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Expressing gratitude and visualising one's best possible self: Assessing the effectiveness of a four-week intervention on affect and health behaviours during the COVID-19 lockdown

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Abstract

This research examined affect and health behaviours over four weeks during consecutive COVID-19 lockdowns in the United Kingdom (UK), and the impact of expressing gratitude (EG) and visualising one's best possible self (BPS) on these outcomes compared to a control condition. Participants ($N = 145$) took part in a 4-week intervention during lockdown and completed an EG, BPS, or control exercise and measures of affect and health behaviours once per week for four weeks. Results showed that participants reported increased positive affect and decreased negative affect, reduced food consumption, and lower levels of moderate and vigorous exercise, but no change in alcohol consumption and walking. There were, however, no significant effects of the interventions vs. control condition on any of the outcomes; these findings were also supported by Bayes factors. This research suggests that people changed their health behaviours and affect during the COVID-19 lockdown, but that BPS and EG interventions may not be viable interventions to promote these outcomes during intense crises such as COVID-19.

Keywords COVID-19 · Expressing gratitude · Best possible self · Affect · Health behaviours

Research has demonstrated that the COVID-19 pandemic and its related restrictions such as self-isolation, quarantine, lockdown, and social distancing negatively impacted mental and physical wellbeing (Bueno-Notivol et al., 2021; Niedzwiedz et al., 2021). Given that health behaviours (e.g., food and alcohol consumption and exercise habits) are leading risk factors for poor mental and physical wellbeing (Manuel et al. 2016), one potential cause might be changes in health behaviours during this intense crisis (Arora & Grey, 2020). For example, research has shown that participants engaged less in physical activity, ate less fruits and vegetables, and consumed more alcohol and sugary foods during COVID-19 lockdown (Deschasaux-Tanguy et al., 2021; Naughton et al., 2020). It is therefore crucial to explore activities that can promote health behaviours and wellbeing during and after such intense crises, especially because the negative impacts of COVID-19 can persist long-term (Pieh et al., 2021). Tentative evidence suggests that one way to achieve this might be through positive psychology interventions (Dennis & Ogden, 2022; Dennis et al., 2022), although more research is needed to confirm these findings.

The present study investigated whether two positive psychology interventions (i.e., expressing gratitude and visualising one's best possible self: Emmons & McCullough, 2003; King, 2001) could improve affect, physical activity, and food and alcohol consumption during COVID-19 lockdown in the United Kingdom (UK), as compared to a control group. Because most previous COVID-19 studies were conducted during the first lockdown and assessed wellbeing and health behaviours before vs. after lockdown (Bennett et al., 2021), we examined changes in health behaviour and affect during the second (5 November to 2 December 2020) and third (6 January to 29 March 2021) lockdowns in the UK. Finally, given that young people were particularly negatively affected by COVID-19 restrictions (Varma et al., 2021), we specifically examined these links in a student population.

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Positive psychology interventions and mental wellbeing

Research has demonstrated immediate and long-term effects of practicing positive psychology activities such as visualising one's best possible future self (BPS) and expressing gratitude (EG) on mental well-being. The BPS task is a positive psychology intervention introduced by King, (2001), that asks participants to write about the best future version of themselves after everything has gone as well as it possibly could, typically focusing on life domains that are most influential in predicting well-being (i.e., one's best possible romantic life, educational attainment, career situation, physical/mental health, and social life: Argyle, 2001; King, 2001; Meevissen et al., 2011). A meta-analysis showed that the BPS is an effective intervention for improving mental wellbeing, optimism, and positive affect compared to controls, and somewhat effective at reducing negative affect and depressive symptoms (Carrillo et al., 2019; see also Meevissen et al., 2011; Peters et al., 2010; Sheldon & Lyubomirsky, 2006).

The EG task is a positive psychology intervention introduced by Emmons & McCullough, (2003). While this task can take different forms, it typically asks participants to write (but not to send) a letter to another person about times when they were grateful for something that this person had done for them, or to write lists of things they are grateful for (Carrillo et al., 2019; Davis et al., 2016; Lyubomirsky et al., 2011; Seligman et al., 2005). Similar to the BPS task, a meta-analysis showed that the EG task is a relatively effective intervention for improving mental wellbeing (i.e., life satisfaction and depression aggregated) compared to controls (Davis et al., 2016; see also Emmons & McCullough, 2003; Froh et al., 2008). Thus, the BPS and EG tasks are considered valuable and low-cost interventions for enhancing mental wellbeing, suggesting that they may also be effective during COVID-19 lockdown (but see Carrillo et al., 2019; Cregg & Cheavens, 2020; Davis et al., 2016; Dickens, 2017; Heekerens & Eid, 2021; Wood et al., 2010).

Although the mechanisms by which the BPS and EG exercises are related to enhanced mental wellbeing remain uncertain, one possible explanation comes from Fredrickson's, (2001) broaden-and-build theory. This theory holds that reflecting on and appreciating one's past, present, and future life circumstances and situations enhance peoples' personal resources (i.e., physical, intellectual, social), ultimately promoting people's ability to cope with current negative emotions and difficult situations (Fredrickson, 2004), such as the COVID-19 crisis. Initial research has proposed that positive psychology interventions may indeed promote mental wellbeing during COVID-19 (Fekete & Deichert, 2022; Fishman, 2020; Krifa et al., 2022; Kumar et al., 2022). For example, Geier & Morris, (2022) found that students assigned to list 5 things they were grateful for in the previous week for 10 weeks reported greater mental wellbeing during COVID-19 compared to an inactive control group who did not receive an assignment. Moreover, during the first UK lockdown, Dennis et al., (2022) assigned participants to either imagine their best possible self after the lockdown (BPS condition), provide a summary of a previous nostalgic event (nostalgia condition), or to list things they were grateful for (EG condition), and assessed immediate effects on mental wellbeing (e.g., affect, social connectedness). They found that BPS participants reported greater positive affect compared to nostalgia participants, and that BPS and EG participants experienced greater social connectedness compared to nostalgia (but not control) participants.

Dennis & Ogden, (2022) extended this work by examining how these interventions influenced mental wellbeing outcomes over two weeks. They found immediate intervention effects for self-esteem and social connectedness such that nostalgia, BPS, and EG participants scored higher on self-esteem than controls who simply summarised a TV plot, and BPS and EG participants scored higher on social connectedness than nostalgia and control participants. More long-term intervention effects were found for fear of COVID-19 such that nostalgia, BPS, and EG participants scored lower on this measure than controls, although it is important to point out that no baseline measures were included in this study. These data thus provide initial evidence that BPS and EG interventions may enhance mental wellbeing during COVID-19 lockdown, although more research is needed to test this hypothesis.

Positive psychology interventions, health behaviours, and physical wellbeing

Despite these promising effects on mental wellbeing, studies investigating how these interventions influence health behaviours and physical wellbeing are scarce, which is surprising given the well-established links between health behaviours, physical wellbeing, and mental wellbeing (e.g., Parletta et al., 2016), suggesting that these interventions may also be effective in promoting health behaviours and physical wellbeing. Tentative support for this hypothesis was found in Emmons & McCullough, (2003) who investigated how an EG exercise influenced physical health outcomes overtime, as compared to participants who listed weekly hassles or life events. Study 1 found that EG participants reported exercising more and experienced fewer physical symptoms than participants who listed weekly hassles or life events, although these findings failed to replicate in Study 2 and Study 3. Instead, Study 2 found that EG participants

reported more prosocial behaviours than participants who listed weekly hassles or who made downward social comparisons, and Study 3 found that EG participants reported getting more sleep and felt more refreshed when waking up compared to control participants who did not complete any exercises.

In addition, another study assigned participants with physical disabilities and chronic pain to a positive psychology intervention (such as the BPS) or a control condition and found improvements in physical health (i.e., pain intensity and pain control) in participants assigned to the positive psychology intervention (Muller et al., 2016). A review further found that positive psychological attributes, particularly those that are predicted by EG and BPS interventions (i.e., positive emotions, optimism, gratitude), were associated with increased participation in cardiac health behaviours (e.g., healthy eating, physical activity) in cardiac patients, with the researchers concluding that future studies need to further investigate the impact of these interventions on health behaviours and outcomes (DuBois et al., 2012). Two other reviews have similarly argued that these interventions are promising in improving physical wellbeing and health behaviours such as physical activity, diet, and smoking, though more research in this area is needed (Boehm et al., 2012; Corte et al., 2020; Park et al., 2016). Other lines of research have found that EG exercises lead to increased sleep quality and reductions in blood pressure (Jackowska et al., 2016; but see Dickens, 2017), and decreases in ill-being such as athlete burnout (Gabana et al., 2019). However, to our knowledge, no research has examined how BPS and EG interventions influence health behaviours such as food and alcohol consumption and physical activity during COVID-19 lockdown.

The present study

Previous research has found that people reduced their health behaviours such as fruit and vegetable consumption and physical activity levels during COVID-19 lockdown (e.g., Naughton et al., 2020; Niedzwiedz et al., 2021), although others have reported improvements in eating habits and physical activity levels (e.g., Bennett et al., 2021; Di Renzo et al., 2020). Likewise, although research has demonstrated a decline in mental health during COVID-19 (e.g., Bueno-Notivol et al., 2021; Smith et al., 2020), some have argued that this decline was only short-term, with people returning to baseline mental health levels shortly after the COVID-19 onset (e.g., Daly & Robinson, 2021; Robinson et al., 2022). It has therefore been suggested that more research is needed to better understand the short- and long-term outcomes of the COVID-19 crisis (Arora & Grey, 2020), especially because most of this research was conducted during the first wave of the COVID-19 pandemic (e.g., Naughton et al., 2020; Niedzwiedz et al., 2021). It seems plausible that people may experience fewer psychological burdens during consecutive lockdowns due to greater psychological immunity against environmental stressors, fear, and anxiety, although the opposite may also be true due to 'pandemic fatigue' (Gupta & Nebhinani, 2020; Moradian et al., 2021; Wilson & Gilbert, 2005). Thus, one aim of this research was to examine positive and negative affect, physical activity levels, and food and alcohol consumption during consecutive COVID-19 lockdowns in the UK.

Moreover, while several studies have found evidence that BPS and EG interventions promote mental wellbeing, only a few studies have investigated how these interventions influence health behaviours and physical wellbeing (Muller et al., 2016). However, these studies were conducted outside the context of the COVID-19 crisis, and much less is known about the effectiveness of these interventions during times of national and international upheaval, such as the COVID-19 crisis (Dennis & Ogden, 2022). To add to this body of research, in the current research we examine whether these interventions not only lead people to experience more positive affect during COVID-19 lockdown, but also motivate them to behave in healthy ways. This research thus sought to examine whether BPS and EG interventions can improve affect and health behaviours during COVID-19 lockdown, as compared to a control group.

Because young people were particularly at risk for poor wellbeing during the COVID-19 restrictions (Naughton et al., 2020; Varma et al., 2021), we tested our aims in a student population. Specifically, undergraduate and postgraduate students who attended a University in the UK completed measures of affect, physical activity, food and alcohol consumption and performed BPS, EG, or control exercises once a week for four weeks during the second and third COVID-19 lockdowns in the UK. We administered the exercises once a week, as research indicates that the effectiveness of these interventions are similar for those who complete the exercises once a week and those who complete the exercises more frequently (Lyubomirsky & Della Porta, 2010). In contrast to Dennis & Ogden, (2022), who administered the BPS and EG exercises for two weeks during COVID-19 lockdown, our study took place over four weeks during this time of crisis, based on research that recommends that these interventions be delivered for at least four weeks (Bolier et al., 2013). Finally, because research has shown that these interventions are effective when delivered both online and in-person (Layous et al., 2013) and due to the COVID-19 restrictions in place, the interventions were delivered online.

We expected that there would be an overall effect of time such that participants would report changes in positive and negative affect, physical activity, and food and alcohol consumption after four weeks in lockdown, although we did not make a specific prediction given that previous COVID-19

research has been mixed (Bennett et al., 2021). Because prior research has found some evidence that the EG and BPS interventions can enhance mental wellbeing during COVID-19 lockdown (Dennis & Ogden, 2022; Dennis et al., 2022; Geier & Morris, 2022), we predicted that the EG and BPS exercises would increase positive affect and decrease negative affect, as compared to the control exercise. While it seems likely that the EG and BPS exercises may increase healthy eating and physical activity, and decrease alcohol and unhealthy food consumption, as compared to the control exercise, no research has tested this during COVID-19. As a result, we did not make specific hypotheses. Moreover, while it has been proposed that the BPS intervention may be more beneficial than the EG intervention to enhance mental wellbeing, due to the limited number of studies comparing the BPS with the EG intervention (Carrillo et al., 2019), we also explored the relative effectiveness of these interventions on the outcomes. Identifying interventions that promote various wellbeing outcomes during lockdown is key to supporting people in the event of future crises (Dennis et al., 2022).

Methods

Participants

University students in the UK completed the study during the second (5 November to 2 December 2020) and third (6 January to 29 March 2021) UK lockdowns in exchange for course credit and a £5 Amazon eGift voucher. Two hundred and fifty-seven participants were recruited, although 108 participants dropped out before or during the assessment period, and four participants were excluded from the study because they did not complete their assigned writing task, resulting in a total sample size of 145 participants (second lockdown, $n = 91$; third lockdown, $n = 54$). Participants were mostly white females ($M_{age} = 20.54$ years, $SD_{age} = 3.25$; 122 females, 22 males, and 1 other; 81% White, 12% Asian/Asian British, 4% Mixed/Multiple ethnic group, 2% Black/Black British, and 1% Other). The study was approved by the local Ethics Committee. Following prior work (e.g., Layous et al., 2013), forty-nine participants were randomized to the BPS intervention, 48 to the EG intervention, and 48 to the control group. Participants completed their assigned writing task and outcome measures in Qualtrics once per week for four weeks (i.e., T1, T2, T3, T4). Because we were interested in people's affect and health behaviours after four weeks in lockdown, we focus on T1 and T4 measures herein. After data collection was complete, we conducted a sensitivity power analysis in G*Power, which is the most informative power analysis as it allows researchers to report the minimum effect size their experiment had 80% power to detect (Perugini et al., 2018). The sensitivity power analysis ($N = 145$; power criterion = 0.80; alpha = 0.05) for the effect of condition on T4 measures with T1 measures as the covariate showed that our study was powerful enough to detect medium effects ($f = 0.26$).

Writing tasks

To assess participants' engagement with the writing tasks (Lyubomirsky et al., 2011), we recorded time spent on the writing task every week, as well as participants' self-reported engagement with the task; participants rated items from the Intrinsic Motivation Inventory (IMI) effort subscale (McAuley et al., 1989; e.g., "I put a lot of effort into the writing activity") on a scale of 1 (*not at all true*) to 7 (*very true*). For each writing task, we computed an effort composite score across the four assessment points, with a higher score indicating greater effort exerted.

Expressing gratitude (EG) EG participants wrote about times when they were grateful for something that another person had done for them. They described why they were grateful and how the person's behaviour affected their life (Lyubomirsky et al., 2011; Seligman et al., 2005). Participants could choose to write to a new person each week or continue their letter to the same person. Participants typically wrote a letter to a family member or a friend/partner in which they expressed gratitude for the emotional and instrumental support they had received from that person. On average, participants spent 44.18 min ($SD = 30.83$) on this task across the four assessment periods, and reported exerting relatively high levels of effort on the task ($M = 4.58$, $SD = 1.33$) across the four assessment periods (Cronbach's $\alpha = 0.94$).

Best possible self (BPS) BPS participants were asked to visualize and write in detail about the best version of themselves 10 years in the future (King, 2001). In sessions one through four, they wrote about their best possible future romantic life, career situation, physical/mental health, and social life, respectively (King, 2001; Layous et al., 2013). Participants typically wrote about being married and having kids (romantic life), having finished their studies (educational attainment), obtained their dream job (career situation), having good exercise/eating habits and feeling happy (physical/mental health), and having a good group of friends and seeing friends regularly (social life). On average, participants spent 33.73 min ($SD = 17.27$) on this task across the four assessment periods, and reported exerting relatively high levels of effort ($M = 4.69$, $SD = 1.05$) on the task across the four assessment periods (Cronbach's $\alpha = 0.89$).

Life details Based on previous research (Layous et al., 2013; Lyubomirsky et al., 2011), control participants wrote about

what they did in the past week in a list format, while leaving out any feelings and opinions. Participants listed things like attending online lectures, cooking, shopping, watching TV/Netflix, studying, going on walks, and talking to family and friends. On average, participants spent 40.35 min ($SD = 42.03$) on this task across the four assessment periods, and reported exerting relatively high levels of effort ($M = 5.15$, $SD = 1.28$) on the task across the four assessment periods (Cronbach's $\alpha = 0.94$).

Measures

Trait self-control The Brief Self-Control Scale (Tangney et al., 2004) was used to measure trait self-control (TSC). At the T1 assessment, participants rated 13 items (e.g., "Sometimes I can't stop myself from doing something, even if I know it is wrong") on a scale from 1 (*not at all like me*) to 5 (*very much like me*). Final scores are the mean of the 13 items (9 items are reverse scored; Cronbach's $\alpha = 0.84$), and higher scores indicate greater TSC.

Affect Following Lyubomirsky et al., (2011), participants rated how much they had experienced six emotions over the past week including three positive emotions (pleased, content, and happy) and three negative emotions (troubled, miserable, and unhappy; e.g., "Over the past week, to what degree have you felt content?"), which was rated on a scale from 1 (*not at all*) to 5 (*extremely*) (Barrett & Russell, 1999; Feldman Barrett & Russell, 1998). Scores were averaged to form one composite score for positive emotions and one for negative emotions at T1 (positive emotions: $\alpha = 0.86$; negative emotions: $\alpha = 0.84$) and T4 (positive emotions: $\alpha = 0.87$; negative emotions: $\alpha = 0.87$), with higher scores indicating greater experiences of that emotion.

Physical activity The International Physical Activity Questionnaire (IPAQ; Craig et al., 2003) asked participants how many days and how much time they spent doing vigorous and moderate physical activities and walking in the past week. The total number of minutes for each activity was multiplied by each activity's Metabolic Equivalent of Task (MET) value (walking MET value = 3.3; moderate activity MET value = 5; vigorous activity MET value = 8) and again by the number of days that the activity was undertaken, resulting in a weekly MET minutes score for each activity. Vigorous and moderate activity significantly correlated (T1: $r = 0.31$, $p < 0.001$; T4: $r = 0.21$, $p = 0.01$), but vigorous activity did not correlate with walking (T1: $r = -0.02$, $p = 0.78$; T4: $r = -0.001$, $p = 0.99$), and the correlation between moderate activity and walking was small (T1: $r = 0.17$, $p = 0.04$; T4 = $r = 0.19$, $p = 0.03$). Thus, the MET minutes achieved for vigorous and moderate activity were summed to form a total T1 and T4 physical activity score, whereas T1 and T4 walking was used as a separate construct. Higher scores indicate more physical activity in the previous week; 3000 MET minutes or higher is typically considered high physical activity, and 600 MET minutes or higher is considered moderate physical activity. Not meeting these criteria is considered low levels of physical activity.

Food and alcohol consumption We used items from the Food-Frequency Questionnaire (FFQ; Hu et al., 1999; Schatzkin et al., 2003) to measure the frequency with which participants consumed alcohol (beer, wine, spirits) and eleven types of healthy (e.g., bananas, tomatoes) and unhealthy (e.g., cake, chocolate) foods in the past week on a scale from 0 (*Never*) to 10 (*3 + times per day*). An additional section asked participants who consumed an item at least once per week to also indicate the quantity consumed. For example, after answering the question "In the past week how often did you eat bananas?", participants rated "Each time you ate bananas how much did you usually eat?" on a scale from 1 (*Less than 1 banana*) to 3 (*More than 1 banana*). To estimate a participant's consumption of each item, the frequency question was multiplied with the quantity question for each item. Individual food and alcohol items were combined into four predefined food groups (Hu et al., 1999; Vilela et al., 2019); consumption of peppers, tomatoes, carrots, and lettuce were summed to form a weekly vegetable consumption score; consumption of cake, biscuits, and chocolate were combined to form a weekly dessert consumption score; consumption of beer, wine, and spirits were summed to create a weekly alcohol consumption score; and consumption of bananas, apples, oranges, and grapes were combined to form a weekly fruit consumption score. Higher scores indicate greater consumption.

Procedure

The study was advertised as an online study about well-being. In the first session (T1), participants gave consent, answered demographics questions (age, sex, ethnicity) and questions related to COVID-19 (household size during lockdown, COVID-19 symptoms), completed measures of TSC, affect, physical activity, and food and alcohol consumption, and were randomly assigned to the BPS, EG, or control exercise, for which they wrote for approximately 10 min. They then participated in the study once per week for three additional weeks in which they completed the same measures as in the first session (except demographics and the TSC measure) and their assigned writing exercise (in that order). In the fourth and final session (T4), participants were debriefed. Figure 1 shows the structure of the study.

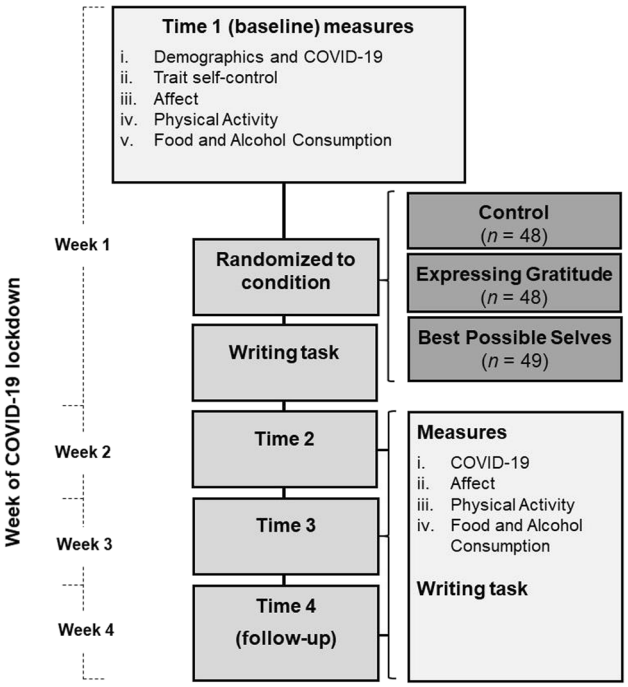

Fig. 1 Structure of the study. Participants completed the study during the second (5 November to 2 December 2020; $n = 91$) and third (6 January to 29 March 2021; $n = 54$) COVID-19 lockdowns in the UK

Results

All data reported in this article have been made available via the Open Science Framework, and can be accessed online (https://osf.io/52enx/?view_only=85d259af459743f287a57355514f78b1). Because we were interested in people's affect and health behaviours after four weeks in lockdown, below we report results pertaining to T1 and T4 (T2 and T3 data can be found online).

Descriptive statistics

At the T1 assessment, participants reported moderate levels of positive affect ($M = 2.96$, $SD = 0.78$; observed range: 1–5) and negative affect ($M = 2.69$, $SD = 0.98$; observed range: 1–5), and moderate levels of moderate and vigorous exercise ($M = 935.26$, $SD = 1371.02$; observed range: 0–8880) and walking ($M = 935.81$, $SD = 846.06$; observed range: 0–4158). Consumption of desserts ($M = 15.14$, $SD = 11.74$; observed range: 0–76), vegetables ($M = 18.35$, $SD = 22.01$; observed range: 0–231), fruit ($M = 12.10$, $SD = 12.07$; observed range: 0–88), and alcohol ($M = 5.11$, $SD = 6.09$; observed range: 0–37) was relatively low.

At the T4 assessment, participants reported somewhat higher levels of positive affect ($M = 3.37$, $SD = 0.81$; observed range: 1.33–5) and lower levels of negative affect ($M = 2.44$, $SD = 0.97$; observed range: 1–4.67), as well as lower levels of moderate and vigorous exercise ($M = 605.24$, $SD = 1035.03$; observed range: 0–5760) and higher levels of walking ($M = 1103.34$, $SD = 1094.80$; observed range: 0–4158). Consumption of dessert ($M = 12.46$, $SD = 11.34$; observed range: 0–70), vegetables ($M = 14.39$, $SD = 17.17$; observed range: 0–140), and fruit ($M = 9.94$, $SD = 11.38$; observed range: 0–63) was lower than at T1, whereas alcohol consumption was slightly higher ($M = 5.51$, $SD = 7.56$; observed range: 0–40). Descriptive statistics by condition are presented in Table 1.

Key analyses

To assess affect and health behaviours over time, we first conducted a number of repeated measures ANOVAs with time (T1 vs. T4) as a within-subjects independent variable (IV) and affect scores and health behaviours as the dependent variables (DV). Next, to test the effect of condition on affect and health behaviours, we conducted a series of MANCOVAs with condition (BPS, EG, control) as a between-subjects IV, T4 affect and health behaviours as DVs, and T1 affect and health behaviours as covariates

Table 1 Descriptive statistics of affect and health behaviours by condition

Measure	BPS	EG	Control
Positive Affect			
T1	2.87(.72)	2.99(.87)	3.03(.77)
T4	3.29(.75)	3.24(.79)	3.58(.88)
Negative Affect			
T1	2.99(.96)	2.67(1.03)	2.43(.88)
T4	2.57(1.04)	2.58(.96)	2.19(.87)
Vegetable Consumption			
T1	20.65(32.61)	16.73(10.69)	17.63(16.58)
T4	17.96(24.64)	12.44(11.81)	12.71(11.10)
Fruit Consumption			
T1	10.82(10.54)	11.71(9.92)	13.79(15.17)
T4	10.82(13.30)	10.33(12.04)	8.65(8.29)
Alcohol Consumption			
T1	7.37(7.22)	4.02(5.39)	3.90(4.83)
T4	8.12(9.74)	4.06(5.46)	4.31(6.13)
Dessert Consumption			
T1	15.69(12.54)	13.25(8.72)	16.46(13.43)
T4	14.53(15.97)	11.38(7.80)	11.44(8.13)
Walking			
T1	1079.23(930.42)	851.06(791.58)	874.16(806.07)
T4	1113.92(1068.48)	1001.00(1031.79)	1194.88(1192.63)
Moderate/Vigorous			
T1	941.22(1232.42)	996.75(1655.09)	867.67(1208.29)
T4	546.12(753.49)	629.75(1225.42)	641.08(1093.24)

(as recommended in Vickers & Altman, 2001).[1] Given the number of tests performed to investigate the effect of condition on affect and health behaviours, Bonferroni correction was applied for these analyses by adjusting the significance level. Statistical significance was thus accepted at $p < 0.002$. To assess whether our data provided support for the null or alternative hypothesis, we also conducted Bayesian analyses in JASP (JASP team) using default priors, with condition as the IV and affect and health behaviours as the DV. Bayes factors (BF^{10}) above 1 provide evidence for the alternative hypothesis, Bayes factors below 1 provide evidence for the null hypothesis, and Bayes factors of 1 indicates that the data do not favour either hypothesis (see Dienes, 2014 for more details).

Affect and health behaviours over time

The ANOVAs revealed a significant effect of time on positive affect, $F(1, 144) = 34.04$, $p < 0.001$, $\eta_p^2 = 0.18$, and negative affect, $F(1, 144) = 8.80$, $p = 0.004$,$\eta_p^2 = 0.06 = 0.06$. Participants experienced more positive affect at T4 ($M = 3.37$, $SE = 0.07$) compared to T1 ($M = 2.96$, $SE = 0.07$), and they also experienced less negative affect at T4 ($M = 2.45$, $SE = 0.08$) compared to T1 ($M = 2.70$, $SE = 0.08$). The ANOVAs further revealed a significant effect of time on vegetable consumption, $F(1, 144) = 13.46$, $p < 0.001$, $\eta_p^2 = 0.09$, and fruit consumption, $F(1, 144) = 6.41$, $p = 0.01$, $\eta_p^2 = 0.04$. Participants ate fewer vegetables at T4 ($M = 14.39$, $SE = 1.43$) compared to T1 ($M = 18.35$, $SE = 1.83$), and they also ate less fruit at T4 ($M = 9.94$, $SE = 0.95$) compared to T1 ($M = 12.10$, $SE = 1.00$). The analyses also demonstrated a significant effect of time on moderate and vigorous exercise, $F(1, 144) = 9.69$, $p = 0.002$, $\eta_p^2 = 0.06$; participants engaged in less moderate and vigorous exercise at T4 ($M = 605.24$, $SE = 85.95$) compared to T1 ($M = 935.26$, $SE = 113.86$). But, there was no significant effect of time on walking, $F(1, 144) = 3.40$, $p = 0.07$, $\eta_p^2 = 0.02$. The ANOVAs revealed a significant effect of time on dessert consumption, $F(1, 144) = 6.77$, $p = 0.01$, $\eta_p^2 = 0.05$; participants ate less desserts at T4 ($M = 12.46$, $SE = 0.94$) compared to T1 ($M = 15.14$, $SE = 0.98$). But, the effect of time on alcohol consumption was not significant, $F(1, 144) = 1.07$, $p = 0.30$, $\eta_p^2 = 0.007$.

To summarize, participants experienced more positive affect and less negative affect at T4 compared to T1. They also ate fewer vegetables, fruits, and desserts, and engaged in less moderate and vigorous exercise at T4 compared to T1. However, they did not change their walking or alcohol consumption from T1 to T4.

Impact of the interventions on affect and health behaviours

The MANCOVA first revealed a non-significant multivariate effect of condition on positive and negative affect, $F(4, 278) = 1.32$, Wilks' $\lambda = 0.96$, $p = 0.26$, $\eta_p^2 = 0.02$, such that the univariate effect of condition on positive affect was not significant, $F(2, 140) = 2.49$, $p = 0.09$, $\eta_p^2 = 0.03$, and the univariate effect of condition on negative affect was also not significant, $F(2, 140) = 1.31$, $p = 0.27$, $\eta_p^2 = 0.02$. The Bayes factor was in support of a null effect of condition on affect (positive affect: $BF^{10} = 0.56$; negative affect: $BF^{10} = 0.21$). Thus, participants experienced more positive affect and less negative affect over time, but participants in the BPS, EG, and control conditions did not differ in positive and negative affect.

The MANCOVA also revealed a non-significant multivariate effect of condition on vegetable and fruit consumption, $F(4, 278) = 1.87$, Wilks' $\lambda = 0.95$, $p = 0.12$, $\eta_p^2 = 0.03$ such that the univariate effect of condition on vegetable consumption was not significant, $F(2, 140) = 1.89$, $p = 0.16$, $\eta_p^2 = 0.03$, and neither was the univariate effect of condition on fruit consumption, $F(2, 140) = 2.72$, $p = 0.07$, $\eta_p^2 = 0.04$. The Bayes factor was in support of a null effect of condition on vegetable and fruit consumption (vegetable consumption: $BF^{10} = 0.27$; fruit consumption: $BF^{10} = 0.55$). Thus, participants ate fewer fruits and vegetables over time, but participants in the BPS, EG, and control groups did not differ in vegetable or fruit consumption.

Furthermore, the MANCOVA revealed a non-significant multivariate effect of condition on moderate and vigorous exercise and walking, $F(4, 278) = 0.33$, Wilks' $\lambda = 0.99$, $p = 0.86$, $\eta_p^2 = 0.005$; the univariate effect of condition on moderate and vigorous exercise was not significant, $F(2, 140) = 0.15$, $p = 0.86$, $\eta_p^2 = 0.002$, and the univariate effect of condition on walking was also not significant, $F(2, 140) = 0.57$, $p = 0.57$, $\eta_p^2 = 0.008$. The Bayes factor was in support of a null effect of condition on moderate and vigorous exercise and walking (moderate and vigorous: $BF^{10} = 0.08$; walking: $BF^{10} = 0.11$). Thus, participants engaged in less moderate and vigorous exercise over time but did not change their walking. Participants in the BPS, EG, and control conditions did not differ in moderate and vigorous exercise or walking.

[1] Before conducting our key analyses, we examined the effects of sex, household size during lockdown, and COVID-19 symptoms on all T1 measures. Bonferroni correction was applied for these analyses by adjusting the significance level: statistical significance was accepted at $p < .006$. Results showed that greater household size predicted increased T1 alcohol consumption ($\beta = .32$, $p < .001$). Therefore, we also conducted our key analyses that involved alcohol consumption with household size as a covariate; the effects of time and condition remained non-significant when controlling for household size. No other significant effects emerged and we therefore excluded these variables from all subsequent analyses.

Finally, the MANCOVA revealed a non-significant multivariate effect of condition on dessert and alcohol consumption, $F(4, 278) = 0.71$, Wilks' $\lambda = 0.98$, $p = 0.59$, $\eta_p^2 = 0.01$; the univariate effect of condition on dessert consumption was not significant, $F(2, 140) = 1.11$, $p = 0.33$, $\eta_p^2 = 0.02$, and the univariate effect of condition on alcohol consumption was also not significant, $F(2, 140) = 0.34$, $p = 0.71$, $\eta_p^2 = 0.005$. The Bayes factor was in support of a null effect of condition on dessert and alcohol consumption (dessert consumption: $BF^{10} = 0.22$; alcohol consumption: $BF^{10} = 0.10$). Thus, participants ate less desserts over time, but did not change their alcohol consumption, and participants in the BPS, EG, and control groups did not differ in their dessert or alcohol consumption.

Overall, these data suggest that practicing gratitude and visualising one's best possible future does not enhance affect or health behaviours during lockdown. Notably, Bayes factors ranged from 0.08 to 0.56 and therefore supported a null effect of condition on all outcomes, providing convincing evidence that BPS and EG interventions did not improve affect and health behaviours during lockdown.[2]

Discussion

This study examined positive and negative affect and health behaviours over four weeks during the second and third COVID-19 lockdowns in the UK, and whether BPS and EG interventions could improve these outcomes compared to a control group. Results showed that participants experienced more positive affect and less negative affect at T4 compared to T1. Participants also ate fewer vegetables, fruit and desserts, and engaged in less moderate and vigorous exercise at T4 compared to T1. However, they did not change their walking or alcohol consumption from T1 to T4. Notably, despite good evidence that participants engaged well with the writing tasks, there were no effects of condition on affect or health behaviours. These findings were also supported by Bayes factors, providing convincing evidence that practicing gratitude and visualising one's best possible future does not improve affect and health behaviours during extreme circumstances such as the COVID-19 lockdown.

[2] To explore whether the intervention might be more effective during the second vs. third lockdown and among certain people (i.e., those who exerted more vs. less effort on the writing exercises and who scored higher vs. lower in trait self-control), we conducted a series of exploratory MANCOVAs or multiple regressions to examine the interaction between these variables and condition in predicting T4 affect and health behaviours, while controlling for T1 affect and health behaviours. Bonferroni correction was applied for these analyses by adjusting the significance level: statistical significance was accepted at $p < .004$. Lockdown period (second vs. third lockdown), effort, and trait self-control did not significantly moderate the effect of condition on any outcomes.

Affect and health behaviours over time

While research has demonstrated a decline in various mental health outcomes during COVID-19 (e.g., Bueno-Notivol et al., 2021; Smith et al., 2020), some have argued that these changes in mental health were only short-term, with people recovering their baseline mental health levels shortly after the COVID-19 onset (e.g., Daly & Robinson, 2021; Robinson et al., 2022). Indeed, in the current study, participants reported experiencing increased positive affect and decreased negative affect after four weeks in lockdown, possibly returning to their 'set point' of subjective wellbeing after the initial shock of the forced lockdown (Lucas, 2007; Sheldon & Lyubomirsky, 2007).

One possible explanation for these findings is that, while most previous COVID-19 studies were conducted during the first lockdown, our study was conducted during consecutive lockdowns where people may have experienced fewer psychological burdens due to greater psychological immunity against fear, anxiety, and negative life events, thus facilitating the return of positive affect (Gupta & Nebhinani, 2020; Wilson & Gilbert, 2005). This type of immunity might explain why our participants experienced increased positive affect and decreased negative affect after four weeks in lockdown. Indeed, research has shown that mental resilience and active coping styles were protective factors against anxiety and depression during COVID-19 (Song et al., 2021). However, these interpretations are speculative and future crisis research should include measures of resilience and adaptation to examine whether these factors can explain changes in affect over time.

A related explanation for the improved affect is that participants may have enacted their own strategies beyond the writing interventions, such as by adopting a positive mindset, meditating or engaging in other mindfulness strategies (Kiper et al., 2022; Zhu et al., 2021). For instance, in a 4-week study conducted during COVID-19, Zhu et al., (2021) found lower scores of distress in mindfulness practitioners compared to non-practitioners, and increased practice predicted improvement in mental wellbeing, suggesting that mindfulness meditation might be a viable intervention to mitigate the psychological impact of COVID-19 (see also Antonova et al., 2021). Moreover, it is possible that changes in COVID-19 rules (such as the local restrictions introduced on 2 December 2020) or lockdown period (second vs. third) could explain the improved affect over time. But we believe this unlikely given that the results were comparable when using T3 measures as outcomes, which were completed before local restrictions were introduced. There were also no effects of lockdown period on T4 outcomes [2], suggesting that these factors had minimal impact on our findings.

Furthermore, in terms of health behaviours, our findings are consistent with previous research showing that

participants engaged in less moderate and vigorous physical activity and ate fewer fruits and vegetables during the first COVID-19 lockdown (Deschasaux-Tanguy et al., 2021; Naughton et al., 2020; Niedzwiedz et al., 2021; Puccinelli et al., 2021). It extends this work by showing that these findings were also evident in subsequent COVID-19 lockdowns, suggesting that this decline in health behaviours was maintained throughout the crisis. Moreover, while Naughton et al., (2020) found no change in the consumption of sugary foods during lockdown, others have demonstrated increased sugary food intake (Deschasaux-Tanguy et al., 2021). We found that participants decreased their dessert consumption from T1 to T4. The overall reduction in food consumption could be due to poor appetite, which was commonly reported during COVID-19 (Owen et al., 2021), although other mechanisms are also plausible. For example, many grocery and convenience stores were closed or had limited opening hours during lockdown, which would have affected food intake patterns (Deschasaux-Tanguy et al., 2021).

The finding that people engaged in lower moderate and vigorous activity is unsurprising given the restrictions on leaving the home and no access to gyms, resulting in a less active lifestyle for many. If this short-term decrease in fruit and vegetable consumption and physical exercise leads to long-term changes in behaviour, however, it could have serious impact on overall health, as fruit and vegetable consumption and physical exercise is associated with reduced risk of cardiovascular disease, cancer and mortality (Aune et al., 2017; Warburton et al., 2006). In contrast, the finding that people consumed fewer desserts could have positive impact on health, as increased sugar intake promotes weight gain, diabetes, and other illnesses (Stanhope, 2016). Although it has been argued that changes in health behaviours during lockdown may persist and continue to negatively impact health and life expectancy outside the context of the COVID-19 crisis (Andrasfay & Goldman, 2022), more research is needed to better understand these issues.

Interestingly, we found no change in walking from T1 to T4, inconsistent with research demonstrating increases in walking during lockdown compared to pre-pandemic levels (Hunter et al., 2021), though some have also found decreases in walking during lockdown (Gallo et al., 2020). One potential explanation for these findings is that we started tracking participants' walking after the lockdown onset when participants could only leave their home to exercise outdoors. Given that walking is a low risk and accessible activity that most people can do (Hanson & Jones, 2015), participants may have developed and maintained good lockdown walking habits, resulting in similar levels of walking at T1 and T4. Indeed, descriptive statistics suggest that participants engaged in moderate levels of walking both at T1 ($M = 935.81$) and T4 ($M = 1103.34$).

Moreover, our finding that participants' alcohol consumption did not change over time is inconsistent with both research demonstrating increased alcohol consumption during lockdown (Deschasaux-Tanguy et al., 2021; Naughton et al., 2020), and research demonstrating decreased alcohol consumption during lockdown (Rodríguez-Pérez et al., 2020), though some have also reported no change in alcohol consumption (Garnett et al., 2020), consistent with our findings. Therefore, studies on alcohol consumption during lockdown are inconclusive, and future studies need to assess motives for alcohol consumption during intense crisis (e.g., drinking to cope: Merlo et al., 2021), as well as examining the effects of various demographic factors. Given that we studied university students who tend to consume higher levels of alcohol, they might have used alcohol consumption as a way of coping with isolation and psychological distress throughout the lockdown period, resulting in similar levels of alcohol consumption from T1 to T4. Sustaining similar levels of alcohol consumption while reducing food intake could intensify health risks further, suggesting that university students who consume alcohol may benefit from receiving support in attaining a healthy diet (Breslow et al., 2010), particularly during intense crisis.

Impact of the interventions on affect and health behaviours

In our study, despite good evidence that participants engaged well with the writing tasks, there was no effect of intervention condition on any of the outcomes. Therefore, we complemented our analyses with Bayes factors, which is recommended to improve inferences in the event of null findings (Lakens et al., 2020). Bayes factors supported a null effect of condition on all outcomes, providing convincing evidence that practicing gratitude and visualising one's best possible future does not improve affect and health behaviours during lockdown, as compared to control participants who listed what they did in the past week. This is inconsistent with research proposing that positive psychology interventions may be beneficial to promote mental wellbeing during COVID-19 (Fekete & Deichert, 2022; Fishman, 2020; Krifa et al., 2022; Kumar et al., 2022), and studies finding initial evidence to support this claim (Dennis et al., 2022; Geier & Morris, 2022), although it is worth noting that the latter studies either used an inactive or no control at all and did not measure health behaviours or physical wellbeing. Our results are consistent, however, with meta-analysis by Cregg & Cheavens, (2020) showing that positive psychology interventions such as gratitude interventions may not be very effective at alleviating symptoms of anxiety or depression.

Indeed, while meta-analyses have found that the BPS intervention facilitates mental wellbeing, optimism, and

positive affect to a medium effect, small effect sizes have also been obtained for these outcomes and for negative affect and depressive symptoms (Carrillo et al., 2019; Heekerens & Eid, 2021). Meta-analyses have further found that EG interventions have a small effect on mental wellbeing and anxiety and depression (Cregg & Cheavens, 2020; Davis et al., 2016; see also Wood et al., 2010). If the true effect of the BPS and EG interventions on wellbeing is indeed small, we might have missed an effect of condition on affect and health behaviours given that our study was only powerful enough to detect medium effects. Future crisis research should conduct studies that have power to detect small effects to test the effectiveness of the BPS and EG interventions, although it is questionable whether small effects should be considered meaningful.

Moreover, our findings are inconsistent with pre-pandemic research proposing that positive psychology interventions may be effective in promoting health behaviours and physical wellbeing such as physical activity, diet, and smoking (Boehm et al., 2012; DuBois et al., 2012; Park et al., 2016), although only a few studies have tested this. An exception is Emmons & McCullough, (2003) who found that EG participants reported exercising more and experienced fewer physical symptoms than participants who listed weekly hassles or life events, although these findings failed to replicate in their follow-up studies which instead found that EG participants reported getting more sleep and felt more refreshed when waking up compared to controls who did not complete any exercises. However, meta-analyses by Dickens, (2017) found no effects of expressing gratitude on physical health, sleep, or exercise. Whether these interventions are effective in improving health behaviours and physical wellbeing therefore remains unclear, though results obtained thus far are not promising.

Additional research is therefore needed before any firm conclusions can be drawn regarding effects on health behaviours, especially because the effectiveness of these interventions seems to depend on the specific behaviours measured (e.g., exercise vs. sleep), and the context (e.g., lockdown vs. no-lockdown; see also Oyserman et al., 2015). In addition, whether the interventions promote mental wellbeing and health behaviours may also depends on the comparison group, which might explain why we failed to find an effect of condition on the outcomes. For example, during COVID-19, Geier & Morris, (2022) found that gratitude participants demonstrated greater mental wellbeing compared to an inactive control group who did not receive an assignment, and Dennis & Ogden, (2022) found immediate effects of the BPS and EG interventions on T1 wellbeing outcomes such that participants scored higher on social connectedness and self-esteem (but not happiness or optimism) than control participants who summarised a TV plot, which is not a common control exercise in research on BPS and EG interventions (Carrillo et al., 2019).

Likewise, Dennis et al., (2022) used different comparison groups than those implemented in the current study. They found that BPS participants reported greater positive affect compared to nostalgia (but not control) participants, and that BPS and EG participants experienced greater social connectedness compared to nostalgia (but not control) participants, although no differences were found for negative affect, total wellbeing, or optimism. In our study, we used a widely used active control group (Carrillo et al., 2019), which could explain the difference in findings between previous studies and our study, given that the use of different control-group types often yield different effects (Karlsson & Bergmark, 2015). Moreover, future crisis research could also vary the frequency with which the interventions are delivered and test the effects on mental and physical wellbeing.

Although self-reported measures were the most feasible during the COVID-19 lockdown, a potential limitation of the present study was that participants reported their affect and food and alcohol consumption in the previous week, which might be subject to biases common in health research such as social desirability and recall bias (Althubaiti, 2016). This might explain, for example, why people reported improved affect at T4. However, the study took place over four weeks and assessed several outcomes, which should reduce these biases, as deliberately changing all these outcomes simultaneously to appear socially desirable would be challenging for the participants (Naughton et al., 2020). Moreover, if participants wanted to appear socially desirable, they should have reported increased (not decreased) healthy eating and exercise (Ball et al., 2010). In addition, our participants were mostly women, limiting the study generalisability. For example, the decline in moderate and vigorous exercise from T1 to T4 might be unique to women, as research has shown that the COVID-19 restrictions disproportionately affected women's physical activity (Nienhuis & Lesser, 2020). More data on gender differences and inequalities during COVID-19 and interventions and policies targeting these inequalities are therefore needed.

We further note that while our findings allow us to draw conclusions about people's affect and health behaviours during a 4-week lockdown, we cannot draw conclusions regarding people's affect and health behaviours during relative to pre-lockdown, or regarding any long-term effects of lockdown on these outcomes. Future research could use daily surveys or diaries and assess affect and health behaviours longitudinally to assess these outcomes long-term as well as the impact of the BPS and EG interventions. Finally, future studies should consider additional moderator variables. For instance, while the COVID-19 restrictions negatively impacted mental health across England, people in the North were more severely impacted (Bambra et al., 2022). Likewise, while some countries reported severe mental health problems during COVID-19 (e.g., increased suicide),

especially among women and youth, other countries reported no change in these outcomes (Di Fazio et al., 2022). Thus, the impact of COVID-19 on health outcomes may vary across populations, regions, and countries, which will be important to address in future crisis research.

Conclusions

This research examined affect and health behaviours over four weeks during the second and third COVID-19 lockdowns in the UK, and the impact of BPS and EG interventions on these outcomes compared to a control group. We found that, although participants reported no change in walking or alcohol consumption, they reported increased positive affect at T4 compared to T1, as well as decreased negative affect, reduced consumption of vegetables, fruit, and desserts, and lower levels of moderate and vigorous exercise. Our findings also indicate that some of the poor health behaviours observed during the first lockdown were maintained during consecutive lockdowns. It is therefore crucial for future research to examine whether these changes in health behaviours persist and have serious long-term impact on health. As there were no effects of condition on affect or health behaviours, our findings suggest that BPS and EG exercises may not be valuable interventions to improve affect and health behaviours during extreme crises such as COVID-19. Nonetheless, given that our interventions were only delivered for four weeks, future studies could examine the impact of extended BPS and EG interventions on post-pandemic health behaviours.

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Data availability Data and materials are available in the Open Science Framework repository (at https://osf.io/52enx/?view_only=85d259af459743f287a57355514f78b1).

Declarations

Conflict of interest The authors have no conflict of interest to declare.

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