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Does an Online Positive Psychological Intervention Improve Positive Affect in Young Adults During the COVID-19 Pandemic?

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Abstract

Meta-analyses indicate that positive psychological interventions are effective at increasing positive affect, as well as reducing anxiety and depression; however, it is unclear how well these effects generalize during periods of high stress. Therefore, the current study tested whether a 2-week online positive psychological intervention delivered during the COVID-19 pandemic, a naturalistic stressor, (1) increased positive affect; (2) improved psychological well-being, optimism, life satisfaction, perceived social support, and loneliness; (3) and reduced negative affect in college students, a group known to have high pandemic distress. Participants ($N = 250$; 76.9% female) ages 18–45 were recruited from the University of Pittsburgh undergraduate subject pool between September and November of 2020. Participants were randomized to the online positive psychological intervention or active control condition and stratified by trait positive affect, sex, and year in college. Participants in both conditions completed one writing activity every other day for two consecutive weeks. Control participants documented their activities for that day (e.g., meals, going to gym). Intervention participants chose from six positive psychology activities. All outcome variables were assessed pre- and post-intervention by validated questionnaires. Across both conditions, positive and negative affect decreased from pre- to post-intervention. No other psychological factor differed by condition, time, or their interaction. The current null findings are in line with a more recent meta-analysis indicating that positive psychological interventions may have smaller effects on psychological well-being and depressive symptoms than was reported pre-pandemic. Study findings may suggest reduced efficacy of virtual positive psychological interventions under highly stressful circumstances.

Keywords COVID-19 · Positive psychological intervention · Positive affect · Social isolation · Well-being

The COVID-19 pandemic contributed to a rise in mental health concerns in the USA and globally (Luo et al., 2020; Vindegaard & Benros, 2020). One important factor associated with greater anxiety and depressive symptoms during the pandemic is social isolation (Luo et al., 2020), which has been impacted by social distancing and stay at home orders (Holt-Lunstad, 2021). One population that is especially vulnerable to social isolation and mental health symptoms during the pandemic is college students (e.g., Li et al., 2021; Son et al., 2020). Many campuses required students to vacate during the Spring 2020 semester, which disrupted coursework, daily routines, and social interactions (Al-Maskari et al., 2021). At this time, students reported concerns related to academic performance, the health of loved ones, poor concentration, and feeling socially isolated (Son et al., 2020). In fact, rates of anxiety and depression have nearly doubled in college students during the pandemic compared to the year before (Li et al., 2021). In light of these findings, access to resources that reduce symptoms of anxiety and depression and promote social interactions may help college students cope with COVID-related stressors.

One such resource that could be delivered remotely to enhance student mental health is a positive psychological intervention. Positive psychological interventions are designed to

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alter cognitive, behavioral, and/or motivational resources with the goal of increasing the duration, intensity, or frequency of positive emotions (Lyubomirsky & Layous, 2013). Prior to the pandemic, positive psychological interventions have been shown to increase positive affect ($d = 0.35–0.45$) and psychological well-being ($d = .20$), while also reducing negative affect, including symptoms of depression ($d = 0.22–0.65$; Boiler et al., 2013; Sin & Lyubomirsky, 2009) and anxiety ($g = 0.34$; Brown et al., 2019). Furthermore, the effects appear to be maintained for at least 3 to 6 months ($d = 0.22$; Boiler et al., 2013). Interestingly, individuals with depression show *greater* benefits from positive psychological interventions than those without depression (Sin & Lyubomirsky, 2009). It is therefore possible that individuals under higher levels of psychological stress, as is likely during a global pandemic, may also benefit from positive psychological interventions. While these meta-analyses do not compare online to in-person administrations, interventions delivered using self-help formats appear to have consistently smaller effect sizes compared to group and individual formats (e.g., self-help: $d = .33$; group: $d = .38$; individual $d = .41$; Boiler et al., 2013). A preliminary study also suggests that positive psychological interventions may even reduce loneliness during the COVID-19 pandemic (Parks & Boucher, 2020). Overall, initial evidence supports the use of positive psychological interventions to enhance positive affect and decrease negative affect and loneliness, which may improve the mental health of college students during the COVID-19 pandemic.

Positive psychological activities encompass a wide range of activities that are believed to increase positive emotions (Boiler et al., 2013; Sin & Lyubomirsky, 2009). Activities can focus on the past, such as savoring past positive experiences, or can be future-oriented like envisioning your best future self. Similarly, these activities may include a social component, like expressing gratitude or performing an act of kindness, or can be more self-focused, such as noticing and leveraging your personal strengths. Regardless of the type of positive psychological intervention, they are all thought to promote happiness by enhancing positive affect, promoting positive thoughts and behaviors, and satisfying basic needs (Positive-activity model; Lyubomirsky & Layous, 2013). Importantly, it has been proposed that positive psychological activities are most effective when the type of activity fits with the characteristics of the individual performing the activity and their desire to perform the activity (Lyubomirsky & Layous, 2013). For instance, someone who feels lonely may show greatest benefit from engaging in more socially oriented activities than someone who already feels socially connected. It is also hypothesized that providing an option of activities allows for individuals to select the activities they find more engaging, potentially leading to greater time and effort spent engaging in the activity (Lyubomirsky & Layous, 2013). As such, providing a range of positive psychological activities may be optimal for increasing positive affect during periods of high stress.

To provide context for the current study, data collection occurred approximately 7 months into the COVID-19 pandemic, prior to the wide public availability of vaccines. The national death toll was over 50,000 by the end of November (CDC, 2021, Provisional Death Counts for Coronavirus Disease 2019 Section). Locally, the Allegheny County infection rate climbed from ~ 400 cases per week in September to ~ 3,500 cases per week in November (Allegheny County Health Department, 2021, COVID-19 Weekly Data and Trends Section). There were also many shut-downs of schools and businesses, illness-related quarantines, and other uncertainties in the period leading up to data collection. While the current study was conducted in the context of the global COVID-19 pandemic, it aimed to leverage this naturalistic event to better understand the efficacy of positive psychological interventions during periods of high psychological stress.

Taken together, the current study tested whether a 2-week online positive psychological intervention could (1) increase positive affect; (2) improve optimism, psychological well-being, and life satisfaction; (3) enhance perceived social support and reduce loneliness; and (4) lower negative affect in college students during the COVID-19 pandemic. Participants were randomized to a positive psychological intervention or active control condition. Both conditions completed online activities every other day for 2 weeks. Participants completed the activities every other day, based on previous findings that completing positive psychological activities less frequently may paradoxically lead to greater enhancement in positive affect, potentially due to habituation that can occur from performing activities daily (Sin & Lyubomirsky, 2009). Positive psychological interventions of a 2-week duration have been shown to effectively increase positive affect ($d = 0.35$; Boiler et al., 2013; Sin & Lyubomirsky, 2009), while requiring participants to complete activities every-other day, instead of daily, may also increase participant adherence. We also explored the impact of the positive psychological intervention on health behaviors, including sleep and physical activity, given cross-sectional and longitudinal studies demonstrating that higher positive affect associates with greater physical activity (Kim et al., 2017; Baruth et al., 2011; Sin et al., 2015; Pasco et al., 2011) and better sleep quality (Ong et al., 2017; von Känel et al., 2014; see Supplementary Materials for additional rationale and details). The study design, aims, data collection strategy, and analytic plan were pre-registered prior to data collection. All pre-registration materials, analyses, and supplementary materials can be found on the study's Open Science Framework page (https://osf.io/79x48/).

Method

Participants

Participants ($N = 250$) ages 18–45 were recruited from the University of Pittsburgh undergraduate subject pool between September and November of 2020. As there was both a control and intervention condition, the study was not advertised as a well-being intervention, per se. Instead, flyers for study recruitment provided the study aim, described as understanding how various writing activities may impact mood and well-being (see Supplementary Materials for recruiting flyer). This also allowed for a less biased recruitment of study participants, as recruiting for a "happiness intervention" could have skewed the participant demographics to those who already report fewer mental health concerns at baseline (e.g., Choi et al., 2017).

Participants were deemed ineligible if they were under the age of 18; currently prescribed medications for cardiac arrhythmias; reported a history of heart surgery, myocardial infarction, or stroke; or currently have symptoms consistent with COVID-19. COVID-19 symptoms were only assessed at enrollment, such that it is unknown whether any participants contracted the coronavirus during the intervention. The original purpose of this study was to validate a positive psychological intervention in preparation for a larger study of similar sample composition that was meant to test whether enhancing positive affect might attenuate cardiovascular responses to psychological stress. Therefore, we excluded participants with a reported history of cardiovascular disease in order to avoid confounding by potential autonomic or other effects of such disease on cardiovascular assessments. Importantly, cardiovascular assessments were not ultimately incorporated into this study and the current report contains all findings as pre-registered.

General Procedures

To minimize in-person contact between participants and staff amidst the growing concern related to COVID-19, all study procedures were administered online and managed through REDCap software (Harris et al., 2009; Harris et al., 2019). Those interested in the study completed an online screening survey to determine eligibility. If eligible, participants were randomized to either an active control condition or a positive psychological intervention. R Studio (Version 1.3.1093; RStudio Team, 2020) was used to generate randomization tables to stratify by sex (male, female), year in college (first, second, third, fourth, fourth +), and quintiles of trait positive affect, leading to 100 potential randomization combinations. There were 290 blocks of 100 observations, with each combination represented once per block.

Participants received a survey link containing the consent form and a video explaining the study procedures. The video also provided an explanation of the writing activities, such that control participants received instructions on how they were expected to record their daily activities. Participants assigned to the intervention condition watched a video explaining each of the possible activities. The rationale for this was to provide greater instruction and sampling of the various activities before starting the intervention, such that participants could get a sense of which activities they were most interested in. After electronically signing the consent form, participants then completed two sets of online baseline questionnaires. In both conditions, participants then completed one writing activity every other day for two consecutive weeks. All participants received two text message reminders on the days when they were scheduled to complete a writing activity. Each writing activity took no longer than ten minutes to complete. At the end of the two weeks, participants had two sets of post-intervention questionnaires that were completed online within 3 days of their last writing activity. All questionnaires administered at baseline were repeated post-intervention, excluding demographic information. The intervention was limited to 2 weeks for both empirical and practical considerations. Empirically, meta-analyses have suggested that shorter (< 4 week) interventions can still increase positive affect ($d = 0.35$; Boiler et al., 2013; Sin & Lyubomirsky, 2009; e.g., Meevissen et al., 2011). Practically, the current study was originally created with the intention of adding laboratory assessments before and after the intervention to understand how increasing positive affect could alter cardiovascular physiology. Therefore, the intervention was 2 weeks so that participants recruited from the undergraduate subject pool could feasibly complete two laboratory assessments and the positive psychological intervention throughout the course of a single semester. All procedures were implemented in accordance with the University of Pittsburgh's Institutional Review Board.

Intervention Conditions

Active Control Condition

Participants in both conditions were asked to write every other day for 2 weeks. Those in the active control condition were asked to list their activities for that day (getting out of bed, getting dressed, walking to class, etc.). A recent meta-analysis suggests that this style of writing has little impact on positive psychological functioning ($r = 0.03$; Frattaroli, 2006); however, extra precautions were taken to minimize increases in positive affect in response to writing daily activities. Participants were encouraged to process their daily activities superficially by receiving the following instructions: (1) list each activity in brief, incomplete sentences; (2) document only facts about performing the activities; and (3) to *not* provide any

information about emotional responses to their daily activities. By following these instructions, participants are presumably deriving less meaning from their activities, which may minimize gains in positive affect in the active control condition (Pennebaker, 1993).

Positive Psychological Intervention

Participants in the intervention group selected a positive psychology activity and wrote a reflection on their experience performing that activity. The following six activities were selected for the intervention: (1) signature strengths, (2) three good things, (3) acts of kindness, (4) best future self, (5) writing and delivering a gratitude letter, and (6) savoring with mindful photography (see Supplementary Materials for the specific prompts given for each activity and relevant citations). The activities were selected based on prior literature showing their efficacy (see Table S1) and to encompass a range of affective and cognitive strategies that vary by orientation (e.g., past, future, and present), specific positive emotion targeted (optimism, gratitude, kindness), and social features (self vs. other focused). By providing a list of six activities, participants were able to select the activities that were most helpful to them. Because there are individual differences in *what* makes people happy (e.g., Sin et al., 2011), allowing participants to choose their activities may maximize the benefits of the intervention (Schueller, 2011; Schueller & Parks, 2012) and increase task engagement (Schueller, 2010). Another benefit of providing a "menu" of activities is to prevent habituation that can occur with repeating the same positive psychological activity across multiple days (Lyubomirsky & Layous, 2013). Providing flexibility in the activities that participants use may reduce habituation and maximize gains in positive affect in response to the intervention.

Online Prompt Administration

All participants, regardless of condition, received two text message notifications—one in the morning and one in the evening—on days when they were expected to complete an activity. In the control condition, the first text message was simply a reminder that they would complete a writing activity later that day. The second text message included a survey link so that they could list their daily activities. In the intervention condition, the first text message included a survey link asking which positive psychological activity they wanted to complete that day. The second text message provided the survey link to complete a reflection on performing that activity. After completing their respective activities, participants were then asked to answer some brief questions assessing their mood, health behaviors, and social functioning for that day.

Intervention Check

All writing samples were analyzed using the Linguistic Inquiry and Word Count software (LIWC; Pennebaker et al., 2001). This software uses a dictionary to classify words by specific categories (e.g., positive emotion words, social words, time orientation, etc.) and calculates the percentage of words in each category by the total number of written words. The LIWC software was used to calculate the percentage of positive emotion words written for each activity. It was expected that participants in the control condition would use fewer positive emotion words relative to the intervention condition.

Questionnaires

Demographic Questionnaires

Participants reported their age, sex (assigned at birth; Male or Female), gender/gender identity, race, ethnicity, year in college (First, Second, Third, Fourth, or Fourth +), and their major and minor area(s) of study. Socioeconomic status was measured as a proxy for circumstantial factors that can influence happiness (Lyubomirsky et al., 2005). Socioeconomic status was estimated by parental education and perceived parental social standing. Parental education was measured on a 1 ("did not complete high school") to 9 ("doctorate") scale (Gianaros et al., 2008). Perceived parental social status was assessed using the MacArthur Scale of Subjective Social Status (Adler et al., 2000).

Medical History

Psychotropic medication use was assessed by self-report. Anxiety symptoms were assessed using the 7-item PROMIS–Anxiety–short form scale and depressive symptoms were assessed using the 8-item PROMIS–Depression–short form scale (Pilkonis et al., 2011; Anxiety α = .89; Depression α = .92).

Hedonic Well-Being

Positive and negative affect were measured by two different instruments: the 20-item Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) and the 18-item Positive and Negative Emotional Style Questionnaire (PES and NES; Cohen et al., 2003; Jenkins et al., 2021). Both questionnaires were administered using both the "past few days" and "in general" timeframes. Although the PANAS is frequently used, its positive affect scale focuses on high-arousal affect (e.g., proud and excited) and is missing some low-arousal positive affect (e.g., calm and content) and mid arousal (e.g., happiness) characteristics that might be especially

relevant when assessing the outcomes of a positive psychological intervention (Pressman & Cohen, 2005). By contrast, the PES and NES scales include positively and negatively valenced adjectives that span the arousal continuum. There are nine adjectives used to measure PES that fall into three subscales: vigor (lively, full-of-pep, energetic), well-being (happy, pleased, cheerful), and calm (relaxed, calm, at ease). Similarly, nine adjectives are also used to measure NES across three subscales: anxiety (on edge, nervous, tense), depression (sad, depressed, unhappy), and hostility (hostile, resentful, angry). All positive and negative affect scales exhibited good internal consistency (PA-few days α = .88; NA-few days α = .83; PA-general α = .84; NA-general α = .83; PES-few days α = .90; NES-few days α = .83; PES-general α = .86; NES-general α = .84). In addition to assessing affect, life satisfaction was measured by the 10-item PROMIS General Life Satisfaction questionnaire (α = .92).

Psychological Well-Being

Psychological well-being was measured using the 42-item Psychological Well-being scale (Ryff, 1989; α = .93). Within the Psychological Well-being scale, there are six subscales including autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance.

Optimism

The Life Orientation Test–revised was used to assess optimism (Scheier et al., 1994; α = .82); while it is believed that the Life Orientation Test best captures dispositional optimism, previous studies have demonstrated that 2-week interventions where participants participated in the Best Future Self activity can increase self-reported optimism on this survey (e.g., Meevissen et al., 2011).

Loneliness

Loneliness was measured using the 8-item UCLA Loneliness Scale (Russell et al., 1978; α = .84).

Social Support

Perceived social support was assessed by the 12-Item Interpersonal Support Evaluation List (Cohen et al., 1985; α = .86).

Perceived Stress

Stress appraisals were assessed by the Perceived Stress Scale (Cohen et al., 1994; α = .85).

Post-Activity Questionnaires

Immediately following the writing activities, one-item questions were presented to assess daily well-being and health behaviors. To assess mood, all 18 items of the Positive and Negative Emotional Style scale were used (see above). Physical activity was assessed by asking "how many minutes of light physical activity did you do today (e.g., walking to class, cleaning, chores, etc.)?". The second question asks, "how many minutes of moderate to vigorous exercise do you do today (e.g., running, gym, sport, etc.)?". To assess sleep, participants reported both the total number of hours they slept the previous night and their overall sleep quality. Sleep quality was assessed on a 0 ("Very bad") to 4 ("Very good") scale. Participants rated their loneliness, social connectedness, perceived stress, and academic stress using a visual analogue scale to reflect how accurate each statement reflected the following statements: "Today I feel lonely or isolated," "Today I feel connected to others," "Today I feel stressed," and "Today I feel nervous or overwhelmed about school." The final question asked intervention participants if they spontaneously used any of the intervention skills during the day. If so, a follow-up question asked which skill(s) they used during the day. The purpose of this question was to understand whether participants were engaging in the positive psychological activities more frequently than was required by the intervention.

Intervention Feedback Survey

Participants in both conditions were asked to provide feedback on their experience with the intervention. All results were recorded on a visual analogue scale from 0 to 100. Participants were asked (1) how confident they were before starting the study that the writing prompts would be beneficial for them, (2) whether they believe the writing prompt impacted their mood throughout the study, (3) how helpful the writing prompts were, (4) and how likely they were to continue implementing the skills after the study.

Statistical Analyses

A Priori Power Analysis

Up to 250 participants were recruited with the assumption that not all students would complete all required portions of the study. A drop-out rate of 40% was anticipated based on previous studies with similar samples (e.g., Hurley & Kwon, 2012). With the proposed final sample (N = 150), it is anticipated that the current study has 80% power to detect a moderate effect size (d = 0.46) using a repeated measures MANOVA with a within-between interaction (G*Power version 3.1.9.2; Faul et al., 2007).

Baseline Comparisons

To check whether participants were successfully randomized into conditions, a Welch's t test or chi-square was used to compare baseline characteristics between the two groups. Welch's t test was conducted because it is less sensitive to unequal variances or differences in samples size between groups relative to the Student's t test. Any group differences at baseline were used as covariates for all subsequent analyses to control for any inherent group differences that may affect the interpretation of the results.

General Statistical Methods

The main study outcomes were assessed using questionnaire data collected at two time points (pre- vs. post-intervention). To reduce the number of statistical tests, Pearson's correlations were first calculated within a variable set and variables that were strongly correlated ($|r| \geq .50$) were included in the same model as dependent variables. Variable sets were predetermined groups of variables that measure overlapping constructs (e.g., positive affect, negative affect). Then, a semi-parametric 2-way repeated measures MANOVA was used to assess changes in a set of variables from pre-to post-intervention using the R package MANOVA.RM (Friedrich et al., 2018). The benefit of this semi-parametric approach is that it does not assume multivariate normality or homogeneity of variance-covariance matrices. Analyses were interpreted based on the parametric bootstrap modified ANOVA-type statistic (denoted by Q_N) and any main effects or interactions that were statistically significant at the conventional threshold of $p < .05$ were further assessed by univariate post-hoc comparisons with Bonferroni adjustment.

Per reviewer feedback on an initial draft of this manuscript, a Bayes factor (B_{10}) was included for all analyses producing non-statistically significant results. The Bayes factor is a ratio of the relative likelihood that the alternative hypothesis is supported relative to the null hypothesis. Briefly, Bayes factor indicates relative support for the null hypothesis according to the following criteria: weak evidence $B_{10} = 1.0$ to 0.33; moderate evidence $B_{10} = 0.33$ to 0.10; strong evidence $B_{10} = 0.10$ to 0.03; very strong 0.03 to 0.01; extreme evidence $< .01$ (Lee & Wagenmakers, 2014). Of note, Bayes factor cannot be computed for repeated measures MANOVA and has instead been reported for repeated measures ANOVA for each dependent variable. Therefore, Bayes factor was reported separately for each dependent variable (see Table S2). Cohen's d statistics are also reported for all results to ease interpretability. All statistical analyses were performed in R Studio (Version 1.3.1093; RStudio Team, 2020) and Bayes factors were computed using the *BayesFactor* package.

Positive Affect

To test whether a positive psychological intervention enhances positive affect, all four measures of positive affect (PANAS-PA-general, PANAS-PA-few days, PES-general, PES-few days) were considered as a set of dependent variables.

Positive Affect Sensitivity Analysis

To determine which subset(s) of positive affect (i.e., low vs. high arousal) are influenced by a positive psychological intervention, all three subsets of positive affect from the positive emotional style questionnaire were considered as a set of dependent variables (calm, well-being, and vigor) using both the "general" and "past few days" time scale. Of note, the impact of a positive psychological intervention on the subsets of positive affect were assessed regardless of whether or not there were any significant findings for the global measures of positive affect to provide a more comprehensive presentation of the results. However, these findings should be interpreted with caution, particularly in the absence of main effects or interactions with the global measures of positive affect.

Psychological Well-Being, Optimism, and Life Satisfaction

Psychological well-being, optimism, and life satisfaction were considered as a set of dependent variables to understand how a positive psychological intervention impacts these additional psychological factors.

Perceived Social Support and Loneliness

To test whether a positive psychological intervention increases perceived social support or reduces perceived loneliness, both outcomes were considered as one set of dependent variables.

Negative Affect

To test whether a positive psychological intervention reduces negative affect, depressive symptoms, anxiety symptoms, and perceived stress, and all four measures of negative affect (PANAS-NA-general, PANAS-NA-few days, NES-general, NES-few days) were considered as one set of dependent variables.

Exploratory Analyses

Exploratory analyses were conducted to examine whether increases in positive affect associated with changes in health behaviors, including sleep and physical activity. Exploratory analyses also aimed to understand whether specific positive

psychological activities were associated with changes in positive affect. Exploratory aims, analytic plans, results, and rationale can be found in Supplementary Materials.

Results

Participant Characteristics

Participants completed a survey prior to obtaining informed consent to determine eligibility. Of the participants screened ($N = 262$), some did not meet the inclusion criteria ($N = 2$), while others withdrew from the study prior to obtaining informed consent ($N = 10$). Therefore, a total of 250 participants (control $n = 129$; intervention $n = 121$) were enrolled in the study. In order for participants to be included in study analyses, they must have completed six writing prompts during the 2-week span; however, they did not have to participate in each of the six activities and could choose to perform the same activity each day, or could choose a different activity each day for the 2-week period (see Tables S3 and S4). Therefore, participants were excluded from analyses if they completed fewer than six of the eight writing prompts ($N = 16$); failed to complete the post-intervention questionnaires ($N = 6$); or failed attention checks that were included in

the questionnaires ($N = 3$); leading to a final sample of 225 participants (control $n = 122$; intervention $n = 103$; see Fig. 1 for study flow chart).

The overall sample had a mean age of 18.7 ± 2.1 years and was 76.9% female. The majority of participants identified as Caucasian (64.4%) and were in their first year of college (68.4%). There were no statistically significant differences in any baseline variables between the control and intervention conditions (Tables 1 and 2). As such, no covariates were used in subsequent analyses. Similarly, both conditions reported similar levels of trait positive affect before randomization, suggesting that the stratified randomization was successful, PANAS-PA: $t(216.47) = 0.21$, $p = .83$; PES: $t(217.24) = -1.28$, $p = .20$.

Intervention Check

Participants in the intervention condition used a greater percentage of positive emotion words during their writing activities ($M = 6.89$, $SD = 1.61$) relative to the control condition, $M = 1.05$, $SD = 1.14$; $t(179.59) = -30.66$, $p < .001$. Therefore, the intervention successfully elicited more positive emotions during the positive psychological activities relative to the control activity.

Fig. 1 CONSORT flow chart describing the enrollment, recruitment, and retention of study participants for the positive psychological intervention
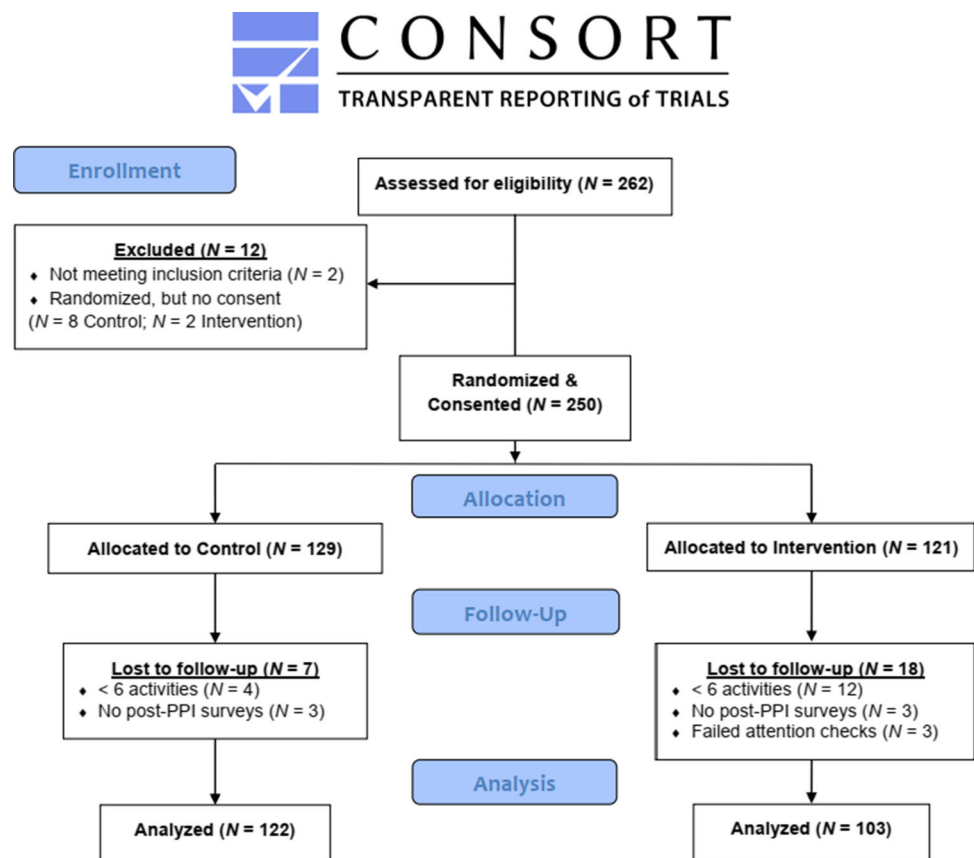
Table 1 Descriptive statistics for demographic and positive affect variables

	Controls (N = 122)	Intervention (N = 103)	Difference	
	M (SD) or N (%)	M (SD) or N (%)	t or X^2	p
Age	18.7 (1.1)	18.8 (2.8)	− 0.58	0.56
Sex				
Female	91 (74.6%)	82 (79.6%)	0.53	.46
Male	31 (25.4%)	21 (20.4%)		
Race				
Caucasian	85 (69.7%)	60 (58.3%)	5.58	.23
Asian	26 (21.3%)	25 (24.3%)		
African American	4 (3.3%)	7 (6.8%)		
Biracial	5 (4.1%)	10 (9.7%)		
Other	2 (1.6%)	1 (1.0%)		
Year in college				
First	81 (66.4%)	73 (70.9%)	2.02	.73
Second	23 (18.9%)	18 (17.5%)		
Third	11 (9.0%)	8 (7.8%)		
Fourth +	7 (5.7%)	4 (3.9%)		
Psychotropic use				
Yes	17 (13.9%)	7 (6.8%)	2.28	.13
No	105 (86.1%)	96 (93.2%)		
Positive affect				
PANAS-PA: In general	33.7 (6.08)	33.5 (6.10)	0.21	.83
PANAS-PA: Last few days	31.1 (7.43)	31.1 (7.75)	.006	.99
PES: In general	27.8 (5.73)	28.7 (5.68)	− 1.28	.20
PES: Last few days	16.6 (6.63)	17.3 (7.18)	− 0.80	.43

Table 2 Descriptive statistics for additional baseline variables

	Controls (Ni = 122)	Intervention (N = 103)	Difference	
	M (SD) or N (%)	M (SD) or N (%)	t or X^2	p
Life satisfaction	40.9 (9.51)	39.7 (9.96)	0.93	.35
Psychological well-being	216 (32.1)	212 (31.8)	0.97	.33
Optimism	19.4 (4.35)	19.7 (4.05)	− 0.44	.66
Negative affect				
PANAS-NA: In general	20.3 (6.08)	20.1 (5.74)	0.22	.83
PANAS-NA: Last few days	18.6 (5.87)	18.9 (5.56)	− 0.39	.70
NES: In general	17.5 (5.26)	17.3 (5.35)	0.28	.77
NES: Last few days	7.35 (5.33)	7.86 (5.37)	− 0.71	.48
PROMIS-ANX	16.9 (5.21)	17.3 (4.96)	− 0.58	.56
PROMIS-MDD	13.8 (6.08)	13.6 (5.12)	0.31	.76
Perceived stress	17.9 (6.05)	18.7 (5.70)	− 0.99	.32
Social support and loneliness				
ISEL (perceived social support)	39.8 (5.81)	38.4 (6.71)	1.66	.09
UCLA Loneliness Scale	10.1 (4.85)	10.8 (4.76)	− 0.96	.33
Health behaviors				
Sleep duration (min)	458 (59.1)	461 (58.8)	− 0.35	.73
Sleep quality (1–5)	2.61 (0.87)	2.57 (0.86)	0.29	.77
Light physical activity (min)	270 (281)	340 (758)	− 0.88	.38
Vig-mod physical activity (min)	119 (172)	142 (191)	− 0.97	.33

Positive Affect

All indicators of positive affect were correlated at $r \geq .50$ (range $r = .61$–.79; Table 3) and therefore entered in a single MANOVA as simultaneous outcome variables. There was a significant main effect of time ($Q_N = 46.14$, $p < .001$), such that positive affect decreased from baseline to post-intervention across both conditions. Post-hoc analyses were performed to understand which measure(s) of positive affect change as a function of time. As depicted in Fig. 2, post-hoc analyses indicate that these effects are primarily due to changes in reports of general positive affect, PANAS-PA: $t(431.15) = -5.60$, $p < .001$; PES: $t(441.86) = -3.22$, $p = .001$ and PANAS-measured positive affect in the past few days, $t(447.71) = -2.41$, $p = .02$; Table S5. There was no main effect of condition ($Q_N = 8.89$, $p = .11$) or condition × time interaction ($Q_N = 12.36$, $p = .49$) on positive affect.

Sensitivity Analysis

Well-being and vigor were correlated at $r = .59$–.80, while calm was correlated with vigor at $r = .17$–.37 and well-being at $r = .33$–.48. Therefore, well-being and vigor were entered into one model while calm was assessed with a repeated-measures ANOVA. Well-being and vigor decreased across time ($Q_N = 18.14$, $p = .02$; Table S5), but there was no main effect of condition ($Q_N = 10.09$, $p = .10$), or condition × time interaction ($Q_N = 1.54$, $p = .61$). By contrast, there was a main effect of condition on calmness, such that the intervention condition reported overall greater calm relative to control

participants ($Q_N = 7.09$, $p = .049$; Table S5). There was no main effect of time ($Q_N = 4.14$, $p = .12$) or condition × time interaction ($Q_N = 0.88$, $p = .56$) on calm.

Psychological Well-being, Optimism, and Life Satisfaction

Optimism, psychological well-being, and life satisfaction were all moderately correlated (range $r = .58$–.63; Table 3) and entered into a single model. There was no main effect of condition ($Q_N = 0.98$, $p = .75$), no main effect of time ($Q_N = 2.41$, $p = .43$), and no condition × time interaction ($Q_N = 1.14$, $p = .70$) on psychological well-being, life satisfaction, or optimism (Fig. 3).

Perceived Social Support and Loneliness

Perceived social support and perceived loneliness were correlated at $r = -.70$ (Table 3) and were included in the same model. There was no main effect of condition ($Q_N = 4.71$, $p = .11$), no main effect of time ($Q_N = 0.90$, $p = .96$), and no condition × time interaction ($Q_N = 0.63$, $p = .62$) on perceived social support and loneliness (Fig. 4).

Negative Affect

Negative affect, anxiety, depressive symptoms, and perceived stress correlated at $r > .50$ (range $r = .53$–.84; Table 3) and were included in the model together as dependent variables. There was a main effect of time ($Q_N = 32.10$, $p = .02$;

Table 3 Correlations between study variables at baseline

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. PA- Gen	-														
2. PA- Days	**.76**	-													
3. PES- Gen	**.71**	**.61**	-												
4. PES- Days	**.62**	**.79**	**.75**	-											
5. GLS	**.41**	**.51**	**.37**	**.55**	-										
6. PWB	**.57**	**.65**	**.44**	**.56**	**.60**	-									
7. LOT-R	**.46**	**.47**	**.45**	**.50**	**.58**	**.63**	-								
8. NA- Gen	-.13	**-.25**	**-.24**	**-.27**	**-.26**	**-.43**	**-.33**	-							
9. NA- Days	-.14	**-.26**	**-.24**	**-.29**	**-.28**	**-.43**	**-.27**	**.79**	-						
10. NES-Gen	**-.25**	**-.33**	**-.34**	**-.38**	**-.36**	**-.48**	**-.36**	**.84**	**.73**	-					
11. NES- Days	**-.26**	**-.38**	**-.34**	**-.40**	**-.40**	**-.51**	**-.38**	**.68**	**.84**	**.77**	-				
12. ANX	**-.21**	**-.33**	**-.32**	**-.37**	**-.30**	**-.50**	**-.30**	**.71**	**.76**	**.70**	**.73**	-			
13. MDD	**-.39**	**-.49**	**-.40**	**-.47**	**-.53**	**-.64**	**-.47**	**.53**	**.61**	**.63**	**.71**	**.67**	-		
14. PSS	**-.35**	**-.47**	**-.36**	**-.50**	**-.48**	**-.58**	**-.47**	**.55**	**.63**	**.54**	**.61**	**.65**	**.62**		
15. ISEL	**.34**	**.36**	**.34**	**.32**	**.31**	**.53**	**.39**	**-.27**	**-.23**	**-.26**	**-.26**	**-.18**	**-.31**	**-.25**	
16. UCLA	**-.42**	**-.49**	**-.41**	**-.45**	**-.38**	**-.66**	**-.53**	**.39**	**.36**	**.41**	**.45**	**.42**	**.47**	**.45**	**-.70**

Bolded values are statistically significant after Bonferroni correction. The numbers in bold italic on the table represent the difference clusters of study variables that were simultaneously entered as dependent variables within the same model. *PA-gen* PANAS-PA (in general), *PA-Days* PANAS-PA (last few days), *PES-Gen* positive emotional style (in general), *PES-Days* positive emotional style (last few days), *GLS* PROMIS-General Life Satisfaction, *PWB* Psychological Well-being Scale, *LOT-R* Life Orientation Test-Revised, *NA-gen* PANAS-NA (in general), *NA-Days* PANAS-NA (last few days), *NES-Gen* negative emotional style (in general), *NES-Days* negative emotional style (last few days), *ANX* PROMIS-Anxiety-Short-Form, *MDD* PROMIS-Depression-Short-Form, *PSS* Perceived Stress Scale, *ISEL* Interpersonal Support Evaluation List, *UCLA* UCLA Loneliness Scale
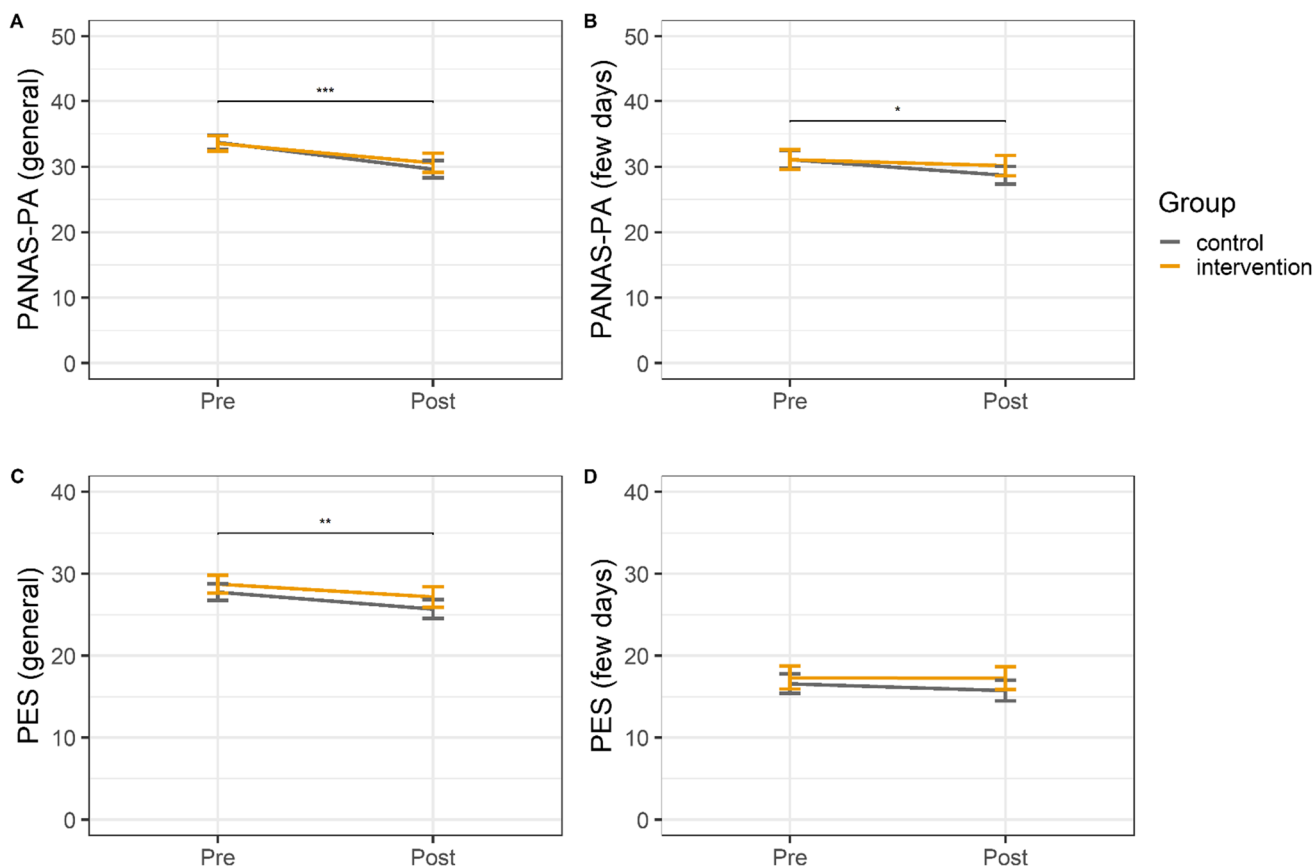
Fig. 2 Changes in self-reported positive affect from pre- to post-intervention in the control and intervention conditions using **A** PANAS-PA (in general), **B** PANAS-PA (last few days), **C** positive emotional style (in general), and **D** positive emotional style (last few days)

Table S5), such that negative affect decreased from baseline to post-intervention in both conditions. To gain insight into which measure(s) of negative affect change across time, post-hoc analyses were performed. As depicted in Fig. 5, post-hoc analyses indicate that these effects are primarily due to changes reports of general negative affect, PANAS-NA: $t(445.95) = -4.86$, $p < .001$ $d = 0.46$; NES: $t(447.88) = -2.14$, $p = .03$; $d = 0.20$. There was no main effect of condition ($Q_N = 3.06$, $p = .69$) or condition × time interaction ($Q_N = 6.65$, $p = .35$) on aggregate indices of negative affect.

Unregistered Analyses

The feedback data were analyzed using a Welch's t test to gain further insights into the perceived effectiveness of the writing prompts in the intervention condition relative to controls (see Table 4). When reflecting on their beliefs at the beginning of the study, participants in both conditions were moderately confident that they would benefit from the writing prompts, $t(222.7) = -1.84$, $p = .06$. Participants in the intervention condition self-reported that the writing activities as more beneficial for their mood, $t(222.8) = -5.32$, $p < .001$ and more helpful, $t(222.8) = -4.87$, $p < .001$ relative to participants in

the control condition. Finally, intervention participants were also more likely to continue the skills after the study ended, relative to controls, $t(222.8) = -3.02$, $p = .002$.

Post-Hoc Power Analysis

It was anticipated that only 150 participants would have completed the intervention; however, the total sample included 225 participants. As such, a post-hoc power analysis was performed to understand the smallest effect size that could have been detected given the final sample size. With a final sample size of $N = 225$, the study achieved 80% power to detect a small-to-moderate effect size ($d = .38$) using a repeated measures MANOVA with a within-between interaction (G*Power version 3.1.9.2; Faul et al., 2007).

Discussion

The 2-week online positive psychological intervention failed to influence positive affect, psychological well-being, perceived social support and loneliness, or negative affect in relative to the control condition. Regardless of condition, positive affect decreased across time, particularly general

Fig. 3 Changes in self-reported **A** psychological well-being, **B** optimism, and **C** life satisfaction from pre- to post-intervention in the control and intervention conditions
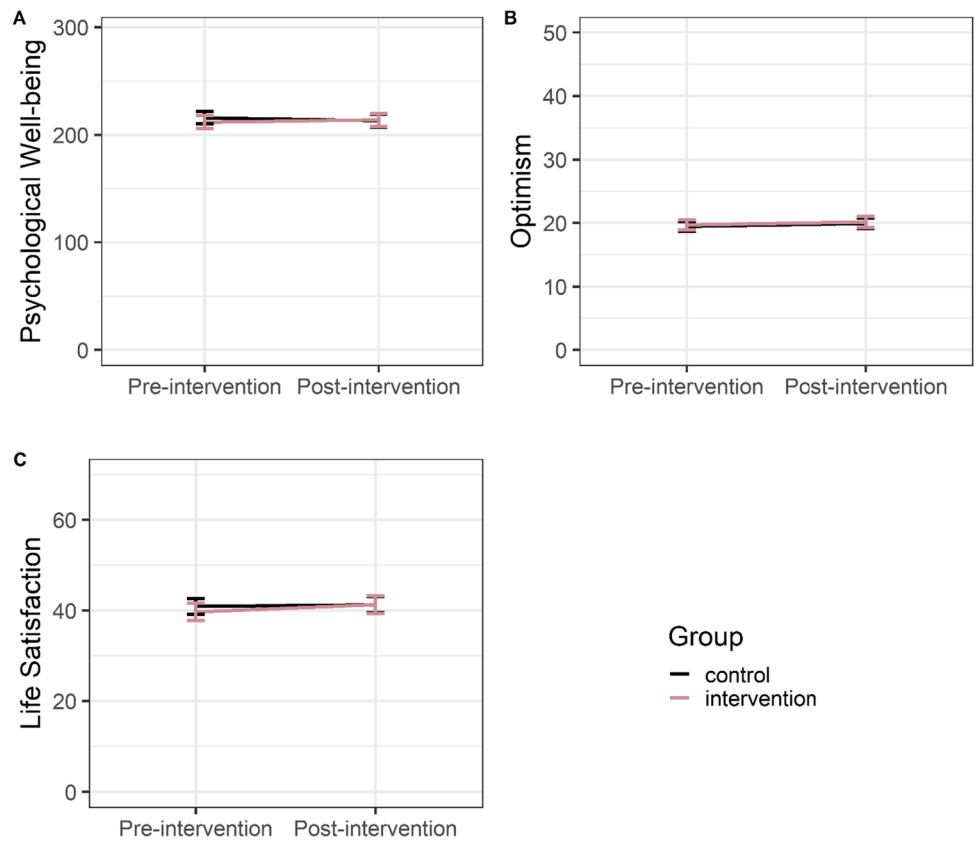
measures of positive affect and when assessed using the PANAS, which measures high-arousal positive affect. Consistent with this finding, subtype analyses suggested that only well-being (mid-level arousal) and vigor (high arousal) subsets of positive affect decreased during the intervention. By contrast, calmness was higher in the intervention group relative to the control condition. General negative affect also decreased from pre- to post-intervention in both conditions.

The current positive psychological intervention might have failed to increase positive affect for a few reasons. First, the participants could have been less engaged in the activities relative to previous studies. Due to the coronavirus pandemic, the positive psychological intervention was administered completely online through text message-delivered survey links. This method closely resembles current and past phone applications, such as *Live Happy*, which provide modules that guide the user through positive psychological activities (Parks
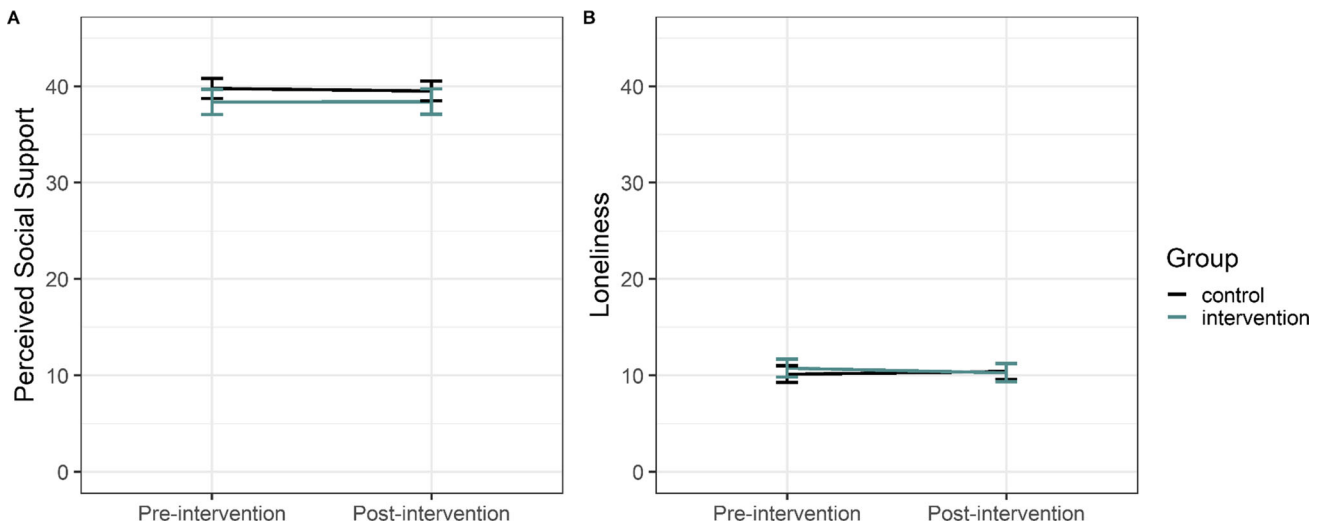

Fig. 4 Changes in self-reported **A** perceived social support and **B** loneliness from pre- to post-intervention in the control and intervention conditions

Fig. 5 Changes in self-reported negative affect and related constructs from pre- to post-intervention in the control and intervention conditions using **A** PANAS-NA (in general), **B** PANAS-NA (last few days), **C** negative emotional style (in general), **D** negative emotional style (last few days), **E** PROMIS-Depression-Short Form, **F** PROMIS-Anxiety-Short Form, and **G** Perceived Stress Scale
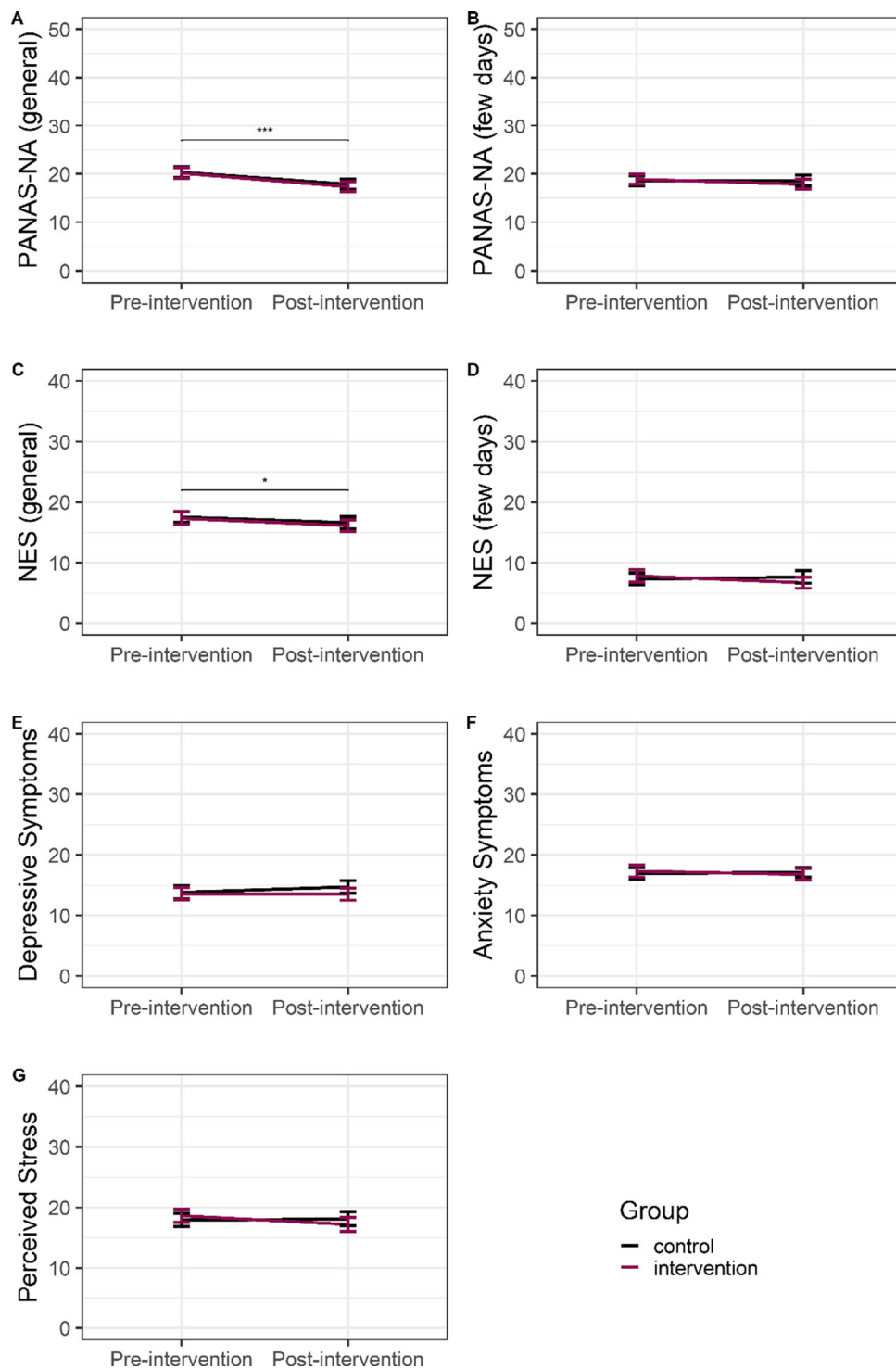
et al., 2012). One study assessing the efficacy of the *Live Happy* application showed that while the application was downloaded on nearly 3,000 devices, only 11% of users completed a minimum of two mood surveys and one activity, limiting insight into the application's efficacy. This may suggest that even those who are motivated to learn self-help strategies for improving happiness may lack the motivation or

support to continually integrate these activities into daily life (Parks et al., 2012; Schueller & Parks, 2014). Importantly, self-selecting into a positive psychological intervention and overall effort spent during related activities are both associated with greater gains in happiness (Lyubomirsky et al., 2011). While the current study was not overtly advertised as a happiness intervention, participants were aware that the purpose

Table 4 Results of intervention feedback survey

	Controls (N = 122) M (SD)	Intervention (N = 103) M (SD)	Difference t	p
Before you started this study, how confident were you that the writing prompts would be beneficial for you? 0 = Not at all confident 100 = Extremely confident	39.3 (24.6)	45.0 (21.5)	− 1.84	.07
What is your best guess about how the writing prompt influenced your mood throughout the study? 0 = No mood benefit 100 = Extremely beneficial for mood	41.8 (24.9)	57.8 (20.4)	− 5.32	< .001
Now that you have completed the writing prompts, how helpful do you think the writing prompts were for you? 0 = Not at all helpful 100 = Extremely helpful	45.4 (24.0)	59.6 (19.6)	− 4.87	< .001
How likely are you to continue implementing the skills that you wrote about on a regular basis over the next several months? 0 = Not at all likely 100 = Extremely likely	40.0 (28.2)	50.6 (24.6)	− 3.02	.003

of the study was to understand how writing activities may impact mood and well-being. It is possible that the ambiguity in the study aim could have led to an under-recruitment of students who were motivated to increase happiness during the pandemic. While effort and level of engagement with the activities were not assessed, those in the intervention condition reported a greater benefit from the writing activities and viewed the activities as being more helpful relative to those in the control condition. As treatment expectations are an important factor in intervention efficacy (Beatty & Binnion, 2016), it seems more likely that the mode of delivery and failure to integrate the skills into daily life could have impacted the intervention efficacy, rather than the lack of treatment expectations.

A second explanation as to why the current positive psychological intervention was not associated with increases in positive affect could be due to the variety of activities that were offered. While each of these activities, individually, has been demonstrated to increase positive affect, most short-term interventions (< 4 weeks) use a single skill for participants to work on rather than providing multiple positive psychological activities (Sin & Lyubomirsky, 2009; but also see Fordyce, 1977). The rationale for including multiple activities was to account for individual differences in what makes people happy (Sin et al., 2011) and preventing habituation that could occur when activities are repeated (Lyubomirsky & Layous, 2013). Interestingly, only a small fraction of study participants (N = 9; 8.7%) completed the same activity throughout the entire 2-week duration, suggesting that habituation was not a major concern in the current study. However, it is possible that 2 weeks is not enough time for participants to identify which activities were most beneficial to them *and* to develop the skills promoted by each

activity. Along these lines, results from our exploratory analyses suggested that writing and delivering a gratitude letter was most strongly associated with gains in positive affect, but this was also the activity chosen least frequently, with only 54% of the participants choosing to write a gratitude letter at least once during the 2-week intervention. This might suggest that the study participants were unable to learn which activities were most effective at eliciting positive affect within the 2-week intervention. Alternatively, participants may also generally lack insight into which activities are most beneficial to them, regardless of the time frame. As such, longer interventions might be necessary for studies that provide a variety of positive psychological activities (e.g., Celano, Freedman et al., 2018; Celano, Albanese et al., 2018).

Third, it is important to consider the unique challenges of administering an online psychological intervention during a global pandemic. As noted earlier, college students have reported more anxiety and stress during the pandemic relative to adults (Huang & Zhao, 2020; Wang et al., 2020). Furthermore, students *without* a pre-existing mental health condition were more likely to be negatively impacted by the pandemic compared to students with a history of mental health concerns (Hamza et al., 2020). This may be even more important for female students (75% of the current sample), as women self-report greater pandemic-related stress relative to men (e.g., Yan et al., 2021). While longitudinal studies suggest that loneliness did not increase throughout the pandemic as was anecdotally believed (Aknin et al., 2022), other social factors have been strongly correlated with mental health during the pandemic, such that social isolation (d = 0.73; Hamza et al., 2020), lower perceived social support, and less social connection (d = 0.41–0.58; Graupensperger et al., 2020) are all associated with poorer mental health outcomes during quarantine.

Because social support has been strongly linked to poor mental health during the pandemic, failing to include activities targeted specifically at reducing feelings of loneliness or social isolation could have negatively impacted the efficacy of the intervention. As such, positive psychological interventions administered during the pandemic may be more successful if they include activities aimed at increasing social connection (e.g., loving-kindness meditation; active constructive responding; Hutcherson et al., 2008; Seligman et al., 2005), or facilitate social interactions by delivering the intervention in a group format (Sin & Lyubomirsky, 2009). Another potential challenge of administering an intervention during the pandemic is that some of the activities, such as acts of kindness, could have been more difficult to perform during quarantine restrictions. Taken together, more work is necessary to understand how the pandemic, and chronic stressors more broadly, may influence the efficacy of previously validated interventions and how facilitating social interactions might enhance intervention efficacy.

Related, it is unclear the extent to which the mode of intervention—an online, self-help format—may have influenced study findings. While early work suggested that positive psychological interventions are feasible to deliver online (Mitchell et al., 2010; Seligman et al., 2005, but also see Mongrain & Anselmo-Matthews, 2012), the self-help nature of online interventions may lead to smaller increases in positive affect relative to interventions conducted in an individual or group format (Boiler et al., 2013). This finding is consistent with results from other psychological interventions that demonstrate self-help interventions are less effective at reducing stress (Spijkerman et al., 2016), anxiety, and depression (Saddichha et al., 2014) relative to online interventions that provide guidance. As such, future work may aim to implement online positive psychological interventions using a guided individual or group format through videoconferencing platforms.

Yet another important factor to consider is whether a 2-week intervention is long enough to impact positive affect in the context of a significant stressful event, such as a global pandemic. To date, a few short-term interventions have been utilized to promote mental health during the COVID-19 pandemic, with success in increasing positive affect (Brouzos et al., 2021), while reducing anxiety, depression, perceived stress, and loneliness (Brouzos et al., 2021; Riva et al., 2021; Wei et al., 2020; Gabrielli et al., 2021). While the mode of delivery spanned from self-help and virtual reality (Wei et al., 2020; Riva et al., 2021) to group or individual formats (Gabrielli et al., 2021; Brouzos et al., 2021), one consistent factor was that each study incorporated aspects of mindfulness and relaxation exercises in addition to activities consistent with positive psychology and cognitive behavioral therapy. As such, the duration of the intervention may be less relevant than the specific activities that participants were able to choose from.

Of note, both positive and negative affect decreased from pre- to post-intervention in both conditions. These findings are somewhat consistent with epidemiological samples that assessed changes in positive and negative affect during the course of the pandemic. Overall, the majority of studies provide support that negative affect increased in the first few months of the pandemic, but returned to near-baseline measures by the middle of 2020 (Aknin et al., 2022). The data are mixed about the findings for positive affect, such that a single study of French adults found that positive affect increased during the first few months of the pandemic (Recchi et al., 2020), while other studies report that positive affect decreased during that same time (Fao et al., 2020; Fujiwara et al., 2020), or remained unchanged (Helliwell et al., 2021; reviewed in Aknin et al., 2022). Given that the current sample was collected later in the pandemic, during the Fall of 2020, it is possible that the overall decreases in positive and negative affect across time may reflect participants returning to pre-pandemic baseline levels of affect.

The 2-week online positive psychological intervention did not influence psychological well-being, optimism, life satisfaction, or negative affect and related symptomatology. Two well-cited meta-analyses originally estimated that positive psychological interventions have moderate effects on psychological well-being ($r = .10–.29$) and depressive symptoms ($r = .11–.31$; Boiler et al., 2013; Sin & Lyubomirsky, 2009). However, a more recent study re-analyzed data from both meta-analyses to account for small sample sizes that are common within the aggregated studies. After weighting the study effects based on their sample size, which is common practice for meta-analyses, the ability for positive psychological interventions to enhance psychological well-being ($r = .02–.08$) or reduce depressive symptoms ($r = .02–.08$) was smaller than originally estimated (White et al., 2019). One common critique of studies that implement positive psychological interventions are the relatively small samples collected for each study. However, the current study collected data from 225 participants, a sample larger than previous studies, and also failed to demonstrate that a positive psychological intervention improves psychological well-being or negative affect. Taken together, more work is necessary to understand the specific emotional and cognitive changes that can occur following various positive psychological activities and interventions.

The current study had several strengths, including the relatively large sample size that was powered to detect a small-to-moderate effect size ($d = .38$), use of an active control condition as compared to a waitlist control, and use of empirically supported positive psychological interventions. However, there were also several limitations, including (1) limiting the sample to undergraduate students, with the final sample primarily comprised of white women in their first year of college, (2) delivering the intervention in an online 'self-

help' format, (3) over a short time frame, (4) failing to provide a positive psychological activity focused on improving social connection and reducing isolation during the pandemic, and (5) not having an assessment of motivation or effort exerted during the activities and (6) some activities included, such as acts of kindness, may have been more difficult to perform during pandemic-related quarantine. While the current study does not support the ability of an online 2-week positive psychological intervention to enhance positive affect or other positive psychological factors during a global pandemic, more research is necessary to understand how to deliver positive psychological interventions in way that maximizes gains in positive affect during periods of high psychological stress.

Additional Information

Conflicts of Interest   Not applicable.

Data Availability   Data for the project can be obtained here: https://osf.io/79x48/.

Code availability   Not applicable.

Authors' contributions   Not applicable.

Ethics Approval   All procedures were approved by the University of Pittsburgh Institutional Review Board.

Consent to participate   Not applicable.

Consent for publication   Not applicable.

Informed Consent   Informed consent was obtained from all study participants.

Supplementary Information   The online version contains supplementary material available at https://doi.org/10.1007/s42761-022-00148-z.

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