Research Article

Gratitude writing for positive and negative affect: moderation by life satisfaction

Samuel J. P. Wyre[*]

[1]Northumbria University, School of Psychology, Northumberland Building, City Campus, Newcastle upon Tyne, NE1 8ST, UK

*: Northumbria University Psychology Student Author

Abstract

Gratitude writing interventions have been found to enhance wellbeing; however, these effects may not be equally effective for everyone. A moderator of interest is life satisfaction. The aim of this study was to explore the effects of a gratitude writing intervention on positive affect (PA) and negative affect (NA). The other aim of the present study was to explore the moderating role of life satisfaction on the effect of a gratitude writing intervention on PA and NA. A cross-sectional, quantitative design was employed. A convenience sample of 90 participants, aged over 18 from the general population, were recruited. Participants completed two self-report questionnaires: the Satisfaction with Life Scale to measure life satisfaction and the Positive and Negative Affect Schedule (PANAS) to measure PA and NA. Participants were randomised to a gratitude writing condition (n = 44), where they expressed gratitude to a person that had changed their life and wrote how that made them feel, or a control writing condition (n = 46), before repeating the PANAS. There was no significant effect found for the gratitude writing intervention on PA and NA, relative to the control condition. There was no significant effect found for the moderator of life satisfaction, possibly due to the length of the gratitude writing. This study demonstrates that further research is required into how life satisfaction moderates gratitude writing, and to assess under what conditions gratitude interventions are most effective. Studies should use a larger sample and a larger dosage.

Keywords: Gratitude, wellbeing, intervention, life satisfaction

Corresponding Author:
Samuel J. P. Wyre, School of Psychology, Northumberland Building, City Campus, Newcastle upon Tyne, NE1 8ST, UK; email: samuel.wyre@northumbria.ac.uk

Introduction

Gratitude has been defined as a psychological construct that involves an individual acknowledging a benefit that they have received from an external source (Emmons & McCullough, 2003). Furthermore, gratitude can be conceptualised as a fleeting emotional state and as a trait (Wood *et al.,* 2008). Trait gratitude is the tendency that an individual experiences this state (Wood *et al.,* 2010). It has been positively correlated to life satisfaction, positive affect (PA), happiness, optimism, and hope, while being negatively correlated with negative affect (NA) and depression (McCullough *et al.,* 2002). State gratitude is defined as the momentary experience of thankfulness (Wood *et al.,* 2008). Like trait gratitude, it has been found to be positively correlated with life satisfaction and PA while being negatively correlated with depression and NA (Watkins *et al.,* 2003). Additionally, gratitude is classed as a social emotion that is commonly aroused after an individual has benefitted from another person's actions (McCullough *et al.,* 2001). Although it is possible for individuals to experience different types of gratitude, like for material goods and life events, it has several social implications such as developing interpersonal relationships (Algoe, 2012). Furthermore, it has been shown that expressing gratitude to another individual may be more impactful than just experiencing the gratitude and not expressing it (Kumar & Epley, 2018). In sum, it has been proposed that gratitude can affect wellbeing directly as a causal agent, or indirectly by lessening the negative emotions (Nelson, 2009).

Gratitude has been demonstrated to have effects on all aspects of wellbeing, including subjective wellbeing (Bono *et al.,* 2004). Subjective wellbeing has been proposed to have three distinct components: life satisfaction, PA and NA (Diener, 1984; Diener & Emmons, 1984; Froh *et al.,* 2009). This tripartite formulation is used to refer to how individuals experience and evaluate their lives, in either a positive or negative way (Diener *et al.,* 1999). Specifically, PA and NA can be used to assess the affective (feeling) side of subjective wellbeing and the mental health status of an individual (Diener *et al.,* 2015; Hu *et al.,* 2015). PA has been found to be positively related to life satisfaction (Gilman & Huebner, 2000), wellbeing (Lyubomirsky & Layous, 2013), and happiness (DeWall *et al.,* 2011). Whereas NA has been found to elevate the levels of depressive symptoms in non-clinical samples (Holmes & Pizzagalli, 2007) and increase anxiety (Watson *et al.,* 2011). The relationship between the two suggests that PA may mitigate the maladaptive effects of NA (Fredrickson *et al.,* 2000). Additionally, these specific domains of PA and NA have been found to be individually affected by interventions that evoke feelings of gratitude (Rash *et al.,* 2011; Pennebaker *et al.,* 1997; Cunha *et al.,* 2019). Gratitude interventions typically get an individual to express gratitude to accentuate the many benefits that gratitude has been demonstrated to have (Davis *et al.,* 2016). On the whole, gratitude interventions have been demonstrated to boost the affective components of subjective wellbeing (Shin *et al.,* 2020; Davis *et al.,* 2016; Dickens, 2017). Activities that can evoke gratitude includes writing a gratitude letter, a gratitude list, and more, which can have different effects on wellbeing.

A large selection of gratitude writing activities exist. Researchers typically direct an individual to express their gratitude to another individual who has significantly contributed to their wellbeing (Wood *et al.,* 2010). Gratitude lists, or gratitude journals, have been demonstrated to increase PA (Emmons & McCullough, 2003). A behavioural expression of gratitude is most commonly a gratitude letter, where participants are encouraged to express grateful feelings to others which leads to sustained wellbeing (Seligman *et al.,* 2005). Additionally, the letters do not need to be sent for an individual to experience the beneficial effects (Lyubomirsky *et al.,* 2011).

Several studies have explored the efficacy of these different gratitude interventions. It has been observed that different gratitude interventions have different effects on PA and NA. Specifically, they found that a gratitude letter increased PA to a greater extent compared to the other gratitude intervention conditions, including gratitude lists (Watkins *et al.,* 2003; Regan *et al.,* 2023). This could be due to the more open-ended nature of gratitude letters allowing participants to write more expressively, which has led to positive outcomes and a reduction in depressive symptoms (Booker & Dunsmore, 2017; Toepfer & Walker, 2009). However, gratitude letters have been found to instil a mixed emotional state, leading to feelings of guilt and indebtedness (Layous *et al.,* 2017; Hosaka & Shiraiwa, 2021). Overall, the evidence for the efficacy and reliability of writing gratitude letters is strong, with gratitude letter interventions being described as one of the most reliable gratitude-based positive psychology interventions (PPIs; Bolier *et al.,* 2013).

It has been demonstrated that PPIs are not equally effective for everyone. The positive-activity model found that a range of individual differences can moderate the effects of PPIs on wellbeing (Lyubomirsky & Layous, 2013). Moderators of PPIs can either be external or internal factors (Ng, 2015; Lyubomirsky *et al.,* 2011). For example, external factors like the dosage, or frequency, of PPIs influence the efficacy of PPIs, and if participants overdo an activity, then this can lead to hedonic adaptation (Lyubomirsky *et al.,* 2005). Additionally, taking part in multiple PPIs at the same time can lead to more benefits than utilising one activity (Parks *et al.,* 2012). PPIs that are administered in individual therapy sessions, under therapeutic guidance, are more effective than self-administered PPIs (Sin *et al.,* 2011). However, it is important to note that self-administered PPIs are still more effective at enhancing an individual's wellbeing compared to not using any PPIs at all (Sin & Lyubomirsky, 2009). There is also a selection of internal factors that may impact the efficacy of PPIs. Internal factors that have been demonstrated to influence the effect of gratitude interventions on aspects of wellbeing include personality, motivation, effort, and depression status (Senf & Liau, 2013; Lyubormirsky *et al.,* 2011; Sin & Lyubormirsky, 2009). Overall, it is clear that a large range of moderators exist for PPIs. Therefore, it is important to better understand how moderators can influence the acute effects of gratitude writing on wellbeing. This is needed to gain a clearer understanding of the optimal conditions under which these interventions can be applied and be the most effective.

A potential moderator of interest is life satisfaction; however, no studies have explored this as a moderator in relation to gratitude writing interventions. Previous research has suggested that there is a positive correlation between an individual's trait gratitude and life satisfaction (Kerry *et al.,* 2023; Hosaka & Shiraiwa, 2021). As previously discussed, the priming or experimental induction of gratitude leads to increased life satisfaction (Emmons & McCullough, 2003; Rash *et al.,* 2011). However, it is less certain whether gratitude interventions have a direct effect on life satisfaction (Kerry *et al.,* 2023). Further research has shown that a cyclical relationship between trait gratitude and life satisfaction exists, whereby increases in either one of these traits leads to increases in the other (Unanue *et al.,* 2019). Additionally, trait gratitude has been found to moderate the effects of a gratitude intervention on life satisfaction (Rash *et al.,* 2011). These findings have important implications for the role of life satisfaction in the wellbeing effects brought about by gratitude interventions. This question will be explored in the current study.

The aim of the present study was to explore the effects of a gratitude writing intervention on PA and NA. An additional aim was to explore the moderating role of life satisfaction on the effect of a gratitude writing intervention on PA and NA. It is hypothesised that: 1) the gratitude writing condition will be associated with a significantly greater increase in PA, between pre- and post-writing, relative to a neutral writing control condition; 2) the gratitude writing condition will be associated with a significantly greater decrease in NA, between pre- and post-writing, relative to a neutral writing control condition and 3) both effects will be moderated by life satisfaction, whereby the effects will persist only for higher levels of life satisfaction.

Method

Participants

An *a priori* power calculation was conducted using G*Power (version 3.1, Faul *et al.,* 2007) with 1 predictor of interest (IV*M) and 3 overall predictors (IV, M, IV*M). The minimum sample size needed to observe a medium effect size (f^2 = .15), was 89 participants at 95% power (α = .05). The final sample of 90 participants satisfied these requirements.

Participants could take part if they were aged 18 years or older, and were recruited from the general population via convenience sampling, between October 2024 and March 2025. The study was advertised using social media (Facebook and Instagram). This study received full ethical approval from the Northumbria University School of Health and Life Sciences Research Ethics Committee. All participants provided electronic informed consent.

Measures

Participants completed the Satisfaction with Life Scale (SWLS; Diener *et al.,* 1985) which is a five-item self-report measures which assesses life satisfaction. Example questions include "*in most ways my life is close to ideal*" and participants are asked to what extent they agree with each statement. Scores range from 5 to 35, where high scores indicate greater life satisfaction. The SWLS has good psychometric properties: the SWLS has good construct reliability ($α = 0.85$) and good convergent and discriminant validity (Diener *et al.,* 1985; Beuningen, 2012).

Participants also completed the Positive and Negative Affect Schedule (PANAS; Watson *et al.,* 1988) as a measure of PA and NA. The PANAS has two 10 item subscales (assessing PA and NA respectively). A higher score indicates greater PA or NA. The PANAS has been used in previous gratitude intervention studies (e.g., Cunha *et al.,* 2019; Fekete & Deichert, 2022) and has good psychometric properties: it has sufficient construct reliability (PA scale: $α = .89$; NA scale: $α = .85$) and good convergent and discriminant validity (Watson *et al.,* 1988; Crawford & Henry, 2004).

Writing Activities

The gratitude writing activity was adapted from Seligman (2011). Participants in the gratitude condition were instructed to think of the face of someone that changed their life for the better and to then write a letter to them about how they changed their life and how it made them feel. The control writing activity was adapted from O'Connell *et al.* (2017). Participants were instructed to think of an old friend that they have lost touch with, and to write a letter to them updating them on the events that since happened (*Supplementary Materials*).

Procedure

This study was pre-registered with the Open Science Framework (https://osf.io/vjczg). This study was completed online using Qualtrics XM (Qualtrics, Provo, UT).

Before completing the study, participants were not informed that the focus of this study was on gratitude writing, or the potential benefits of such techniques. Participants were simply informed that the aim of the study was to explore the effects of reflective writing. This was done to reduce demand characteristics, which are problematic in this area of research (Dickens, 2017).

Participants were asked to state their gender (male; female; other, please specify; prefer not to say) and age in years, before completing the SWLS and PANAS. Participants were then randomised (using the randomiser function on Qualtrics) to either the gratitude writing condition or the control condition. Participants were required to spend at least 10 minutes on their assigned writing activity and were not able to move onto the next activity until 10 minutes had elapsed. Participants then

completed the PANAS again. Two attention check questions were embedded before and after the condition, to ensure that participants were paying attention to the questions.

Data analysis

All data analyses were conducted using SPSS (Version 29; IBM Corp., Armonk, NY, USA). Any participants who met exclusion criteria, but ignored information telling them not to take part, were removed along with any extreme outliers (defined as deviations greater than 3.24 standard deviations from the mean). Extreme outliers were removed because a *z*-score of 3.24 equates to a probability of 0.5% or less of that value falling under the normal distribution. The removal of extreme outliers has been demonstrated to significantly increase accuracy and reduce errors of inference (Osborne & Overbay, 2004).

Also, if more than two values were missing from a subscale, or they had not completed the study, then they were removed. However, if only one value was missing from the subscale, then the mean of the other values in the subscale were calculated. This number was then rounded to the nearest whole number and imputed for the missing value. All categorical variables were dummy coded. Scores were then calculated for the SWLS and pre- and post-intervention PA and NA subscale scores. A change of scores was computed between the pre-and post-intervention PA and NA scores by subtracting pre-PA and NA from post-PA and NA. Assumption tests for moderation analysis were run. Analysis was run with and without any identified outliers. If the *p*-value significance was not affected; then the participants were left in the dataset for final analysis. All other assumptions were met.

Moderation analysis was conducted using SPSS PROCESS Model 1 (Version 4.1; Hayes, 2013). Means were centred for all variables that define products. Separate models were computed for the PA and NA change scores. Hypothesis 1 was tested by investigating the significance of the effect of condition on PA. Hypothesis 2 was tested by investigating the significance of the effect of condition on NA. Hypothesis 3 was tested by investigating the significance of the interaction effect in both models. An *a priori* decision was taken (before analysis) to only probe simple slopes if any findings were significant. Means and standard deviations were calculated for the participants age as a whole cohort and for the individual conditions. Results were considered to be statistically significant if *p*-values < .05.

Results

The total number of responses was 135. A total of 44 participants left the study when they reached the writing task, and 1 participant violated the exclusion criteria. Overall, 45 participants were removed from the sample because they demonstrated a lack of

adherence to the task instructions. Data analyses were conducted on a final sample of 90 participants with complete data (Figure 1).
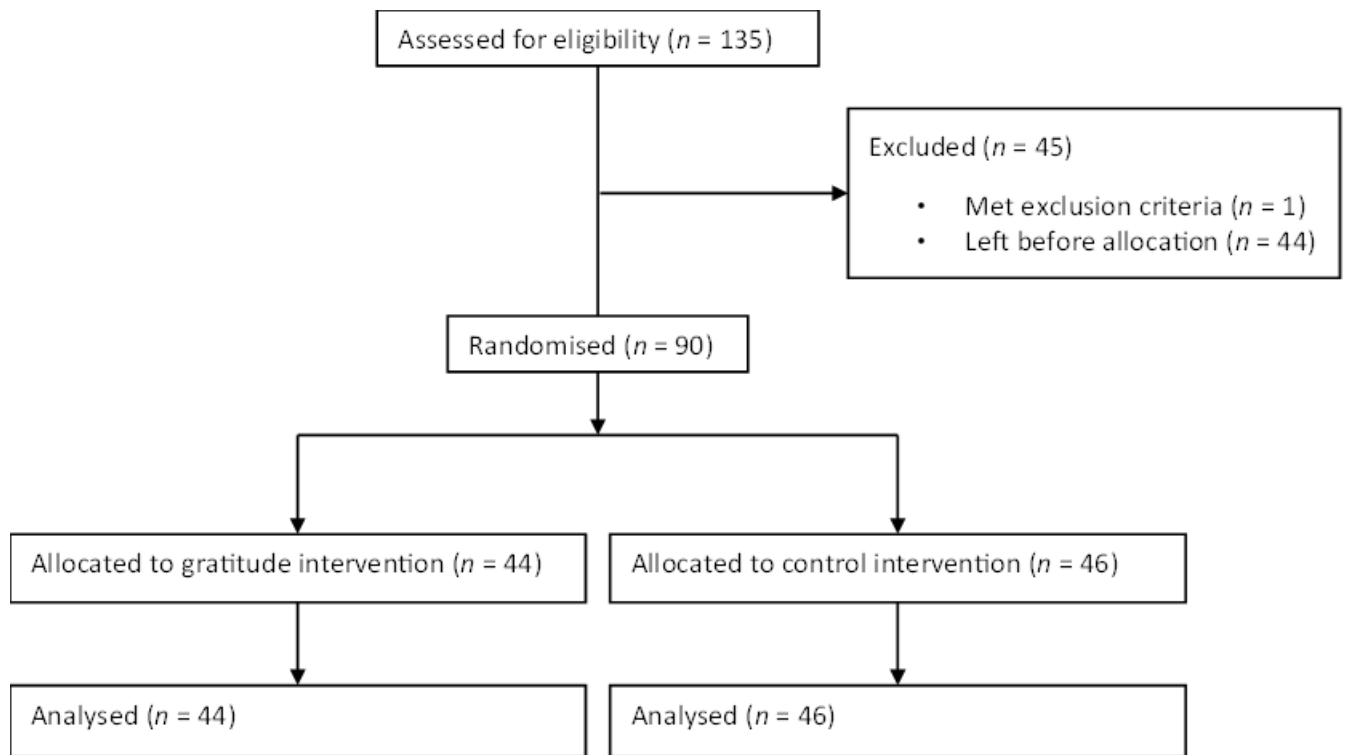

Figure 1: *Participant flow*

The overall cohort contained 90 participants (male = 26, female = 63, non-binary = 1), with a mean age of 26.40 years (SD = 11.66 years). There were 44 participants in the gratitude writing condition (male = 14, female = 30; M_{age} = 26.10 years; SD_{age} = 10.10 years). There were 46 participants in the control writing condition (male = 12, female = 33; M_{age} = 26.90 years; SD_{age} = 12.46 years). Descriptive results of sample characteristics can be found in Table 1.

Table 1: Gender characteristics of participants (n = 90)

	Gratitude (*n* = 44)	**Control (*n* = 46)**	**Full sample**
Female (n, %)	30 (68.2)	33 (71.7)	63 (70.0)
Male (n, %)	14 (31.8)	12 (26.1)	26 (28.9)
Non-binary (n, %)	0 (0)	1 (2.2)	1 (1.1)

Positive Affect

The first moderation analysis examined the influence of gratitude writing on positive affect and whether life satisfaction moderates the relationship between gratitude writing and positive affect (Figure 2). The model was able to account for 1.8% of the variance in PA score and was not significant ($R^2 = .02$, $F(3,86) = .51$, $p > .05$; Table 3).

Of the individual predictors, neither life satisfaction ($B = -.074$, $t(86) = .60$, $p > .05$) nor the condition ($B = .79$, $t(86) = 1.09$, $p > .05$) were significant. Overall, there were no significant effects found in the analysis.
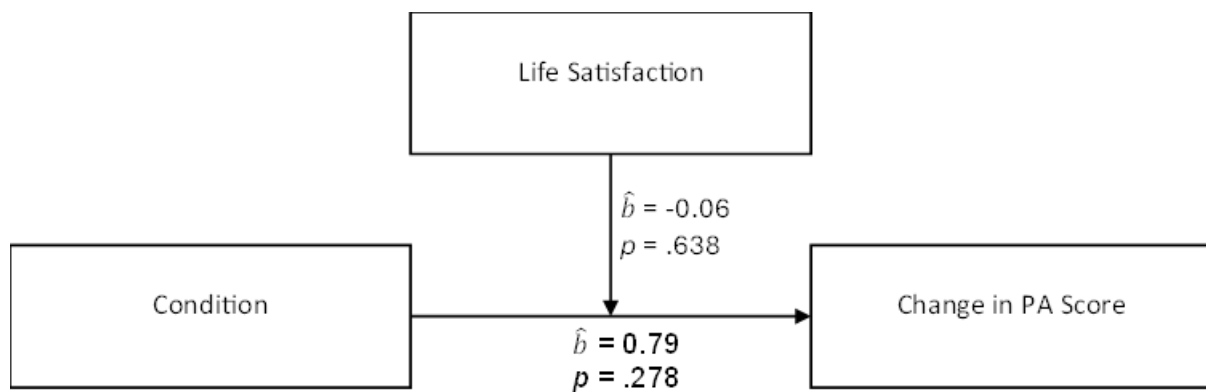

Figure 2: *Simple Moderation Model with Life Satisfaction Effect as a Moderator for Condition Effect on PA Change*

Table 2: Life Satisfaction Effect on Condition Effect on PA Change

	B	SE B	t	p
Constant	1.00 [-.44, -.01]	.72	1.39	.17
Condition	.79 [-.65, 2.23]	.72	1.09	.28
SWLS	-.07 [-.32, .17]	.12	-.60	.56
Condition × SWLS	-.60 [-.31, .19]	.13	-.47	.64
SWLS = Satisfaction with Life Scale				

Negative Affect

The second moderation analysis examined the influence of gratitude writing on negative affect and whether life satisfaction moderates the relationship between gratitude writing and NA (Figure 3). The moderation model was able to account for

.97% of the variance in NA score and was not significant (R^2 = .10, $F(3,86)$ = .29, p > .05; Table 4). Of the individual predictors, neither life satisfaction (B = .06, $t(86)$ = .61, p >.05) nor the condition (B = -.46, $t(86)$ = -.75, p > .05) were significant. Overall, there were no significant effects found in the analysis.
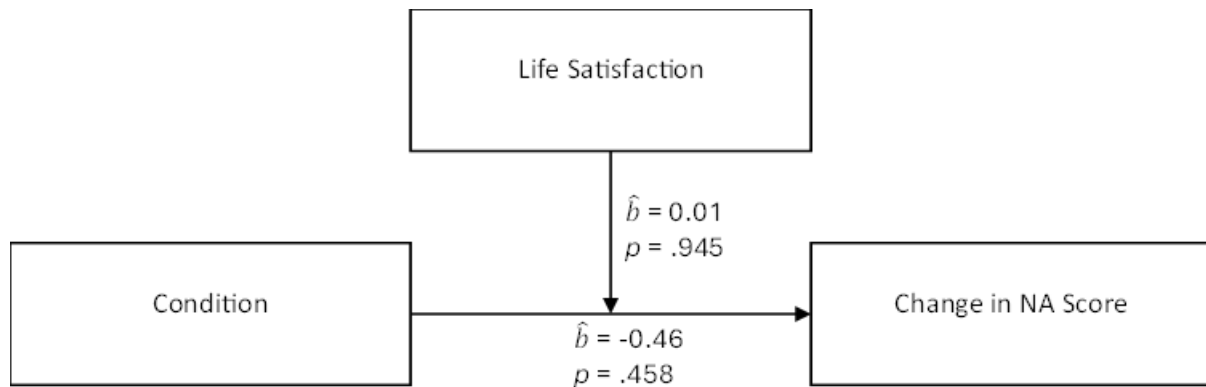

Figure 3*: Simple Moderation Model with Life Satisfaction Effect as a Moderator for Condition Effect on PA Change*

Table 3: Life Satisfaction Effect on Condition Effect on NA Change

	B	SE B	t	p
Constant	-1.30 [-2.52, -.09]	.61	-2.14	.04
Condition	-.46 [-1.67, .76]	.61	-.75	.46
SWLS	.06 [-.15, .27]	.11	.61	.55
Condition × SWLS	.01 [-.20, .22]	.11	.07	.95

SWLS = Satisfaction with Life Scale

Discussion

The aim of this study was to explore the effects of a gratitude writing intervention on PA and NA. The second aim, was to explore the moderating role of life satisfaction on the effect of a gratitude intervention on PA and NA.

Overall, there was not a significant increase in PA between pre- and post-writing. This result was not expected as it disagrees with the previous literature. It is proposed that expressing positivity enhances positive affect (Ruch, 1993; Harker & Keltner, 2001) and this is supported by extensive data (Seligman *et al.,* 2005; Lambert *et al.,* 2010;

Sheldon & Lyubomirsky, 2012). This has been demonstrated specifically with gratitude interventions (Emmons & McCullough, 2003; Stone *et al.,* 2022). Studies typically employ a larger dosage of gratitude interventions, in which they completed multiple gratitude letter writing activities, or spent more time writing the letters (Boehm *et al.,* 2011; Seligman *et al.,* 2005). The dose of an intervention is one of the most well-established treatment moderators in psychology (Howard *et al.,* 1986). This could be why the present study did not corroborate with the previous literature. Future research should take this into account by including more time for participants to write their letter for more pronounced effects. Additionally, a longitudinal study over a larger number of weeks may also increase the efficacy of the gratitude letter.

Secondly, the analysis did not find a significant reduction of NA between pre- and post-writing. This result was not wholly unexpected as previous research is more mixed when it comes to the effects of gratitude interventions on NA. No significant differences for gratitude interventions effect on NA versus a neutral control have been found (Dickens, 2017). This could be because previous literature has found that writing gratitude letters can instil a mixed emotional state (Layous *et al.,* 2017). Furthermore, participants have reported feeling a sense of indebtedness, shame, and guilt when writing a gratitude letter to someone important in their life, potentially increasing NA, as opposed to lowering it (Oishi *et al.,* 2019; Walsh *et al.,* 2022). However, it has also been found that a gratitude letter could decrease negative affect (Toepfer *et al.,* 2012; Tolcher *et al.,* 2024). It is unclear what directly causes these differences. This could be because some individuals do not enjoy gratitude letter interventions. For example, Smith *et al.* (2025) found that participants found it discomforting to write about their emotions and unfamiliarity with the writing task could make it difficult to complete. It could also be one of the many other moderators affecting the efficacy of gratitude interventions such as personality or dose (Senf & Liau, 2013; Lyubomirsky *et al.,* 2005). Further research is necessary to understand how to reduce NA in the general population when utilising gratitude interventions. For example, controlling for feelings of indebtedness could see a reduced NA (Hosaka & Shiraiwa, 2021).

Finally, no significant moderation effects were observed in either model. This means that the hypothesis that life satisfaction would moderate the effects of gratitude letter writing, whereby the effects would only persist for higher levels of life satisfaction, was rejected. The reason for this could be that the present study did not find a significant relationship between life satisfaction and PA or NA. This is not corroborated with previous literature that did find a significant relationship between the two variables (Busseri, 2018; Jovanović & Joshanloo, 2022). Studies exploring the relationship were typically done with much larger sample sizes compared to that of the current study (Busseri, 2018; Jovanović & Joshanloo, 2022). Therefore, it could be assumed that the relationship between life satisfaction and PA and NA is more nuanced. As this was the first study to examine the moderating effect of life satisfaction on this relationship, it may be of interest to explore this relationship with a larger sample size and smaller effect size to draw any definitive conclusions.

A number of limitations of the present study need to be noted. Firstly, even though the questionnaires utilised displayed good reliability and validity, problems could arise from their usage. Self-reported data may be affected by social desirability bias (Nederhof, 1985), especially as the activities used had a social aspect and could have led to negative feelings or embarrassment (Oishi *et al.,* 2019; Walsh *et al.,* 2022; Smith *et al.,* 2025). This might mean that participants did not complete the repeated PANAS truthfully, or did not interact with the intervention as expected, due to feeling embarrassed (Krumpal, 2013). Previous literature has found that when social norm beliefs are altered to be more favourable towards gratitude PPIs, they are more effective (Layous *et al.,* 2012). This was done by participants reading peer testimonials explaining the benefits of PPIs. Although this could be due to an increased belief in PPIs, it is equally likely that it shifted the participants social norms (Kaczmarek *et al.,* 2014). The current study had no such peer testimonials that could shift these norms and allow the participants to write more openly, which could have led to more truthful responses to the repeated PANAS, and allow the intervention to have more success. Future research should explore this effect further to reduce social desirability bias amongst individuals taking part in gratitude interventions.

Secondly, another limitation is the sample utilised in the present study was WEIRD (western, educated, industrialised, rich, and democratic; Henrich *et al.,* 2010), which significantly limits the generalisability of the current findings. This is due to solely recruiting participants using social media. This is an issue for the current study as only 12% of the world's population fit into the WEIRD category but can represent up to 80% of study participants (Azar, 2010). Studies specifically utilising PPIs have been found to follow this trend, with 78.2% of them focusing on a WEIRD sample; although it does seem to be improving, more work still needs to be done to improve applicability of PPIs (Hendriks *et al.,* 2019). Research has found that an individual's culture can affect the outcome of gratitude interventions. For example, it has been found that Eastern, collectivist cultures do not experience the same benefit from gratitude interventions as Western, individualist cultures due to their cultural perspective (Boehm *et al.,* 2011; Layous *et al.,* 2013; Shin *et al.,* 2020). Due to the online recruitment of the current study, anyone could have taken part, including those from different cultures, which could affect the results. In addition, the generalisability of the current study is severely limited. Therefore, future research is necessary to further examine the relationship between culture and its effects on gratitude intervention outcomes.

A further limitation of the present study was the small sample size. An *a priori* power calculation showed that 89 participants were required to detect a significant medium effect. This effect size was chosen due to the feasibility of being able to recruit enough participants within the timeframe of the present study. However, it was known that the more subtle effects of a gratitude writing intervention may not have been detected. A small effect size has been used in a wide range of previous literature utilising gratitude interventions (Davis *et al.,* 2016; Dickens, 2017). Therefore, future research should seek to recruit a larger sample to observe a significant small effect.

Despite these limitations, the present study does have some advantages. For instance, the study and recruitment were completed online. This allowed for the collection of the required sample size quickly and at no cost (Jones *et al.,* 2008). Additionally, completing a gratitude letter intervention electronically has been demonstrated to have the same effects as physically writing a letter, therefore it is acceptable to administer the intervention in this manner without suffering a loss of effect (Hosaka & Shiraiwa, 2021; Allen *et al.,* 2020). Overall, the use of online gratitude interventions should be considered for future studies due to its benefits.

The findings from the current study may have several implications for future research directions. Mainly, it demonstrates that further research is necessary into what dosage of gratitude interventions bring about a significant effect. Although studies with larger dosages, in which participants complete more interventions over a larger timespan, have demonstrated a significant effect on wellbeing and life satisfaction (Boehm *et al.,* 2011; Walsh *et al.,* 2022). There is also a selection of evidence that did not find a significant difference between expressed gratitude and control groups in life satisfaction (Froh *et al.,* 2009; Berger *et al.,* 2019). It has been proposed that this is due to the increased frequency of the gratitude interventions (Kirca *et al.,* 2023). This then leads to some participants perceiving the gratitude interventions as excessive and inhibiting the effects of gratitude interventions on life satisfaction (Renshaw & Hindman, 2017). This demonstrates that '*more is better*' is not the case and can lead to hedonic adaptation (Lyubomirsky *et al.,* 2005). Although in the present study, the intervention may have been too short, future research should determine at what point an intervention becomes excessive to participants. This shows that the underlying relationship between gratitude interventions and life satisfaction still requires further research into the direction of their relationship. Research should also investigate what dose provides the best efficacy, as there is evidence for a small dose, as well as a large dose, having no effect (Kirca *et al.,* 2013). Focusing on this relationship could provide a link between all aspects of the present study. For example, if the dose can provide a significant effect, then this could increase PA and provide the significant relationship to life satisfaction as is seen in the previous literature. This would then be able demonstrate whether life satisfaction can act as a moderator on gratitude interventions. If life satisfaction was shown to act as a moderator for gratitude interventions, then it could lead to the development of more effective and personal gratitude interventions to boost an individual's wellbeing.

In conclusion, the current study examined the effect of a gratitude letter on PA and NA. It also explored the moderating effect of life satisfaction on the relationship between a gratitude letter intervention and PA and NA. The hypotheses were not met, as the gratitude letter intervention did not affect PA or NA. Additionally, life satisfaction did not moderate the relationship between the variables of interest. This study adds to the growing body of research into PPIs and their efficacy. As this was the first study to investigate the moderating effect of life satisfaction on gratitude letter writing, future

research would be beneficial in examining this concept further by utilising a larger sample to observe a significant smaller effect size and a higher dosage.

Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article and/or its supplementary materials.

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