduce stress among students, a clearer understanding of key mechanisms underpinning this relationship are needed to better inform theoretical models and potential interventions targeted at improving well-being in university students. The present study provides the first direct test of whether capacity for emotion regulation mediates the relationship of gratitude with stress at the beginning and middle of the academic semester. This study is also the first to assess this relationship in a cross-lagged panel mediation model. We used a repeated measures design and a total of 343 undergraduate students completed two online surveys with validated measures of gratitude, stress, and emotion regulation—one at the beginning and the second in the middle of the academic semester. Results showed that emotion regulation mediated the relationship between gratitude and stress at the beginning of semester, and again 6 weeks later. A Clogg's z-score test suggested that the strength of the indirect effect significantly increased across the two time points. A post-hoc cross-lagged panel model found that high gratitude at the beginning of the semester predicted low stress in the middle of the semester via emotion regulation. These data provide novel evidence that emotion regulation may serve as a key protective factor against undergraduate stress. The results provide evidence to support leading theories on how gratitude can reduce stress and promote well-being in university students. They also highlight the practical importance of strengthening emotion regulation abilities in university students and can be used to inform future targeted interventions to improve well-being in university students.

KEYWORDS

emotion regulation, gratitude, mediation, stress, university students

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1 | INTRODUCTION

University students are negatively impacted by poor mental health outcomes. An international study of 14,000 undergraduate students found that one in three reported at least one mental health disorder (Auerbach et al., 2018). Indeed, studies have shown that university students can be at a higher risk for increased stress, aggression, depression, and anxiety (Banu et al., 2015; Bewick et al., 2010; Cooke et al., 2006; Stallman, 2010). Heightened stress (the perception that environmental demands exceed one's perceived resource capacity) can also negatively impact cognitive functioning, behavior, and mental and physical well-being (Boals & Banks, 2012; Lupien et al., 2009). University students typically demonstrate elevated levels of stress compared to non-students (Banu et al., 2015; Bewick et al., 2010; Thawabieh & Qaisy, 2012), which is further heightened during peak assessment times (Spivey et al., 2020). Indeed, a sample of Australian university students reported significantly higher levels of psychological distress than the general population (Stallman, 2010). Furthermore, an exploratory study of students' weekly stress levels and sources of stress throughout the semester found that the start and end of the academic semester constituted the riskiest periods for negative stress-related consequences (Pitt et al., 2018) and that some of the major sources of stress included academic, financial/work, and university/life balance. Increases in undergraduate stress levels throughout the academic semester have also been echoed in other studies (e.g., Baghurst & Kelley, 2014; Rafidah et al., 2009). Gaining a comprehensive understanding of factors that protect against university stress is crucial to informing current theoretical models of the relationship and interventions targeted at stress reduction. One possible factor in stress reduction is gratitude.

Gratitude refers to a general state or moment of appreciation for a benefit one has or will receive due to external factors (Eamons & McCullough, 2003). Numerous studies have now been conducted demonstrating the positive effects of gratitude on well-being in university students. For instance, experiencing gratitude has been found to improve student well-being and protect mental health factors such as self-esteem and social support (Kong et al., 2015; Mason, 2019). A recent study also found that gratitude interventions improved the well-being of university students during the COVID-19 pandemic (Geier & Morris, 2022). Similarly, both gratitude and resilience have been found to be necessary conditions to promote vitality (high energy, stamina, physical and mental vigour) in students (Garg & Sarkar, 2020). It is clear that gratitude plays a key role in university student well-being, but what is less clear are the potential mechanisms of this relationship.

One avenue through which gratitude may promote well-being is through facilitating emotion regulation – the ability to alter the experience of emotions to act in accordance with desired goals (Melnick & Hinshaw, 2000). A commonly used framework for understanding emotion regulation is the *Process Model of Emotion Regulation*. According to this framework, an emotion can be regulated at multiple points throughout its' generation (Gross, 2015). For example, one point where an emotion can be regulated is through

cognitive change whereby an individual alters the emotional impact of a situation by altering their appraisal of it. For example, when facing a challenging work task, an individual may alter their cognitions from viewing the task as a potential failure to an opportunity to learn and improve. Similarly, *response modulation* reflects when an individual directly influences the experiential, behavioural, or physiological components of the emotional response after it has developed (Gross, 2015). For example, after receiving upsetting news, an individual may consciously take deep, calming breaths to manage their immediate emotional reaction. Such strategies can be implemented to regulate an emotion, both before its conception and after the emotion has occurred (Gross, 2015). For example, by selecting or modifying situations that will increase the likelihood of experiencing desirable emotions, or by adjusting one's appraisal of a situation to alter the impact of an emotion (Gross, 2015).

The effective use of emotion regulation might help to facilitate the positive effects of gratitude on stress. This likely occurs via gratitude facilitating cognitive change – an aspect of emotion regulation whereby an individual modifies their appraisal of a situation to alter its emotional impact (Gross, 2015). For instance, engaging in gratitude can lead to a positive shift in cognition or a change in the appraisal of a situation whereby an individual will be more likely to have a less stressful interpretation of an event (Alkozei et al., 2018). Indeed, research shows that higher levels of dispositional gratitude encourage more positive reframing and effective coping strategies in university students (Lambert et al., 2009, 2012), and the use of emotion reappraisal strategies (Boggio et al., 2020). It is important to consider that the relationship between gratitude and emotion regulation could be bidirectional. For instance, a recent study found that gratitude mediated the relationship between emotion regulation strategies and sense of life meaning (Lin, 2022). However, another recent article found that in a group of employees, when employees regulated their own emotions, gratitude did not moderate the relationship between emotion regulation strategies and burnout (Guan & Jepsen, 2020). It is possible that emotion regulation may provide a mechanism through which gratitude is able to reduce university stress and improve well-being throughout different periods of the academic semester, however no study to date has investigated this. Understanding this relationship in more detail would be important in informing intervention development and practice in university students.

Multiple models lend support to the proposal that gratitude promotes well-being via emotion regulation. *The Broaden and Build Theory* suggests that experiences of positive emotions broaden an individual's thought-action repertoire, which can subsequently build their enduring personal resources, such as physical, intellectual, social, and psychological resources (Fredrickson, 1998). Gratitude could improve well-being, and decrease stress, by broadening an individuals' thought-action repertoire through the increase of positive emotions, which subsequently cultivates their personal and coping resources to elicit cognitive change (Fredrickson, 1998). Specifically, practicing gratitude can promote positive emotions and allow for the reframing of one's appraisal of a situation—allowing the broadening of a person's attention and cognitive abilities (e.g., Armenta

et al., 2017; Kashdan et al., 2006). The expanded cognitive resources and increased flexibility associated with the positive emotions gained from gratitude enable individuals to regulate their emotions more skilfully and promote strategies to modulate and manage their emotional responses to stressors (e.g. cognitive reappraisal, mindfulness techniques, etc.). This theory aligns well with the Process Model of Emotion Regulation which also suggests that gratitude could promote emotion regulation via eliciting cognitive change. Therefore, by cultivating positive emotions through gratitude, it is possible that individuals are better equipped to regulate their emotions and cope with the increasingly high stressors of university, ultimately promoting their well-being. Importantly, to date no study has investigated whether emotion regulation underpins the relationship between gratitude and stress in university students.

The key focus of the current study is to address this gap and determine if gratitude can promote personal resources—specifically emotion regulation—which could then reduce stress in university students. This will create a better theoretical understanding of how gratitude promotes well-being. Furthermore, as university students remain at an increased risk of stress compared to non-university students (Banu et al., 2015; Bewick et al., 2010), identifying key mediators that students can leverage to help reduce their stress is important in informing well-being interventions for university students.

1.1 | The present study

We aimed to explore the associations between gratitude, emotion regulation capacities, and stress in university students, and determine if these relationships replicate at two time points across the semester that have different levels of academic demands (the beginning and middle of the academic semester). Secondly, we aimed to understand if emotion regulation capacities mediated the relationship of gratitude with stress and to explore whether the strength of this mediation changed across different time points of a university semester. Finally, a post hoc aim of this study was to determine if gratitude levels at the beginning of the semester would predict stress in the middle of the semester, and if this relationship would be mediated by emotion regulation ability. Firstly, we predicted that higher levels of gratitude would be associated with better emotion regulation, and lower stress at both time points. Secondly, we predicted that the relationship of gratitude with stress would be mediated by emotion regulation and that this effect would be replicated at the second time point.¹

2 | METHOD

2.1 | Participants and recruitment

For the pre-registered analyses (see data availability statement), an a priori power calculation (using G*Power; Faul et al., 2009) determined

a minimum of 215 participants were required to have sufficient power ($1-\beta > 80\%$, $\alpha = 0.05$) to detect a small effect size. Participants were recruited via an online platform where undergraduate students participate in research studies for course credit. All participants were required to have high levels of English proficiency and no current or recent (within the past 6 months) diagnoses of serious psychiatric illness (e.g., bipolar disorder, schizophrenia) or neurological disorders. A total of 343 participants were recruited at Time 1, and 223 of these individuals completed the survey again at Time 2². Three participants were excluded from Time 2 as their participant ID did not match any Time 1 data. This left a total of 343 participants at Time 1 ($M_{\text{age}} = 20.47$, $SD = 5.45$, range = 16–50) and 220 participants at Time 2 (see Table 1 for demographic characteristics).

2.2 | Procedure

Between February 2022 to 2 August 2022³ participants were invited to follow a link to an online Qualtrics survey. Participants provided consent prior to beginning the survey. The survey was completed within the first 6 weeks of semester (Time 1), and then 6 weeks after Time 1 (Time 2). The survey took approximately 30 min to complete. Ethical approval was provided by the Human Research Ethics Committee at the University of Queensland (Project number: HE000127).

TABLE 1 Participant gender and ethnicity at Time 1 and Time 2.

	Time 1		Time 2	
	N	%	N	%
Gender N(%)				
Cisgender male	66	19.24	31	14.16
Cisgender female	267	77.84	178	81.28
Transgender male	0	0	0	0
Transgender female	3	0.87	2	0.91
Non-binary	3	0.87	6	2.74
Unspecified	4	1.17	2	0.91
Ethnicity N(%)				
Caucasian	208	60.64	139	62.90
Asian	102	29.74	61	27.60
Multicultural	16	4.66	8	3.62
Middle Eastern	5	1.46	5	2.26
Latinx	1	0.29	1	0.45
African	1	0.29	1	0.45
Indigenous Australian/Torres Strait Islander	4	1.17	2	0.90
Pacific Islander	2	0.58	2	0.90
Other	4	1.17	1	0.45

2.3 | Key measures

2.3.1 | Gratitude

The Gratitude Questionnaire-Six Item Form (GQ-6; McCullough et al., 2001) was used to index levels of gratitude. Across six items, participants rated how much they agreed with each statement from 1 (strongly disagree) to 7 (strongly agree). For example, participants rated their agreement with the following item “*I have so much in life to be thankful for*”. Scores were then averaged to provide an overall estimate of gratitude, whereby higher scores indicated higher levels of gratitude. This measure has been validated in university samples (Garg & Katiyar, 2021; McCullough et al., 2002). The internal reliability consistency, assessed via McDonald's omega was: $\omega = 0.90$, 95% CI [0.89, 0.94]. A confirmatory factor analysis of time 1 data suggests a good model fit ($\chi^2 = 23.662$, $df = 8$, $p = 0.003$), Comparative Fit Index = 0.98, Root Mean Square Error of Approximation = 0.08.

2.3.2 | Emotion regulation

To index emotion regulation, we used the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004). This measure contains 36 statements of behaviour or cognition that assess six aspects of emotion regulation: (1) nonacceptance of emotional responses, (2) engaging in goal-directed behaviours, (3) impulse control, (4) emotional awareness, (5) access to emotion regulation strategies, and (6) emotional clarity. Participants rated the extent to which each statement was true for them on a scale from 1 (almost never) to 5 (almost always). An example item from this scale is: “*I am clear about my feelings*”. Scores were totalled for a global score, whereby higher scores indicated poorer emotion regulation. This measure has been extensively validated (Ritschel et al., 2015). The internal reliability consistency, assessed via McDonald's omega for each subscale was: Nonacceptance, $\omega = 0.93$, 95% CI [0.92, 0.97]; Goals, $\omega = 0.89$, 95% CI [0.88, 0.91]; Impulse, $\omega = 0.93$, 95% CI [0.89, 0.96]; Awareness, $\omega = 0.89$, 95% CI [0.86, 0.92]; Strategies, $\omega = 0.93$, 95% CI [0.89, 0.94]; Clarity, $\omega = 0.88$, 95% CI [0.87, 0.91]. A confirmatory factor analysis of time 1 data suggests a good model fit ($\chi^2 = 1768.935$, $df = 545$, $p < 0.001$), Comparative Fit Index = 0.98, Root Mean Square Error of Approximation = 0.08.

2.3.3 | Stress and general affect

The Depression, Anxiety, Stress Scale-21 (DASS-21; Henry & Crawford, 2005) is a validated measure of negative emotions. It is a 21-item scale with three subscales (each containing seven items) measuring perceived depression, anxiety, and stress (e.g., “*I couldn't seem to experience any positive feelings at all*”). Participants rated agreement with each item on a scale from 0 to 3. Scores were totalled within each subscale, whereby higher scores indicated higher stress, anxiety, and depression. The internal reliability consistency, assessed

via McDonald's omega for each subscale was: Stress, $\omega = 0.88$, 95% CI [0.87, 0.91]; Anxiety, $\omega = 0.88$, 95% CI [0.83, 0.90]; Depression, $\omega = 0.93$, 95% CI [0.927, 0.97]. A confirmatory factor analysis of time 1 data suggests a good model fit ($\chi^2 = 230.106$, $df = 132$, $p < 0.001$), Comparative Fit Index = 0.99, Root Mean Square Error of Approximation = 0.05.

2.4 | Analyses

Missing data were assessed using Little's MCAR test and these results are reported in the Supplementary Document. Scatterplots visually representing the reported correlations and distribution graphs can be viewed in the Supplementary File. Background and demographic analyses were conducted in JASP version 0.16.3.0. All remaining analyses were conducted in R version 4.1.0. We conducted Pearson correlations between gratitude, emotion regulation, stress, and aggression for each time point. Four separate mediation analyses were performed using the PROCESS Macro (Hayes, 2017), where at Time 1 and 2, gratitude was the independent variable, difficulties in emotion regulation was the mediator variable, and stress was the dependent variable. The final estimate of the indirect effect was represented by the mean indirect effect computed across 5000 nonparametric bootstrap samples. To assess differences in the magnitude of the indirect effects between Time 1 and Time 2, we applied Clogg's z-score tests using the standardised beta coefficient and standard error for the indirect effect at Time 1 and Time 2 (Clogg et al., 1995).

2.4.1 | Post hoc analyses

To investigate the potential causal influence of gratitude on emotion regulation and stress a cross-lagged panel mediation model was conducted. First, autoregressive (e.g., Time 2 emotion regulation ~ T1 emotion regulation) and cross-lagged regressions (e.g., Time 2 emotion regulation on Time 2 gratitude and emotion regulation) were conducted on the Time 1 and Time 2 variables. Next a mediation analysis was performed using the PROCESS Macro (Hayes, 2017), where gratitude at Time 1 was the independent variable, emotion regulation at Time 2 was the mediator variable, and stress at Time 2 was the dependent variable. The final estimate of the indirect effect was represented by the mean indirect effect computed across 5000 nonparametric bootstrap samples.

3 | RESULTS

3.1 | Relationships between variables

At Time 1 and 2, higher gratitude scores were significantly associated with greater emotion regulation capacity and lower stress. Poorer emotion regulation was associated with higher levels of stress (see

Table 3). Paired samples *t*-tests were conducted comparing Time 1 and Time 2 data on participants' mental health, gratitude, and DASS-21 scores. There were no significant differences between Time 1 and Time 2 on any outcome, including levels of stress (see Table 2).

3.2 | Mediations at Time 1 and Time 2

Results at both Time 1 and Time 2 suggest that emotion regulation ability mediated the relationship between gratitude and stress (see Figures 1 and 2). At both time points, higher gratitude predicted better emotion regulation, which predicted decreased stress (see Table 3). The direct effects at both time points were non-significant. The indirect effects (with percentile bootstrapping) at both time points were significant, suggesting that higher gratitude predicted decreased stress via emotion regulation capacity (see Table 4). At Time 1, approximately 36% of the variance in perceived stress was accounted for by gratitude and emotion regulation ($R^2 = 0.36$, $F(2, 333) = 95.06$, $p < 0.001$). At Time 2, approximately 50% of the variance in perceived stress was accounted for by gratitude and emotion regulation ($R^2 = 0.50$, $F(2, 215) = 95.06$, $p < 0.001$). The comparison of the indirect effects across Time 1 and Time 2 were significant, suggesting that the indirect effect at Time 2 was stronger than the indirect effect at Time 1 ($z = -2.635$, $p = 0.008$). Given the multiple comparisons conducted and the addition of a subsequent post hoc mediation model, a Bonferroni correction was applied to control for Type I error. The Bonferroni correction was applied by dividing the pre-registered alpha level of 0.05 by the three comparisons, resulting in an adjusted alpha level of 0.0167 for each mediation test. Using the Bonferroni-adjusted alpha level, the cross-sectional mediation relationships identified at Time 1 and Time 2 remain statistically significant.

3.2.1 | Post hoc analyses

Autoregressive model

An autoregressive model was conducted to examine the stability of the emotion regulation and stress across Time 1 and 2. The

regression analysis revealed better emotion regulation at time 1 was significantly associated with better emotion regulation at Time 2 ($\beta = 0.778$, $SE = 0.040$, 95% CI [0.700, 0.856]). Similarly, higher levels of stress at time 1 were significantly associated with higher levels of stress at time 2 ($\beta = 0.658$, $SE = 0.047$, 95% CI [0.566, 0.750]).

Cross-lagged model

A cross-lagged model was conducted to investigate the reciprocal relationships between gratitude, emotion regulation, and stress across time. The analysis revealed higher levels of gratitude at Time 1 were significantly associated with better emotion regulation at Time 2 ($\beta = -4.984$, $SE = 1.066$, 95% CI [-7.079, -2.889]). Additionally, better emotion regulation at Time 2 was significantly associated with better emotion regulation and gratitude at Time 1 ($\beta = 0.717$, $SE = 0.040$, 95% CI [0.639, 0.795]). Finally, gratitude at Time 1 was not associated with stress at Time 2 ($\beta = -0.347$, $SE = 0.234$, 95% CI [-0.805, 0.111]), but higher stress at Time 1 was significantly associated with increased stress at Time 2 ($\beta = 0.639$, $SE = 0.048$, 95% CI [0.544, 0.734]).

Cross lagged mediation model

This model assessed emotion regulation at Time 2 as mediator between gratitude at Time 1 and stress at Time 2. Results suggest that

TABLE 3 Pearson correlations between key variables across Time 1 and Time 2.

Variable	1.	2.	3.	4.	5.
1. T1_DERS	—				
2. T1_GQ	-0.376***	—			
3. T1_DASS_S	0.603***	-0.241***	—		
4. T2_DERS	0.801***	-0.414***	0.603***	—	
5. T2_GQ	-0.369***	0.763***	-0.270***	-0.502***	—
6. T2_DASS_S	0.567***	-0.204**	0.703***	0.705***	-0.325

Abbreviations: DASS_S, Depression, Anxiety, Stress Scale - Stress Subscale; DERS, Difficulties in Emotion Regulation Scale; GQ, Gratitude Questionnaire; T1, Time 1; T2, Time 2.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

TABLE 2 Means, standard deviations, and independent samples *t*-tests for key participant background variables at Time 1 and Time 2.

	Time 1		Time 2		<i>t</i>	<i>p</i>	<i>d</i>	LCI	UCI
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>					
DASS_S	7.05	4.27	7.41	4.37	-0.514	0.608	0.035	-0.17	0.10
DASS_A	5.18	4.18	5.23	4.28	-0.276	0.783	0.019	-0.15	0.11
DASS_D	5.64	4.73	5.81	5.04	-0.74	0.458	0.050	-0.18	0.08
Gratitude	5.71	0.99	5.76	0.91	1.198	0.232	0.081	-0.05	0.21
MHC-SF	41.67	12.99	43.07	13.87	-1.511	0.132	0.102	-0.24	0.03

Abbreviations: DASS_S/A/D, Depression, Anxiety, Stress scale - stress, anxiety, and depression subscale; DERS, Difficulties in Emotion Regulation Scale; GQ6, Gratitude 6 questionnaire; L/UCI, Lower and Upper 95% confidence intervals; MHC-SF, Mental Health Continuum-Short Form; T1, Time 1 sample; T2, Time 2 sample.

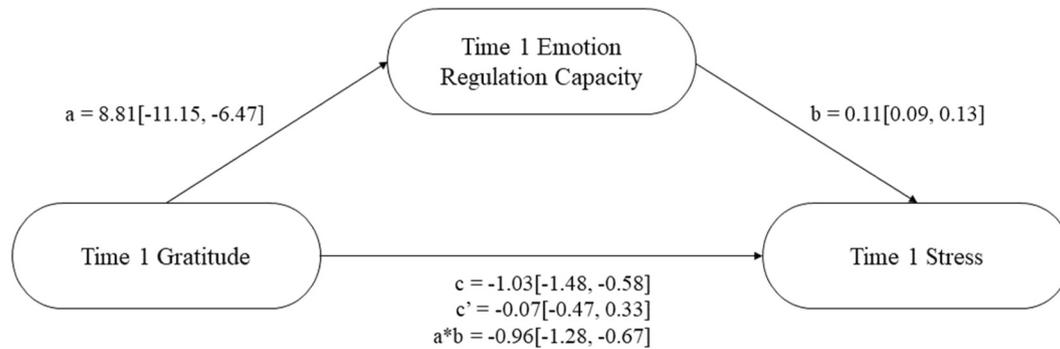


FIGURE 1 Emotion regulation capacity mediates the relationship between gratitude and stress Time 1. The indirect effect for each mediation used Bootstrapping.

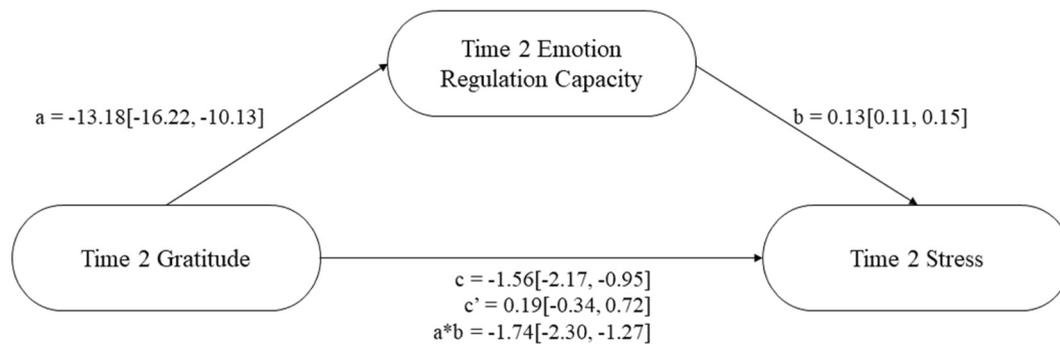


FIGURE 2 Emotion regulation capacity mediates the relationship between gratitude and stress Time 2. The indirect effect for each mediation used Bootstrapping.

Relationship	β	<i>B</i>	<i>SE</i>	<i>p</i> -value	Lower <i>CI</i>	Upper <i>CI</i>
T1 gratitude and stress mediation						
GQ6 on DERS	-0.38	-8.81	1.19	<0.001	-11.15	-6.47
DERS on DASS_S	0.60	0.11	0.01	<0.001	0.09	0.13
Direct effect	-0.02	-0.07	0.20	0.726	-0.47	0.33
Total effect	-0.24	-1.03	0.23	<0.001	-1.48	-0.58
Indirect effect	-	-0.96	0.15	-	-1.28	-0.67
T2 gratitude and stress mediation						
GQ6 on DERS	-0.50	-13.18	1.55	<0.001	-16.22	-10.13
DERS on DASS_S	0.72	0.13	0.01	<0.001	0.11	0.15
Direct effect	0.04	0.19	0.27	0.488	-0.34	0.72
Total effect	-0.32	-1.56	0.31	<0.001	-2.17	-0.95
Indirect effect	-	-1.74	0.27	-	-2.30	-1.27

TABLE 4 Standardised and unstandardised regression coefficients, standard error, *p*-value and 95% confidence intervals for each mediation model.

Note: The indirect effect for each mediation used Bootstrapping.

Abbreviations: CI, confidence interval; DASS_S, Depression, Anxiety, Stress scale - stress subscale; DERS, Difficulties in Emotion Regulation Scale; GQ6, Gratitude 6 questionnaire; T1, Time 1; T2, Time 2.

emotion regulation at Time 2 mediated the relationship between gratitude at Time 1 and stress at Time 2 (see Figure 3). Higher gratitude at Time 1 significantly predicted better emotion regulation

at Time 2 ($B = -10.68$, $SE = 1.60$, $p < 0.001$, 95% CIs [-13.85, -7.52]). The results suggest there was a significant total effect of gratitude at Time 1 on stress at Time 2 ($B = -0.96$, $SE = 0.32$,

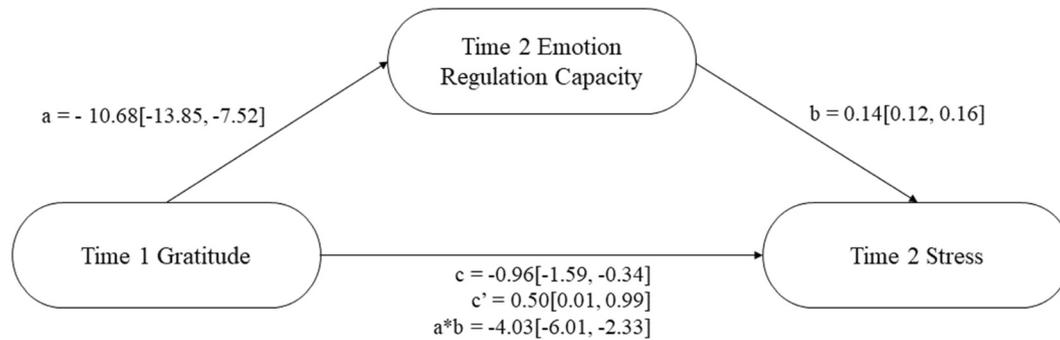


FIGURE 3 Emotion regulation at Time 2 mediates the relationship between gratitude at Time 1 and stress Time 2. The indirect effect for each mediation used Bootstrapping.

$p = 0.003$, 95% CIs $[-1.59, -0.34]$; see Figure 3; the contradictory nature of this to the direct effect of the cross-lagged model is discussed). However, it is important to consider the limited amount of variance explained by gratitude at Time 1 ($R^2 = 0.0415$). The direct effect was significant ($B = 0.498$, $SE = 0.25$, $p = 0.047$, 95% CI $[0.006, 0.991]$), and the indirect effect with percentile bootstrapping was significant ($B = -1.462$, $BootSE = 0.25$, $Boot95\%$ CIs $[-1.98, -1.00]$). This suggests that higher gratitude at Time 1 predicted decreased stress at Time 2 via emotion regulation capacity at time 2. Approximately 50% of the variance in stress at Time 2 was accounted for by emotion regulation at Time 2 and gratitude at Time 1 ($R^2 = 0.50$, $F(2, 214) = 109.1096$, $p < 0.001$). Using the Bonferroni-adjusted alpha level of 0.0167, the significance of the relationships identified in this cross-lagged mediation model remain excluding the direct effect which becomes non-significant.

4 | DISCUSSION

University students have consistently been shown to be negatively impacted by stressors which contribute to poorer mental health (Auerbach et al., 2018; Banu et al., 2015; Bewick et al., 2010; Cooke et al., 2006; Roche et al., 2022; Stallman, 2010). Understanding factors that can mitigate stress is pivotal for improving student mental health. In line with our first prediction (that higher levels of gratitude would be associated with better emotion regulation, and lower stress at both time points), and the broader literature, higher levels of gratitude were associated with lowered levels of stress (Moon & Jung, 2020; Nezek et al., 2019; Yildirim & Alanazi, 2018). Importantly, these associations were found at both Time 1 and Time 2.

We meaningfully extend the current literature by demonstrating that, in line with our second prediction (that the relationship of gratitude with stress would be mediated by emotion regulation at both time points), emotion regulation mediated the relationship between gratitude and stress at both the beginning and middle of the academic semester. Additionally, results of the post hoc cross-lagged mediation model suggested a potential causal relationship whereby experiencing gratitude may enhance one's ability to emotionally regulate over time. These results highlight that emotion regulation

may provide a key mechanism through which gratitude is able to reduce stress. Furthermore, these results provide a first important step in suggesting that a combined intervention targeting gratitude and emotion regulation may yield significant therapeutic benefits for university students, however further research is needed on this.

This study was the first to compare the magnitude of the indirect effect across two time points in an academic semester. The strength of the indirect effect was stronger later in the semester compared to the beginning. This is particularly interesting as participants' perceived stress levels did not significantly change across the two time points. It is possible that students were able to compensate for increased academic pressures and stressors throughout the progression of the semester through enhanced emotion regulation abilities. Similarly, as the semester progresses, students may develop better strategies for coping with stress, either through naturally adjusting to the academic setting or by more actively employing strategies to manage their emotions. However, as this study did not measure stressors, this conclusion must be interpreted with caution. It is also important to consider that students who were experiencing higher levels of stress and were less adept at coping with stressors at the second time point were more likely to leave the study—thus leaving a sample that either had a less stressful second half of the semester or individuals who were better equipped to manage their stress. It is possible that emotion regulation abilities are important in regulating university student stress, however future research should aim to directly measure stressors and coping strategies to provide a more comprehensive understanding of how students navigate stress across an academic semester.

As noted above, this study conducted a post hoc analysis to determine potential causality between gratitude, emotion regulation, and stress. The autoregressive model suggested that emotion regulation and stress demonstrated temporal stability. The results of the cross-lagged panel mediation analysis found that emotion regulation at Time 2 mediated the relationship between gratitude at Time 1 and stress at Time 2. The substantial portion of variance in stress at Time 2 explained by the model highlights the significant role that both gratitude and emotion regulation play in stress dynamics. Furthermore, while the direct effect of gratitude on stress becomes non-significant after adjusting for multiple comparisons, the robust

indirect effect through emotion regulation firmly establishes emotion regulation as an important mediator in this dynamic. These results are particularly interesting as their temporal nature provide support for a causal relationship, whereby the stress-alleviating benefits from gratitude are predominantly channelled through its enhancement of emotion regulation capabilities. This suggests that individuals with higher levels of gratitude may experience decreased stress over time, in part due to their enhanced ability to regulate their emotions.

These results provide support for the potential theoretical mechanism underpinning the relationship gratitude has with stress and aggression. As noted earlier, the *Broaden and Build Theory* (Fredrickson, 1998) provides a possible theoretical explanation for how positive emotions enhances emotion regulation. It is possible that participants' levels of gratitude influenced their ability to cultivate positive emotions, whereby those with higher levels of gratitude were better equipped to regulate their emotions and subsequently cope with feelings of stress. Therefore, these results provide a novel insight into the possible mechanism through which gratitude is able to promote well-being.

The results of this study also support prior research on coping strategies inherent to self-regulatory behaviour. Prior studies suggest that behavioural self-regulation is associated with greater resilience (Artuch-Garde et al., 2017) and use of problem-focused strategies (de la Fuente et al., 2015). A recent study that investigated the effects of self-regulation and external regulation on academic stress found that students' self-regulation capacity predicted their levels of stress (de la Fuente et al., 2020). This aligns with findings from the current study, whereby emotion regulation ability (a type of self-regulation) was important in mediating stress in undergraduate students. Therefore, having higher levels of emotion regulation—or self-regulatory ability—provides students with more resources to combat feelings of stress throughout a university semester.

4.1 | Limitations and future directions

The present study had several key strengths, including a large sample and validated assessments. We recruited participants at two different time points in a semester providing replication of our results and the chance to conduct a cross-lagged panel mediation model. However, although we aimed to assess participants in low and high stress periods, we did not find significant differences in student's perceived stress scores between Time 1 and Time 2. As stressors were not measured objectively (e.g., through identifying hours spent studying, number of exams/assignments due, using a life events checklist) it is unclear whether similar stress scores across the two time points was due to students with more gratitude and better emotion regulation skills managing their stress, or whether at the Time 2 assessment students did not have an increased level of stressors. Furthermore, 143 participants left the study between Time 1 and Time 2. It is possible that students who were experiencing more stress at Time 2 were those who dropped out. Future research

is needed to determine how these relationships vary not only over the course of a semester, but also throughout high and low stressors experienced in everyday life. Future research should also include objective measures of stressors to ensure changes in stress (or lack thereof) over the semester are linked to increases in academic stressors. Another important consideration is that emotion regulation was assessed using the DERS which mostly measures *difficulties* in emotion regulation. Although Gratz and Roemer (2004) designed the DERS to be a comprehensive multidimensional assessment of emotion regulation and dysregulation, future research should include and compare different assessments of emotion regulation to ensure the modes identified in the current study are robust.

Another limitation to this study is that the relationship between gratitude at Time 1 and stress at Time 2 was not significant in the cross-lagged regression model but was significant in the mediation model. This could be due to different analytical approaches and underlying assumptions to each model. For instance, the cross-lagged model assesses stability across different time points. If the association is influenced by other factors, it may not reach statistical significance. In the mediation model, the focus is on the specific pathway and indirect effect. It is possible that gratitude may have a significant influence on stress when mediated by emotion regulation even if the direct relationship is not significant in a cross-lagged model. Future research is needed to further assess these findings in other university samples to determine the robustness of the causal mediation model. Furthermore, the two key mediational relationships of interest were conducted on cross-sectional data. Because prior literature suggests that conducting mediation analyses with cross-sectional data can increase the risk of biased estimates when interpreting potential longitudinal causal pathways (Maxwell & Cole, 2007), we conducted a cross-lagged panel mediation model. Whilst, this analysis was helpful in providing preliminary support for a causal pathway, this analysis was conducted post hoc and consequently had no a priori predictions for these effects. Further experimental research is therefore now needed to directly test these relationships in a controlled manner.

There are also important limitations pertaining to the sample generalisability and gender distribution. This study was conducted on undergraduate psychology students in a single Australian University. Hence, it is possible that the pattern of results found in the current study do not generalise to undergraduate students across non-Western cultures. An important next step in this literature would be to replicate this study in Universities across different cultures to determine if emotion regulation is able to mediate the relationship between gratitude and stress in a broad range of undergraduate students.

Furthermore, gender differences in the sample may have impacted the results. Across both time points, over 75% of our sample were cisgender females. It is well documented that there are sex differences in hormonal and molecular stress responses across the lifespan (see Bale & Epperson, 2015 for a review). Indeed, studies have demonstrated that the type of psychological stressor is important in determining the responses in males and females. For instance, in social stressor scenarios, women demonstrated significantly

greater free cortisol responses than men, whereas in mathematical and verbal challenges the reverse relationships were observed (see Goel et al., 2011 for a review). Therefore, it is likely that the relationship between gratitude, emotion regulation, and stress may vary in its intensity across different genders. Future research is now needed to determine how sex may moderate the relationships identified in the current study.

It is also possible that other variables not investigated in the current study may impact the observed relationships. Specifically, contextual factors (e.g., study load or teacher organisation) may assist students in moderating their stress levels throughout the academic semester. Recent studies have demonstrated that factors such as the teacher's behaviour and organisation are predictors of student engagement, stress and emotional well-being (Frenzel et al., 2018; Krijgsman et al., 2019; Lekwa et al., 2019; Suldo et al., 2019). Furthermore, a recent study found that both student-related self-regulation capacity and students' perception of the teaching process served as protective factors that buffer against stress although self-regulation was a stronger protective factor than perception of teaching (de la Fuente et al., 2020). Similarly, a path analysis model of protection and risk factors for academic stress found that effective teaching directly predicted student positivity, academic behavioural confidence, engagement, and stress in teaching which subsequently impacted stress in learning (de la Fuente, 2021). Therefore, while it is clear that internal regulatory behaviours such as emotion regulation are important in mitigating stress experienced by university students, future studies should also consider the impact of contextual regulatory factors such as effective teaching, teacher organisation, and student workload.

5 | CONCLUSION

This study is the first to date to highlight the pivotal mediatory role of emotion regulation in mitigating the experience of stress in university students throughout an academic semester. The results of this study shed light on the theoretical underpinnings of the gratitude–stress relationship and highlight the importance of strengthening emotion regulation abilities through targeted interventions in university students. As university students consistently demonstrate poorer well-being and increased stress than non-students, this knowledge is important in informing the design of interventions aimed at improving well-being in university students. Specifically, our evidence suggests that interventions which cultivate both gratitude and emotion regulation abilities might be particularly useful in building students' ability to manage and respond to stress.

ACKNOWLEDGEMENTS

This study did not receive any funding.

Open access publishing facilitated by The University of Queensland, as part of the Wiley - The University of Queensland agreement via the Council of Australian University Librarians.

CONFLICT OF INTEREST STATEMENT

The authors have declared that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

This study was preregistered with the Open Science Framework. The pre-registration document, de-identified data, JASP file, and R-script used can be accessed via the following link (https://osf.io/keugt?view_only=02814e8f2e6c43cf97f60d02506d07f3).

ETHICS STATEMENT

Ethical approval was provided by the Human Research Ethics Committee at The University of Queensland (Project number: HE000127).

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ENDNOTES

- ¹ We also pre-registered to examine the relationship between gratitude, emotion regulation, and aggression. Patterns observed for stress were similar for aggression, but the aggression results are included only in the supplementary materials due to space limitations.
- ² Independent samples *t*-tests of Time 1 data found that participants who completed both timepoints demonstrated higher levels of gratitude than those who completed only Time 1. Mediation analyses were run on these two groups of participants separately and the direction and significance of the mediations did not change (see Tables S2 and S3 in the Supplementary Document for these results). Thus, all participants were used in relevant analyses.
- ³ Independent samples *t*-tests found no difference between participants that completed the survey in semester 1 or semester 2 of 2022 (see Table S1 in the Supplementary Document for these results) so the two cohorts were collapsed together for analysis.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Demichelis, O. P., Fowler, J. A., & Young, T. (2024). Better emotion regulation mediates gratitude and increased stress in undergraduate students across a university semester. *Stress and Health*, e3417. <https://doi.org/10.1002/smi.3417>