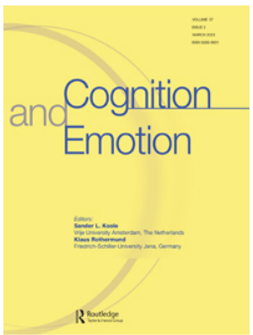

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Induced gratitude and hope, and experienced fear, but not experienced disgust, facilitate COVID-19 prevention

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ABSTRACT

Hope, gratitude, fear, and disgust may all be key to encouraging preventative action in the context of COVID-19. We pre-registered a longitudinal experiment, which involved monthly data collections from September 2020 to September 2021 and a six-month follow-up. We predicted that a hope recall task would reduce negative emotions and elicit higher intentions to engage in COVID-19 preventative behaviours. At the first time point, participants were randomly allocated to a recall task condition (gratitude, hope, or control). At each time point, we measured willingness to engage in COVID-19 preventative behaviours, as well as experienced hope, gratitude, fear, and disgust. We then conducted a separate, follow-up study in February 2022, to see if the effects replicated when COVID-19 restrictions were relaxed in the UK. In the main study, contrary to our pre-registered hypothesis, we found that a gratitude recall task elicited more willingness to engage in COVID-19 preventative behaviours in comparison to the neutral recall task. We also found that experienced gratitude, hope, and fear were positively related to preventative action, while disgust was negatively related. These results present advancement of knowledge of the role of specific emotions in the COVID-19 pandemic.

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Hope; gratitude; fear; disgust; preventative behaviour

One way to reduce COVID-19 is to engage in preventative health behaviours, such as washing hands more frequently, engaging in social distancing, and receiving vaccinations (e.g. Haug et al., 2003; Skegg et al., 2021). Preventative health behaviours refer to actions that create a benefit for the individual and, in turn, for the community or society. Importantly, it has been found that intentions to engage in social distancing are related to actual social distancing behaviours (Gollwitzer et al., 2022). We also know from research on collective action that intentions often result in actual engagement (De Weerd & Klandermans, 1999; Webb & Sheeran, 2006). Thus, in the context of COVID-19, measuring intentions rather than actual behaviours may be a good marker of whether individuals will engage in preventative health behaviours. Moving beyond previous studies, it is important to examine willingness to engage in action in the long term, not just at a single time point, as has been evidenced by COVID-19 burnout (Queen & Harding, 2020). This is essential, as prior evidence tells us that COVID-19 will have a long-term impact on societies (Rourke, 2020). The current project investigated experienced emotions and participants' willingness to engage in preventative health behaviours in a year-long longitudinal study and a separate, follow-up study in the UK. In doing so, we examined whether recalling hope and gratitude, as well as experienced emotions

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of gratitude, hope, fear, and disgust, are associated with preventive health behaviours.

Emotions and COVID-19 context

In the context of COVID-19, it is plausible that both positive and negative emotions can facilitate preventative action. Broadly, positive emotions can encourage attention, creative thinking, well-being, coping, resilience and reduce the effects of negative emotions (see Fredrickson, 2001 for a review). Research shows that not only positive emotions, such as hope, but also negative emotions, such as guilt, can sometimes facilitate positive outcomes, as even though the experience itself may be negative, negative emotions can also "do good", e.g. guilt facilitating reparative action in interpersonal or intergroup relations (Cohen-Chen et al., 2014). It has been found that reappraisal interventions can reduce negative emotions and increase positive emotions (both current and anticipated emotions), in the context of COVID-19 (Wang et al., 2021). However, the reappraisal manipulations in this research did not have an impact on preventative behaviours, probably because the interventions did not elicit specific emotions. One way to impact preventative action is through eliciting the experience of specific emotions, as prior research has found that specific emotions are associated with unique appraisals, which can impact motivations and behaviours (Lerner et al., 2015; Roseman, 2011; Shaver et al., 1987; Smith & Ellsworth, 1985).

According to the appraisal tendency framework (ATF), emotions differ by certain appraisals, such as certainty about the future, which impact motivations and behaviours (Lerner et al., 2015). One important appraisal in the context of COVID-19 is certainty, as it is likely to impact willingness to engage in preventative action. Prior research has found that disgust and anger are associated with feelings of certainty while fear is associated with feelings of uncertainty (Bachkirov, 2015; Polyportis et al., 2020; Tiedens & Linton, 2001). Fear and disgust are both associated with contagion concerns (Olatunji et al., 2009; Thorpe et al., 2011); thus, they are likely to play a key role in reactions to COVID-19. Indeed, fear of COVID-19 has been found to be associated with anti-COVID-19 behaviours (e.g. washing hands, wearing marks; Zingora et al., 2022). However, anger is triggered by appraisals of injustice and harm (see Lerner & Tiedens, 2006; Russell & Giner-Sorolla, 2013); thus, it is likely to have a more peripheral role in the COVID-19 context in comparison to disgust and fear. For this reason, we focused on the latter two negative emotions in the present research. Fear, like hope, is a forward-focused emotion, based on appraisals of uncertainty, in which we consider the current situation to be ambiguous and the future uncertain (Baumgartner et al., 2008; Winterich & Haws, 2011). Fear and hope also trigger more in-depth processing and attention to the situation at hand (Polyportis et al., 2020). However, the appraisal that differs between fear and hope is coping potential, with hope often triggering resourcefulness and perseverance (see Nabi & Myrick, 2022 for a review), making hope a good potential candidate emotion to be elicited long term to encourage COVID-19 preventative action. For this reason, we aimed at eliciting hope rather than fear in the present research. Beside looking at the effect of recalling hope versus gratitude, it is also important to examine specific experienced emotions, i.e. hope, disgust, and fear, rather than general reappraisals, and how these specific emotions impact willingness to engage in preventative action.

Gratitude and hope in COVID-19 context

Emotions have already been shown to play a role in the COVID-19 pandemic, influencing social outcomes and well-being. Prior research has identified that trait gratitude has been shown to be associated with more COVID-19 prosocial behaviours, such as adhering to public health guidelines (Syropoulos & Markowitz, 2021). Additionally, a gratitude intervention (i.e. to list three things that went well) was shown to have a positive impact on social connectedness in the context of COVID-19 (Dennis et al., 2022). In terms of state gratitude, it was found to be significantly higher in the gratitude condition in comparison to the control and Best Positive Self conditions, but levels of state gratitude did not differ between the nostalgia and gratitude conditions. In another study, a gratitude writing task was shown to reduce stress and negative affect, more so than an expressive writing task or control condition; however, levels of state gratitude remained relatively stable (Fekete & Deichert, 2022). Another study conducted in the context of COVID-19 found that, in comparison to a control condition, both a kindness and a gratitude manipulation (i.e. thinking of things they are grateful for) triggered more positive emotions; however, there was no difference between the two positive

intervention effects (Datu et al., 2022). Additionally, the manipulations had no impact on life satisfaction, COVID-19 anxiety, and negative emotions; even though they did find that measures of gratitude and kindness were highest in respective conditions; thus, the manipulations elicited appropriate experiences. Another study has shown that a gratitude intervention based on weekly reflections (i.e. thinking and writing about up to five things in life to be grateful for) for 10 weeks improved university students' mental well-being during the COVID-19 pandemic (Geier & Morris, 2022). Cumulatively, there is evidence that both trait (i.e. dispositional) and state (i.e. experienced) gratitude play a role in eliciting positive feelings and social outcomes in the COVID-19 context. However, the long-term impact of gratitude in the COVID-19 context, or how it compares to hope, which is also a positive emotion, is unknown. Accordingly, our research aims at addressing this gap in the literature.

Hope has been linked to increased well-being during the COVID-19 pandemic; for example, trait hope mediated the relationship between COVID-19 stress and subjective well-being in a sample of undergraduate students in Turkey (Genç & Arslan, 2022). Another study with American adults found that trait hope predicted greater well-being, lower anxiety, and lower COVID-19-related perceived stress after a month via the mediation of perceived emotional control (Gallagher et al., 2021). These studies suggest that trait hope can counteract the negative effects during the pandemic and may facilitate positive social outcomes. These studies have focused on trait hope, but state hope (i.e. experienced in the moment or induced) may also play a role. This is important as state and trait emotions can both impact behaviour (Smith et al., 2018). Although trait hope is an ingrained and personality-based characteristic, while state hope is a discrete emotion arising from a specific appraisal within a specific context, the cognitive and affective mechanisms are similar, as with most relationships between traits and corresponding states (Fleeson, 2001). Specifically for hope, the similarities between trait hope and state hope have been documented in past literature (Luthans & Jensen, 2002; Ong et al., 2009; Snyder, 2000; Snyder et al., 1996; Yoshinobu et al., 1991). Based on this, initial understandings about possible attitudes and action tendencies arising from trait hope can indicate the role played by state hope. Also, we are not aware of any prior research that has examined the impact of hope recall tasks in the context of COVID-19 (i.e. elicited by an intervention or task), which may also have an impact on COVID-19 preventative action. Like gratitude, it is important to examine the long-term impact of recalling and experiencing hope, and whether hope is associated with COVID-19 preventative action.

Hope and gratitude both involve positive valence, meaning that they feel pleasant to the individual experiencing these emotions and therefore are mostly considered positive emotions (Cohen-Chen et al., 2014). However, contextual factors can influence the valence of emotions considered pleasant and it has been shown that emotions can entail both positivity and negativity (An et al., 2017). Hope and gratitude are also relevant to daily social interactions, and in some instances morality (Haidt, 2003). However, hope and gratitude are specific discrete emotions, triggered by unique appraisals (Lazarus, 1991; Smith & Ellsworth, 1985). For example, when feeling gratitude, we may reflect on what others have done for us (Fox et al., 2015), while hope derives from thoughts regarding what our social world may be like in the future (Averill, 1994; Cohen-Chen et al., 2014; Stotland, 1969).

Hope is both a forward-focused and energising emotion (Snyder, 2000). Experiencing hope involves a pleasant affective response to envisioning a future which is better than the current situation, and to which the experiencer attaches meaning and relevance (Stotland, 1969). Hope's behavioural and attitudinal outcomes involve cognitively developing alternatives and plans to achieve future goals, which have been found to motivate behaviour (Yoshinobu et al., 1991). Particularly in collective contexts, when coupled with agency and a sense of efficacy, hope can induce collective action intentions (Cohen-Chen & Van Zomeren, 2018), while efficacy had no such effect in situations perceived as hopeless. In conflict, hope has been found to induce conciliatory attitudes such as support for concession-making (Cohen-Chen et al., 2014, 2015). Cumulatively, it seems that hope can action behaviour conducive to promoting social change.

On the other hand, gratitude is an emotion that focuses on reflections of what we have already received (Haidt, 2003), mostly from others (Algoe, 2020; Fox et al., 2015). This reflection on what we have received in the past then elicits the current state of gratitude. Thus, hope is a self-directed emotion focused on future possibilities, while gratitude is an other-directed emotion focused on past

gains and facilitating future reciprocal behaviours (Chang et al., 2020). For example, gratitude has been associated with numerous prosocial behaviours (Haidt, 2003), such as reducing selfishness, increasing forgiveness, helping (Bartlett & DeSteno, 2006; McCullough et al., 2008) and donation behaviour (Paramita et al., 2020). Gratitude also has a positive impact on emotional and social well-being (Jans-Beken et al., 2020). Lastly, gratitude has been found to lead to better relationships with others, repayment of benefactor, and expanding our moral circle (Bartlett & DeSteno, 2006; McCullough et al., 2001). Thus, experienced gratitude also has the potential to facilitate positive behaviours, encouraging COVID-19 preventative action.

Fear and disgust in COVID-19 context

However, as outlined before, sometimes negative emotions can also encourage positive outcomes through the actions they facilitate (Cohen-Chen et al., 2014), but it is also evident from prior research that interventions to date have not always had a large impact on negative experienced emotions (e.g. Datu et al., 2022). Thus, it is important to examine when negative emotions can have a positive impact encouraging COVID-19 preventative action. The COVID-19 pandemic has been a time of increased negative emotions (e.g. Xue et al., 2020), such as fear and disgust. A sample experiencing lockdown was found to have heightened disgust sensitivity in comparison to one that was not under lockdown (Stevenson et al., 2021). However, disgust can be experienced as both a state and trait (i.e. disgust sensitivity), but to our knowledge prior research has not examined experienced disgust in the context of COVID-19, i.e. state disgust. Anxiety, a feeling like fear but experienced long term as a mood, has been shown to mediate the relationship between COVID-19 conspiracy beliefs with placing more importance on governmental restrictions (Peitz et al., 2021). Fear for COVID-19 has been found to be related to anti COVID-19 behaviours (Zingora et al., 2022). Thus, both disgust and fear are likely to be heightened during the COVID-19 pandemic.

Though prior research suggests that fear and disgust may have differential impacts on preventative action. Both fear and disgust are avoidance emotions (Ekman, 1999), related to the function of protecting oneself from harm and disease (Rozin & Fallon, 1987), suggesting that these emotions should encourage preventative action. Furthermore, disgust often triggers the need to exclude others from our social circle (e.g. Dasborough et al., 2020; Greenbaum et al., 2020), thus, people may follow COVID-19 restrictions to see themselves as superior and separate from others. Fear can also encourage individuals to flee the situation under certain circumstances when there is a threat from disease (Pliskin et al., 2015).

On the other hand, disgust and fear have also been linked with defensive responses (Herek & McLemore, 2013; Liberman & Chaiken, 1992), suggesting these emotions may discourage preventive action. However, it has been found that fear can facilitate health preventative behaviours, when people are aware of what they need to do to cope with the situation (Maddux & Rogers, 1983). Also, when the fear stimuli are not too threatening, fear can facilitate positive health behaviours, i.e. behaviour change (Petty, 1995). It has also been shown that fear can turn into hope when efficacy is high (Nabi & Myrick, 2022) and this can then lead to behaviour change, i.e. increase sun protective behaviours. Interestingly, in this research hope was associated with behaviour change but not attitude change. Based on prior evidence, it is probable that experienced gratitude, hope, and fear are likely to have positive relationships with preventative behaviours, whilst experienced disgust is less likely to be related to preventative action.

The present research

We pre-registered a larger project on OSF, which involved hypotheses about the impact of gratitude and hope recall tasks on COVID-19 preventative behaviours.[1] We first conducted a pilot study in July 2020, recruiting 300 participants from Prolific, to inform the measures and materials used in the main study (pilot study data set can be found on OSF). Most of the measures were the same as the main study. In the main study, we wanted to test whether a simple recall task of hope or gratitude (vs. no emotion recall) would have a positive impact by increasing individuals' willingness to engage in COVID-19 preventative behaviours. Moving beyond other research looking at the role of emotions in COVID-19 preventative behaviours, we wanted to test whether hope versus gratitude recall tasks would impact behaviour intentions over time, i.e. across multiple time points. Therefore, we conducted a longitudinal study (Study 1) in which participants engaged with the same

recall task once a month for six months and then followed up with another time point six months later where participants did not engage in the recall task. The chosen time points for this study are based on previously used methods (e.g. Gilles et al., 2011), as it is necessary to look at the outcomes consistently across a six-month time frame (September 2020 to February 2021) and then conduct another 6 month follow up (August 2021) to see if there is sustained change in behaviours even when not exposed to the emotion manipulation, and, co-incidentally, this was a period where restrictions were being relaxed. The period of September 2020 to February 2021 included key events related to the pandemic in the UK, such as the introduction of the rule of six, tier systems, and national lockdowns (see the Institute for Government analysis/summary of events, 2021). Thus, it was also useful to examine these time periods to compare the impact on the different experienced emotions (i.e. hope, gratitude, fear, and disgust), in comparison to a baseline control condition, which was necessary as it enabled us to monitor the impact of key events on these emotions. At each time point, after the recall task, participants rated how much gratitude, hope, fear, and disgust they were experiencing currently and when focusing on the future, as well as reported their willingness to engage in health preventative action. In addition to this longitudinal study, we also tested whether recalling hope and gratitude would have an impact on willingness to engage in preventative action (Study 2), even at a time when restrictions were lifted and engaging in COVID-19 preventative action was more of a personal choice than a government mandate.

Hypotheses

The current paper will focus on hypotheses relevant to experienced emotions (i.e. state emotions) and preventative action. Based on the unique effects of hope (i.e. encouraging other health-protective behaviours and forward thinking), we predicted that recalling hope would be more effective in reducing fear (Hypothesis 1a) and disgust (Hypothesis 1b), and would encourage preventative action (Hypothesis 2) in comparison to a gratitude recall task and neutral task.

Based on prior evidence suggesting that gratitude is key to the pandemic (Datu et al., 2022; Dennis et al., 2022; Fekete & Deichert, 2022; Syropoulos & Markowitz, 2021), gratitude is another likely candidate emotion to facilitate outcomes; however, we predicted that it would have a smaller impact in comparison to recalling hope, due to hope's motivating nature (Nabi & Myrick, 2022; Snyder, 2000). It is also useful to compare these two positive emotion recall conditions as prior research has not found a difference between the positive recall tasks (Datu et al., 2022), but has not compared specific emotion recall tasks; thus, this research will uncover when the two positive emotions can be associated with positive action, comparing their effects on preventative action and negative emotions. We will examine hope and gratitude's impact as induced emotions (i.e. elicited by recall tasks) and experienced emotions (i.e. experienced currently and when considering the future).

Hypotheses 1 and 2 were pre-registered as part of a larger project with multiple variables and hypotheses, such as trait emotions, trust, and efficacy beliefs.[2] We also conducted further multilevel model analyses to explore whether experienced emotions (hope, gratitude, fear, disgust) predict willingness to engage in preventative behaviours, and if these experienced emotions have an impact even when controlling for the impact of time and recall task condition. After our pre-registration and based on prior literature reviewed previously, we predicted that levels of experienced hope, gratitude, and fear would be associated with greater willingness to engage in preventative action, but disgust would be less likely to be related to preventative action.

Study 1

Method

Design

This experiment utilised a 3 Emotion Recall Task Condition (Hope versus Gratitude versus Control, between-participants) x 7 Time (once a month for a period of 6 months and a 6 month follow up without the emotion recall, within-participants) mixed design. We examined the impact of time and emotion recall on preventative behaviours and experienced emotions by clustering mixed multilevel model analysis by participants (to facilitate the exploration of repeated measures nested within an individual).

Participants

Under the original analysis assumption, a G*Power 3.1 (Faul et al., 2009) a-priori power analysis indicated

that an adequate sample size would be 247 (assuming an effect size of 0.20, with a power of 0.85 and α of .05, performing MANOVA analysis, repeated measures, with between-within interactions). Due to the longitudinal design and assuming attrition rates, we aimed to recruit 375 participants. We recruited from Prolific, participants were rewarded £2 at each time point. To take part in the research, participants had to be British, not having completed our pilot study, and a prior approval rate of 97% or above in prior studies. See Table 2 for full details of how many participants took part in each time point by emotion recall task condition.

At time point 1, participants mostly identified as being female (71%).[3] In terms of age, there was a variable age range ($M_{age} = 36.98$, $SD_{age} = 12.6$, range: 18–88). The sample was predominantly White (86%). The majority of participants had a university degree or higher (63%). At time point 7, 247 participants (64%) returned to take part in the follow-up questionnaire. Of the remaining sample, most identified as female (75%), White (87%), and received a university degree of higher (66%). The sample still had a variable age range ($M_{age} = 39.53$, $SD_{age} = 13.25$, range: 19–89).

Materials and procedure

Participants were presented with an information sheet and consent form at each time point. They then completed the measures/materials in the following order:

Demographics. Participants first filled in the following demographic variables: age, gender, education, nationality, and ethnicity.

Emotion recall: Participants were randomly assigned to recall five things that made them feel either hopeful or grateful (instructions below), or, for the neutral condition, they recalled five things that they planned to do the following Wednesday. Participants were randomly assigned to one of the conditions at time point 1 and thereafter completed the same recall task in the remaining timepoints. Participants completed the same emotion recall task at each of the 6 initial time points, but not at the 7th final time point.

> *Please describe 5 events, situations, episodes, or objects that make you feel grateful/hopeful for what you currently have in the context of the COVID-19 pandemic. Describe in detail how these events, situations, episodes, or objects make you feel and why you feel this way?*

Experienced emotions (current and future): Participants then self-reported how much they were currently experiencing several distinct emotions. They also rated the same list of discrete emotions but in relation to what our future may be like in the context of the COVID-19 outbreak. Specifically, for the current emotions block they were asked to indicate how much you feel the following emotions in relation to the current circumstances concerning the COVID-19 pandemic. Then, for the future emotions block they were asked to indicate how much you feel the following emotions in relation to what our future in the next month may be like because of the COVID-19 pandemic.

The current and future emotions were presented in two separate blocks, in a randomised order. The emotion items were rated on a Likert scale from 1 (*Not at all*) to 7 (*Extremely*). For theoretical reasons our analysis focused on hope, gratitude, disgust, and fear as these emotions are associated with different appraisals and behavioural tendencies (see OSF for the full list of emotion items).

Reliability was high (Cranford et al., 2006) at both within and between levels across the seven time points for all four of the emotions we analyzed. The reliability across the *current hope*, was high within participants ($R_c = .75$) and between participants ($R_{KF} = .97$). Similarly, reliability across the *current gratitude* items was high within participants ($R_c = .80$) and high between participants ($R_{KF} = .97$). For *current fear*, reliability was high within participants ($R_c = .79$) and between participants ($R_{KF} = .98$). Finally, reliability across the *current disgust* items was moderate to high within participants ($R_c = .73$) and high between participants ($R_{KF} = .97$).

For *future hope* items, reliability was high within participants ($R_c = .83$) and between participants ($R_{KF} = .98$). For *future gratitude*, reliability was high within participants ($R_c = .82$) and between participants ($R_{KF} = .97$). The reliability across the *future fear* items was high within participants ($R_c = .82$) and high between participants ($R_{KF} = .98$), and for *future disgust*, high within participants ($R_c = .75$) and between participants ($R_{KF} = .98$).

Preventative behaviours. Participants were then asked about their willingness to engage in *preventative health behaviours (i.e. in the next month how willing would you be to …*), on a scale from 1 (*Not at all likely*) to 7 (*Extremely likely*). The instructions and scale items were partially adapted from Chuang et al. (2015), and the scale comprised additional

items related specifically to COVID-19 (e.g. track-and-trace app, social distance, avoiding public transport, wear a mask, wash hands more frequently). The scale included 12 items in total (full list of items can be found on OSF). The reliability across the *preventative behaviours* items was moderate to high within participants ($R_c = .67$) and high between participants ($R_{KF} = .98$) across 7 time points.

After completing all items, participants gave their consent to have their data submitted. All participants were fully debriefed after the final time point. Ethical approval for this study was obtained from the University of Surrey.

Data analysis strategy

The goal of this research was to examine the impact of the hope and gratitude recall tasks on experienced emotions and preventative action. We also explored the impact of experienced hope, gratitude, fear, and disgust on willingness to engage in preventative behaviours, controlling for the impact of time and recall task. We decided to include participants throughout the study, even if they missed a time point. To account for missing data, along with its longitudinal and hierarchical nature, we decided to execute multilevel model analysis (MLM) instead of originally assumed MANOVA. We reasoned that because of the intensive longitudinal nature of our data, this type of analysis would allow us to distinguish between- and within-person level of data, nested within a person (Bolger & Laurenceau, 2013; Maas & Hox, 2004). Clustering by participants in MLM allows not only for including participants who had missed certain time points, but it also provides random effects (intercepts and slopes) for each participant. In terms of the missing data, one of the advantages of multilevel modelling is that it can handle intensive longitudinal data. MLM assumes that the data are missing at random and there is nothing systematic about the missing time points. Therefore, the model can handle participants who took part in the entire study as well as participants who took part only in certain time points. MLM computes the slope between those defined time points.

The data were analyzed in R version 3.6.3 (R Core Team, 2018), using the "lmer" package (Bates et al., 2015), and "emmeans" package (Lenth et al., 2021) to compute simple effects across mixed models. To control for convergence of the executed MLM, we optimised the models for the non-linear parameter estimation using box-constrained optimisation L-BFGS-B from the "optimx" package (Nash, 2014). Complementary analyses were run using jamovi 2.2.2 (The jamovi project, 2021).

The predictor variables were disaggregated into a within-person and a between-person component. The between-person component was calculated based on an overall grand mean of the participant's average score of each predictor variable, for example: Current hope ($\text{CurrentHope}_{\text{between}}$), current gratitude ($\text{CurrentGratitude}_{\text{between}}$), current fear ($\text{CurrentFear}_{\text{between}}$), and current disgust ($\text{CurrentDisgust}_{\text{between}}$). In order to compute the within-person component, the between-person component was subtracted from the uncentred individual score of each participant from the monthly values of, for example, current hope ($\text{CurrentHope}_{\text{within}}$), current gratitude ($\text{CurrentGratitude}_{\text{within}}$), current fear ($\text{CurrentFear}_{\text{within}}$), and current disgust ($\text{CurrentDisgust}_{\text{within}}$).

Apart from manipulation checks (e.g. testing whether gratitude and hope differed by condition), the hypotheses were tested with a series of MLM, including preventative behaviours as a dependent variable, and experienced current emotions as predictors, on between- and within-person level. The equation of the model, where the preventative behaviours variable is predicted by current-oriented emotions is demonstrated below:

$$
\begin{aligned}
\text{Preventative Behaviors}_{it} = {} & \gamma_{01}(\text{CurrentHope}_{\text{between}}) \\
& + \gamma_{10}(\text{CurrentHope}_{\text{within}}) \\
& + \gamma_{02}(\text{CurrentGratitude}_{\text{between}}) \\
& + \gamma_{20}(\text{CurrentGratitude}_{\text{within}}) \\
& + \gamma_{03}(\text{CurrentFear}_{\text{between}}) + \gamma_{30}(\text{CurrentFear}_{\text{within}}) \\
& + \gamma_{04}(\text{CurrentDisgust}_{\text{between}}) \\
& + \gamma_{40}(\text{CurrentDisgust}_{\text{within}}) \\
& + \text{time} + \text{condition} \\
& + u_{0i} + u_{1i}\,(\text{CurrentHope}_{\text{within}}) \\
& + u_{2i}(\text{CurrentGratitude}_{\text{within}}) + u_{3i}\,(\text{CurrentFear}_{\text{within}}) \\
& + u_{4i}(\text{CurrentDisgust}_{\text{within}}) + \varepsilon_{it}
\end{aligned}
$$

In this model, *i* refers to individuals and *t* refers to time point, whereas γ_{01} to γ_{04} index present-oriented emotions on a between-person level. On the other hand, γ_{10} to γ_{40} describe all four model variables on a within-person level. u_{0i} represents the random intercept, and terms from u_{1i} to u_{4i} represent the random

slopes for the model variables, respectively to the numbers allocated to between- and within-person effects. Finally, ε_{it} stands for the regression residual for participant *i* on day *t*. We also repeated the analyses with experienced future emotions entered in the model rather than current emotions; however, there were no differences in the results (see Appendix 1).

Results

Descriptive statistics

Table 1 shows the overall means, standard deviations, correlations on between- and within-person level, along with intraclass correlations of the study variables. Table 2 presents the means and standard deviations of the study variables by conditions and time points, along with the number of participants in each time point and condition. The descriptive statistics indicate that overall willingness to engage in preventative behaviours in our study was high (M = 6.01, SD = .92). The means in Table 2 indicate that participants in the gratitude recall condition were most likely to engage in preventative behaviours, whereas the scores were the lowest, although still very high, in the neutral recall condition. The values in the follow-up measure (time point 7) were consistently the lowest within each condition, but also had the highest standard deviation, which suggests a broader dispersion of values in the follow-up.

Manipulation checks. First, to assess the success of our emotion recall tasks we examined whether experienced *hope* and *gratitude* were significantly different across conditions. We performed the analyses with both current and future-focused emotions; however, due to similar results future emotions analyses are presented in Appendix 1. In terms of *current hope*, the effect of the emotion recall condition was significant, $t(553.07) = 2.74$, $p = .006$. The values of experienced *current hope* were highest in the hope recall condition ($M = 4.28$, $SD = 1.39$), lower in gratitude recall condition ($M = 4.10$, $SD = 1.38$), and the lowest in the neutral recall condition ($M = 3.76$, $SD = 1.51$). The difference between neutral and hope recall conditions was significant (Est = -.51, $SE = .14$, $p < .001$), whereas the difference between hope and gratitude recall conditions was not significant ($p = .28$). *Current hope* was marginally different between the neutral and gratitude recall conditions ($p = .067$). The main effect of time was also significant for *current hope*, *t*

Table 1. Descriptive statistics and between-person and within-person correlations in the study 1 variables across 7 time points.

Variable	Between person (n = 381)											Within person (n = 2575)										ICC (BP)
	M	*SD*	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	
1. Prev. behaviours	6.01	0.92	–	**−.12**	.09	**.17**	**.19**	**−.16**	**.12**	**.15**	**.23**	**−.17**	-	**−.10**	**.07**	**.11**	**.16**	**−.14**	**.07**	**.10**	**.20**	**−.14**	.66
2. Discrimination	2.53	1.38		-	**.11**	.05	.00	−.02	.10	**.11**	.01	−.02		-	**.08**	.04	.04	.01	**.07**	**.08**	**.04**	.01	.84
3. Future hope	4.03	1.51			-	**.54**	**−.26**	**−.25**	**.90**	**.65**	**−.23**	**−.25**			-	**.51**	**−.24**	**−.23**	**.82**	**.63**	**−.20**	**−.26**	.46
4. Current gratitude	4.17	1.62				-	**.00**	**−.12**	.66	**.88**	.01	**−.16**				-	**−.05**	**−.11**	**.60**	**.81**	−.03	**−.11**	.53
5. Future fear	3.31	1.61					-	**.51**	**−.20**	−.09	**.94**	**.54**					-	**.44**	**−.21**	**−.10**	**.85**	**.47**	.52
6. Current disgust	2.23	1.50						-	**−.22**	**−.16**	**.50**	**.51**						-	**−.21**	**−.14**	**.43**	**.87**	.59
7. Current hope	4.04	1.44							-	**.66**	**−.19**	**−.25**							-	**.59**	**−.18**	**−.22**	.49
8. Future gratitude	4.12	1.59								-	−.06	**−.20**								-	**−.06**	**−.15**	.50
9. Current fear	3.30	1.57									-	**.50**									-	**.44**	.56
10. Future disgust	2.14	1.46										-										-	.59

Notes: ICC = intraclass correlation. All variables' values ranged from 1-7. *M* and *SD* are based on averaging reports from seven time points. Significant correlations are in bold ($p < .05$, two-tailed).

Table 2. Number of participants, means, and standard deviations of the study variables across 7 time points, by conditions for study 1.

Condition	Time	*N*	Preventative behaviours		Future hope		Current gratitude		Future fear		Current disgust		Current hope		Future gratitude		Current fear		Future disgust	
			M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Neutral	1	131	5.94	0.74	3.28	1.37	3.78	1.65	3.86	1.64	2.60	1.62	3.46	1.35	3.57	1.70	3.76	1.58	2.49	1.54
	2	115	5.91	0.86	3.17	1.41	3.67	1.66	3.86	1.66	2.70	1.63	3.09	1.35	3.57	1.68	3.78	1.58	2.55	1.69
	3	104	5.94	0.91	3.90	1.52	3.89	1.65	3.26	1.54	2.18	1.34	3.79	1.44	3.91	1.62	3.22	1.45	2.15	1.44
	4	100	5.95	0.81	3.94	1.54	4.01	1.72	3.18	1.54	2.15	1.44	4.07	1.52	4.03	1.73	3.06	1.56	2.15	1.42
	5	99	6.17	0.74	3.82	1.61	4.01	1.70	3.79	1.63	2.37	1.62	3.74	1.56	4.08	1.71	3.86	1.66	2.17	1.48
	6	97	6.07	0.87	4.26	1.53	4.13	1.61	3.05	1.57	2.13	1.46	4.10	1.57	4.14	1.60	3.21	1.57	2.04	1.43
	7	85	5.34	1.14	4.36	1.56	4.39	1.62	3.00	1.51	2.18	1.39	4.38	1.47	4.42	1.57	2.89	1.51	2.03	1.25
Hope	1	120	5.99	0.93	3.93	1.43	3.92	1.64	3.80	1.72	2.60	1.59	4.03	1.38	3.80	1.48	3.75	1.56	2.48	1.40
	2	102	5.98	0.99	3.61	1.31	3.84	1.64	3.75	1.40	2.54	1.61	3.69	1.32	3.68	1.53	3.73	1.40	2.59	1.64
	3	98	6.08	0.83	4.64	1.32	4.52	1.62	3.10	1.56	2.06	1.38	4.62	1.19	4.42	1.45	3.03	1.47	1.97	1.45
	4	82	6.04	0.89	4.47	1.47	4.38	1.58	3.20	1.78	2.21	1.57	4.62	1.42	4.40	1.47	3.07	1.63	2.05	1.63
	5	93	6.16	0.96	4.24	1.43	4.28	1.66	3.30	1.70	2.23	1.76	4.27	1.43	4.32	1.45	3.37	1.65	2.16	1.70
	6	82	6.17	1.05	4.65	1.47	4.36	1.69	2.59	1.42	1.86	1.41	4.39	1.47	4.46	1.52	2.59	1.48	1.78	1.36
	7	73	5.45	1.18	4.39	1.41	4.32	1.51	2.62	1.43	1.74	1.19	4.56	1.26	4.21	1.57	2.59	1.42	1.69	1.06
Gratitude	1	130	6.17	0.73	3.68	1.41	4.53	1.55	3.67	1.53	2.33	1.49	3.89	1.37	4.15	1.55	3.47	1.50	2.32	1.49
	2	114	6.20	0.67	3.62	1.53	4.12	1.54	3.72	1.51	2.33	1.49	3.59	1.34	4.11	1.49	3.52	1.51	2.29	1.46
	3	108	6.18	0.78	4.35	1.39	4.38	1.57	3.02	1.59	1.98	1.33	4.21	1.33	4.41	1.57	3.12	1.56	1.88	1.26
	4	90	6.14	0.94	4.31	1.46	4.37	1.51	3.08	1.59	2.03	1.40	4.36	1.29	4.36	1.51	3.35	1.61	1.98	1.34
	5	97	6.19	0.94	4.12	1.46	4.37	1.60	3.30	1.52	2.16	1.49	4.03	1.38	4.40	1.61	3.46	1.57	2.07	1.43
	6	90	6.25	0.85	4.45	1.42	4.42	1.60	2.56	1.50	1.86	1.31	4.38	1.40	4.42	1.54	2.81	1.46	1.77	1.25
	7	87	5.65	1.04	4.49	1.47	4.22	1.57	2.71	1.32	1.93	1.29	4.48	1.39	4.33	1.58	2.66	1.38	1.77	1.21

(1782.86) = 5.91, $p < .001$; however, the interaction effect was not significant; thus, in general people became more hopeful across time.

There was a significant effect of emotion recall condition for *current gratitude,* $t(533.17) = 4.01$, $p < .001$. The highest scores of experienced *current gratitude* were obtained in the gratitude recall condition ($M = 4.36$, $SD = 1.56$), lower in the hope recall condition ($M = 4.21$, $SD = 1.61$), and the lowest in the neutral recall condition ($M = 3.96$, $SD = 1.67$). The difference between neutral and gratitude recall conditions was significant (Est = -.44, $SE = .16$, $p = .019$), whereas the neutral-hope ($p = .14$) and hope-gratitude contrasts were not ($p = .68$). The main effect of time was significant for *current gratitude*, $t(1775.27) = 4.33$, $p < .001$, and the interaction between time and recall condition was significant as well, $t(1777.76) = -2.99$, $p = .002$. At time point 1 there was a significant difference between current gratitude in the neutral and gratitude recall conditions, this pattern remained until time point 7 (see Figure 1 for interaction plots and Table 2 for means). There was no difference in current gratitude experienced between the gratitude and hope recall conditions at time points 1 and 7, but between time points 3 through 6 people experienced more current gratitude in the gratitude recall condition than the hope recall condition. Further manipulation checks were also conducted, with the inclusion of the other positive emotions as a covariate, time, condition, and interaction between time and condition factors (see Appendix 2). Controlling for the other positive emotions reduced the effect of condition on *current hope*, but the effect of recall condition on *current gratitude* remained significant.

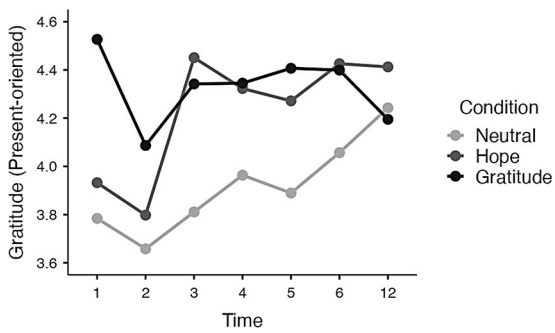

Figure 1. Interaction between time and condition for experienced current-oriented gratitude.

Effects of emotion recall tasks on experienced negative emotions

Next, we examined whether the hope recall triggered the greatest reduction in experienced fear (Hypothesis 1a) and disgust (Hypothesis 1b). For both negative emotions, only the effect of time was significant, $t(1772) = -3.34$, $p < .001$ for *current disgust*, and $t(1770) = -4.54$, $p < .001$ for *current fear*. The means suggested some fluctuation but, in general, people felt less fear and disgust at the final time point. Neither the main effect of emotion recall condition (current disgust: $p = .12$, current fear: $p = .51$) nor the interaction between emotion recall condition and time (current disgust: $p = .81$, current fear: $p = .66$) were significant. This disconfirms our first hypothesis that the hope recall would be better at reducing experienced negative emotions, in comparison to the gratitude and neutral recall conditions. We performed these analyses for experienced future negative emotions as well, which resulted in similar effects (see Appendix 1).

Effects of emotion recall tasks on preventative behaviours

We next examined whether preventative behaviours were significantly different across the three conditions (Hypothesis 2) and time. When willingness to engage in *preventative behaviours* was the DV, in this model the effects of both time, $t(1764) = -2.29$, $p < .022$, and emotion recall condition, $t(625.2) = 2.26$, $p = .024$, were significant. However, the interaction between time and emotion recall condition was not significant, $p = .72$. The willingness to engage in preventative behaviours was the highest in the gratitude recall condition ($M = 6.12$, $SD = .86$), lower in the hope recall condition ($M = 6.00$, SD = .99), and the lowest in the neutral recall condition ($M = 5.92$, $SD = .89$). The difference between neutral and gratitude recall conditions was statistically significant, Est = -.22, $SE = .09$, $p = .036$. The neutral vs hope, $p = .62$, and hope vs gratitude, $p = .40$, contrasts were not significant. In terms of the effect of time, although scores were high in the first six time points, the results from the follow-up show that the willingness to engage in preventative behaviours dropped across all the emotion recall conditions ($M = 5.48$, $SD = 1.12$), but remained the highest in the gratitude recall condition, lower in the hope condition, and the lowest in the neutral recall condition (see Table 2 for means).

The effect of experienced emotions on preventative behaviours

We ran multilevel models to explore the association between experienced emotions and preventative behaviors. We computed a MLM to explore if experienced current emotions (hope, gratitude, fear, disgust) were associated with willingness to engage in preventative behaviours related to the COVID-19 pandemic, controlling for the effects of time and emotion recall task condition. Results with standardised and unstandardised coefficients can be found in Table 3. In this model, we found a significant negative effect of time, $B = -.05$, $p < .001$, and a significant effect of emotion recall condition, $B = .09$, $p = .043$, even when entering the emotions into the model, indicating the same pattern of means across the recall tasks as the previous analyses.

The results showed that experienced *current gratitude* was not a significant predictor of preventative behaviours on either between- or within-person level. Experienced *current hope*, however, predicted preventative behaviours on the within-person level exclusively, $B = .03$, $p = .039$, which indicates that when participants reported higher *current hope* concerning the COVID-19 pandemic, they also reported higher willingness to engage in preventative behaviours. On the other hand, experienced *current fear* and *current disgust* predicted preventative behaviours significantly on a between-person level: Fear positively, $B = .025$, $p < .001$, and disgust negatively, $B = -.22$, $p < .001$. This shows that participants who had general higher levels of experienced fear during the study, reported on average higher willingness to engage in preventative behaviours. However, higher levels of experienced disgust were associated with decreased willingness to engage in preventative action. Disgust was also a significant negative predictor on a within-person level, $B = -.04$, $p = .005$. The coefficient indicates that when participants reported higher feelings of disgust in the context of the pandemic, they were less keen on engaging in preventative behaviours.

We also repeated these analyses with future emotions, again resulting in similar effects (see Appendix 1). Additionally, to account for the 6-month gap between time point 6 and 7, and because time point 7 did not involve a recall task, we have conducted the same analyses without the follow-up time point included in the original analyses. Results with standardised and unstandardised coefficients can be found in Table 4. Most results remained similar, and they did not contradict our current interpretation of the findings by condition and

Table 3. Parameter estimates for multilevel models of preventative behaviours as a function of current-oriented emotions (final time point included).

Fixed effects (intercepts, slopes)	*B*	*SE/SD*	*T*	*β*	*p*	CI LL	CI UL
Intercept	**5.36**	.20	26.98	6.04	<.001	4.97	5.76
Time	**−0.05**	.004	−13.14	−0.05	<.001	−0.06	−0.04
Condition	**0.09**	.04	2.03	0.09	.043	0.00	0.17
Level 1 (within-person)							
Hope	**0.03**	.01	2.08	0.03	.039	0.00	0.06
Gratitude	0.01	.01	0.63	0.01	.531	−0.02	0.04
Fear	0.02	.01	1.80	0.02	.073	−0.00	0.05
Disgust	**−0.04**	.01	−2.86	−0.04	.005	−0.07	−0.01
Level 2 (between-person)							
Hope	0.04	.04	0.90	0.04	.368	−0.05	0.12
Gratitude	0.05	.04	1.21	0.06	.226	−0.03	0.12
Fear	**0.25**	.03	7.60	0.32	<.001	0.18	0.31
Disgust	**−0.22**	.03	−6.43	−0.27	<.001	−0.29	−0.15
Random effects							
Level 1 (within-person)							
Residual	0.22	.47	-	0.22	-	0.46	0.50
Level 2 (between-person)							
Intercept	0.44	.66	-	0.44	-	0.61	0.72
Hope	0.01	.08	-	0.01	-	0.03	0.13
Gratitude	0.01	.10	-	0.01	-	0.07	0.15
Fear	0.00	.05	-	0.00	-	0.00	0.08
Disgust	0.00	.05	-	0.00	-	−0.00	0.08

Notes: *B* = unstandardised estimates; *SE* = standard error; *SD* = standard deviation; *β* = standardised estimates; CI = 95% confidence interval; LL = lower limit; UL = upper limit; significant coefficients are in bold ($p < .05$, two-tailed). For fixed effects, *SE* have been reported. For random effects, *SD* have been reported.

Table 4. Parameter estimates for multilevel models of preventative behaviours as a function of current-oriented emotions (final time point not included).[6]

Fixed effects (intercepts, slopes)	*B*	*SE/SD*	*T*	*β*	*p*	CI LL	CI UL
Intercept	**5.25**	.20	26.50	5.85	<.001	4.84	5.64
Time	**0.02**	.01	3.76	0.02	<.001	0.01	0.04
Condition	0.08	.01	1.76	0.08	.078	−0.00	0.16
Level 1 (within-person)							
Hope	**0.02**	.01	2.02	0.03	.044	−0.00	0.05
Gratitude	0.02	.01	1.38	0.02	.167	−0.01	0.04
Fear	0.02	.01	1.54	0.02	.123	−0.00	0.04
Disgust	**−0.03**	.01	−2.25	−0.03	.025	−0.06	−0.00
Level 2 (between-person)							
Hope	0.05	.04	1.04	0.05	.301	−0.04	0.13
Gratitude	0.03	.04	0.79	0.04	.429	−0.04	0.10
Fear	**0.24**	.03	7.44	0.31	<.001	0.18	0.30
Disgust	**−0.22**	.03	−6.58	−0.27	<.001	−0.28	−0.16
Random effects							
Level 1 (within-person)							
Residual	0.17	.41	-	0.17	-	0.40	0.44
Level 2 (between-person)							
Intercept	0.44	.67	-	0.44	-	0.61	0.72
Hope	0.01	.08	-	0.01	-	0.04	0.12
Fear	0.00	.04	-	0.00	-	−0.02	0.06
Disgust	0.01	.08	-	0.01	-	0.04	0.11

Notes: *B* = unstandardised estimates; *SE* = standard error; *SD* = standard deviation; *β* = standardised estimates; CI = 95% confidence interval; LL = lower limit; UL = upper limit; significant coefficients are in bold ($p < .05$, two-tailed). For fixed effects, *SE* have been reported. For random effects, SD have been reported.

emotions. However, after removing the final time point, the effect of time was no longer a negative predictor of willingness to engage in preventative behaviours, but a positive predictor of willingness to engage in preventative behaviours.

Discussion

In this longitudinal study that spanned a year, we found that a gratitude recall task increased willingness to engage in health preventative behaviours, more so than the baseline neutral recall task. This aligns with prior research showing the positive impact of gratitude in the context of COVID-19 (Datu et al., 2022; Dennis et al., 2022; Fekete & Deichert, 2022; Syropoulos & Markowitz, 2021). However, the gratitude and hope recall tasks had similar impacts on preventative action, which aligns with prior research showing that gratitude has an equally positive impact as other positive manipulations, i.e. kindness (Datu et al., 2022). We found this result over the course of time points when the participants engaged in the recall task, but not when investigating the six-month follow-up which did not encompass a recall task (see Table 4). This may suggest that it is important to actively engage in a gratitude or hope recall task to see an effect. Another reason for this result may be that the final time point took place during a period where restrictions were being relaxed; thus, the context itself may have decreased willingness to engage in preventative action.

With regards to the emotions participants reported experiencing (i.e. levels of gratitude, hope, disgust, and fear), we found that gratitude and hope recall tasks elicited respective emotions more so than the neutral condition; however, participants in the positive emotion recall conditions experienced similar levels of gratitude and hope. Therefore, both positive emotion recall tasks resulted in more positive emotional experiences. We also found that disgust and fear did not differ by recall conditions; thus, we did not find support for our hypothesis that a hope recall task would be the most efficacious at reducing negative emotions. Instead, both fear and disgust were significantly different across time and in general were lower at the final time point, suggesting that these emotions were influenced more by external and societal events than the recall task itself.

We also explored whether experienced emotions (hope, gratitude, fear, disgust) were associated with willingness to engage in preventative behaviours related to the COVID-19 pandemic, whilst controlling for time and condition in the model. Overall, we found that the effects of time and condition remained significant even when including levels of experienced

emotions in the model. The results suggested that on the within person level, hope but not gratitude was related to preventative action; thus, at times when an individual felt more hope they reported greater willingness to engage in COVID-19 preventative behaviours. However, hope was not related to preventative action at the between person level, and the effects of negative emotions were much stronger. At the between person level, we found that disgust was related to less preventative action while fear was related to more preventative action. This suggests that negative emotions have a strong relationship with preventative action, even despite positive emotions experienced and elicited. These findings also support our assumption that fear is more likely to be a positive predictor of preventative action (e.g. Nabi & Myrick, 2022; Zingora et al., 2022), while disgust is more likely to be associated with defensive responses (Herek & McLemore, 2013). Thus, we did not find support for disgust promoting avoidance and preventative action (Dasborough et al., 2020; Ekman, 1999; Greenbaum et al., 2020; Rozin & Fallon, 1987).

Study 2

To assess the effects of gratitude and hope recall tasks observed in the longitudinal study and address some limitations from this study, we conducted a follow-up study that involved a recall task and was conducted at a time (late February 2022) when restrictions were relaxed, and residents of the United Kingdom were asked to accept the presence of COVID-19. To extend Study 1 findings, we also examined whether the gratitude (vs. hope) recall needed to focus on aspects related to COVID-19 specifically, or whether feeling these emotions more generally would have an impact on willingness to engage in preventative action in the future. This seems important to test as incidental emotion effects, i.e. unrelated to the situation, can be different from integral emotion effects, i.e. directly related to the situation (see Polyportis et al., 2020).

Given the time in which the study was conducted, we decided to have all emotion recall tasks and measures focused on the future, which seemed relevant as we did not see large differences between experienced current and future emotions in Study 1. This also seemed beneficial as the neutral recalling task was also focused on the future. Like the longitudinal study, we also examined relationships between currently experienced hope, gratitude, fear, and disgust (felt in relation to what the future may be) with preventative action, to see if these emotions had similar relationships with preventative action during this time.

Method

Design

This study utilised a 5 Emotion Recall Condition (Gratitude COVID-19 vs. Gratitude General vs. Hope COVID-19 vs. Hope General vs. Neutral) between-participants design. We examined the impact of the emotion recall tasks on preventative behaviours and emotions (gratitude, hope, fear, and disgust) experienced in relation to what the future may be.

Participants

Based on the longitudinal study, we conducted a G*Power (Faul et al., 2009) a-priori power analysis assuming an effect size of 0.20, with a power of 0.95 and α of .05, performing ANOVA analysis. This indicated that an adequate sample size would be 470. We recruited from Prolific, participants had to be British and not having completed our pilot study or main longitudinal study. Participants were mostly female (86%).[4] In terms of age, there was a wide age range ($M_{age} = 37.67$, $SD_{age} = 12.25$, range: 18-75).

Materials and procedure

Participants were first presented with an information sheet and consent form. They then completed demographic items for their age and gender. Participants were then randomly assigned to one of five emotion recall conditions. Two conditions asked them to recall five things that made them feel either hopeful or grateful for the future in relation to the COVID-19 pandemic. Alternatively, for the two other emotion conditions they were asked to recall five things that made them feel either hopeful or grateful for their future in general. For the neutral condition, they recalled five things that they planned to do the following Wednesday, like in Study 1. The emotion recall wording for the COVID-19 specific focus and general focus were as follows:

> ***COVID Instructions**: Please describe 5 events, situations, episodes or objects that make you feel grateful/hopeful for what the future of the COVID-19 pandemic may be like. Describe in detail how these events, situations,*

episodes or objects make you feel and why you feel this way considering the context of the COVID-19 pandemic.

***General Instructions**: Please describe 5 events, situations, episodes or objects that make you feel grateful/hopeful for what the future may be like. Describe in detail how these events, situations, episodes or objects make you feel and why you feel this way.*

After the recall task, participants self-reported how much they were currently experiencing several distinct emotions in relation to what our future may be like because of the COVID-19 pandemic, specifically they were asked to *indicate how much you currently feel the following emotions in relation to what our future may be like because of the COVID-19 pandemic.* We used the same emotion terms for gratitude, hope, fear, and disgust as in Study 1. The emotion items were rated on a Likert scale from 1 (*Not at all*) to 7 (*Extremely*). Participants were also asked about their willingness to engage in ten *preventative health behaviours* in the future, on a scale from 1 (*Not at all* likely) to 7 (*Extremely likely*), using similar measures as those from Study 1 except we now used 10 items. The scale was found to be reliable, Cronbach α = .89. The wording of all measures can be found on OSF.

Descriptive statistics

Means and standard deviations for the emotion and preventative behaviours can be found in Table 5. We found that gratitude and fear were correlated with willingness to engage in preventative behaviour but hope and disgust were not significantly related to preventative behaviours, see Table 6.

Effects of emotion recall tasks

We conducted a MANOVA, entering experienced emotions as dependent variables (gratitude, hope, fear, and disgust) and emotion recall condition (Gratitude COVID-19, Gratitude General, Hope COVID-19, Hope General, Neutral) as the independent variable.

Table 6. Correlations for all measures study 2.

	Preventative Behaviour	Hope	Gratitude	Fear
Hope	.02			
Gratitude	.13**	.69**		
Fear	.34**	-.24**	-.09*	
Disgust	-.08	-.28**	-.24	.40**

*$p < .05$. ** $p < .01$.

The main effect of emotion recall condition was found to have a significant impact on experienced emotions, Pillai V = .06, $F(4, 495) = 1.77$, $p = .03$, $\eta_p^2 = .01$. Univariate analysis indicated significant effects on experienced gratitude, $F(4, 495) = 3.32$, $p = .01$, $\eta_p^2 = .03$, hope, $F(4, 495) = 2.82$, $p = .03$, $\eta_p^2 = .02$, and fear, $F(4, 495) = 2.65$, $p = .03$, $\eta_p^2 = .02$; however, the effect of recall condition on experienced disgust was not statistically significant, $F(4, 495) = 0.34$, $p = .85$, $\eta_p^2 = .003$.

Post-hoc comparisons, indicated that levels of experienced hope were lower in the neutral condition in comparison to the gratitude COVID-19, $p = .007$, gratitude general, $p = .007$, and hope COVID-19 conditions, $p = .04$. Levels of hope were marginally different in the hope general condition than the gratitude COVID-19, $p = .08$, and gratitude general conditions, $p = .09$, no other effects were statistically significant, all $ps > .29$. We found that experienced gratitude was higher in the gratitude COVID-19 condition in comparison to both the hope general, $p = .04$, and neutral conditions, $p = .004$. Gratitude was also higher in the gratitude general condition in comparison to both the hope general, $p = .04$, and neutral conditions, $p = .003$. No other comparisons between conditions on levels of gratitude were found to be significant, all $ps > .12$. We found that levels of fear were lower in the gratitude COVID-19 condition in comparison to both the gratitude general, $p = .04$, and hope general, $p = .02$, conditions. Fear was also lower in the hope COVID-19 condition in comparison to both the gratitude general, $p = .03$, and hope general, $p = .02$, conditions. However, the COVID-19 conditions did not lead to lower levels of fear in comparison to the neutral condition, all $ps > .13$, though the hope

Table 5. Means and standard deviations for study 2.

Dependent Variable	Gratitude COVID	Gratitude General	Hope COVID	Hope General	Neutral
Hope	4.80 (1.24)	4.78 (1.19)	4.66 (1.30)	4.45 (1.59)	4.26 (1.58)
Gratitude	4.58 (1.50)	4.58 (1.68)	4.21 (1.68)	4.09 (1.70)	3.90 (1.75)
Fear	3.08 (1.27)	3.52 (1.61)	3.06 (1.56)	3.58 (1.55)	3.20 (1.52)
Disgust	2.12 (1.39)	2.21 (1.31)	2.28 (1.57)	2.28 (1.40)	2.34 (1.46)
Preventative Behaviour	5.02 (1.16)	5.32 (1.19)	4.86 (1.46)	5.15 (1.36)	4.89 (1.36)

general condition was marginally different, $p = .08$. For all means across recall conditions see Table 5.

Next, we conducted an ANOVA with preventative behaviours as the dependent variable and emotion recall condition (Gratitude COVID, Gratitude General, Hope COVID, Hope General, Neutral) as the independent variable. The main effect of emotion recall condition was found to be only marginally significant, $F(4, 495) = 2.18$, $p = .07$, $\eta_p^2 = .02$, with means suggesting that preventative behaviours were highest in the gratitude general condition.[5]

Emotions and preventative behaviours

We tested across the sample whether any of the experienced emotions were associated with preventative behaviours, since the emotion recall task only had a marginal impact on willingness to engage in preventative behaviours. Specifically, we conducted a multiple regression analysis with measured emotions (hope, gratitude, fear, and disgust) as predictors of willingness to engage in preventative behaviours. The overall model was significant, $R^2 = .18$, $F(4, 495) = 26.99$, $p < .001$. We found that experienced gratitude, $\beta = .14$, $t(495) = 2.45$ $p = .02$, and fear, $\beta = .43$, $t(495) = 9.48$, $p < .001$, were associated with greater willingness to engage in preventative action. Whilst greater levels of disgust was related to less willingness to engage in preventative action, $\beta = -.23$, $t(495) = -5.00$, $p < .001$, and hope was not a significant predictor of preventative action, $\beta = -.04$, $t(495) = -0.70$, $p = .48$.

Discussion

We found the recalling tasks to have an overall marginal effect on preventive behaviours, suggesting participants' tendency to report the highest willingness to engage in preventive action in the gratitude general recall condition. The impact of the general gratitude condition on preventative action may have resulted because COVID-19 restrictions were relaxed at this point; however, this result should be interpreted cautiously as the overall effect of condition was marginally significant. Collapsing across the experimental conditions, we found that levels of experienced gratitude and fear were associated with greater willingness to engage in preventative behaviour, while disgust was again shown to promote less willingness to do so, and we found that hope, contrary to Study 1, was unrelated to preventative action in this context where restrictions had been lifted. Thus, during this time when restrictions were being relaxed in the UK, we found again that experienced gratitude and fear were positively related to preventive action.

In terms of experienced positive emotions, we again found less differentiation in terms of the different recall tasks, though the positive emotions were always higher in the positive emotion conditions than the neutral condition. Interestingly, we found that levels of disgust did not differ by the recall tasks; however, fear was lower when participants recalled positive emotions specifically related to COVID-19, but fear was not lower when recalling positive emotions in general. This may suggest that positive emotions can be used to counteract fear, but they need to be specific in focus, i.e. elicited integrally.

General discussion

Contrary to our initial pre-registered hypotheses, we found that a gratitude recall task increased willingness to engage in COVID-19 preventative behaviours, more so than the baseline neutral recall task. We found that the gratitude recall task had this impact across the study time points, and even found that recalling gratitude had a small impact at a time when restrictions were relaxed. This research suggests that gratitude can be used in a positive way in the context of COVID-19, which aligns with prior research (e.g. Dennis et al., 2022), and can facilitate preventative behaviours. This research extends past research demonstrating the multitude of ways that gratitude can be good for us, such as increasing well-being (Jans-Beken et al., 2020) and suggests that gratitude can have the potential to impact health preventative behaviours even outside of the context of COVID-19. However, we did not find that the gratitude and hope recall tasks had dissimilar effects, which aligns with other prior research showing that positive interventions having similar effects, i.e. gratitude versus kindness (e.g. Datu et al., 2022).

In both the longitudinal and follow-up study, we found less differentiation in terms of experienced hope and gratitude (i.e. experienced or state emotions). Participants generally felt more positive emotions in the positive emotions recall conditions than the neutral condition, and gratitude was slightly higher in respective conditions, but hope was high in both emotion recall conditions. However, when examining associations between levels of the experienced

emotions and preventative action we found gratitude to be a more consistent predictor of preventative action, as gratitude but not hope was found to be a significant predictor in the follow-up study. Additionally, in the longitudinal study we found that hope was related to preventative action only at the within person level. Thus, even though these experienced emotions were not that different by the positive emotion recall tasks, they showed unique relationships with COVID-19 preventative action in the different contexts.

On the other hand, we did find disgust and fear to have different impacts in the case of the COVID-19 pandemic. We found that disgust was related to less preventative action, while fear was associated with more preventative action, and this was found in both the longitudinal and follow-up study. This may suggest that disgust triggers feelings of certainty (Tiedens & Linton, 2001), and that people can relax their health protective response. It may also suggest that disgust is more closely linked to defensive responses (Herek & McLemore, 2013; Rozin & Fallon, 1987). In comparison, during the uncertain time of COVID-19, experienced fear increased willingness to engage in preventative action (see Zingora et al., 2022 for COVID-19 fear and anti-COVID-19 behaviours). This may suggest that fear focused attention to the situation and promoted thinking critically about what individuals need to do to reduce the risks from COVID-19 (Polyportis et al., 2020). Encouragingly, this pattern of results persisted even in the follow-up study which was a time when COVID-19 restrictions were relaxed. Across both studies, we also found that experienced disgust and fear were more strongly related to willingness to engage in preventative behaviours (though in opposite directions) than positive emotions were, i.e. gratitude and hope. We also found that levels of disgust and fear were not influenced by the emotion recall tasks.

Implications

This research demonstrates that positive emotions were associated with preventative action, and therefore can potentially be used to facilitate positive outcomes across multiple time points (that is, over time with longitudinal implications), which has both theoretical and practical value, as their roles in facilitating preventive behaviours can be important when designing future interventions. As we found that gratitude impacted willingness to engage in preventative behaviours, beyond a single time point, which is typical of positive emotion research (e.g. Bartoș et al., 2020). This is an important contribution to the field of emotion research, and it has wider impact as very little longitudinal research has been conducted in this domain. This research shows that simple emotion recall tasks on a monthly basis can be beneficial. Importantly, the recall task must be engaged in and can be both general or specific to the outcome itself, though the influence that general versus specific instructions have, are likely to differ by how much uncertainty and personal choice is present. Thus, gratitude recall can be effective at multiple time points, but instructions may need to be adapted for the context.

The current results suggest that the specific emotion of gratitude can be used to facilitate positive action. Therefore, gratitude is likely to be a useful tool in years to come, as we heal from the COVID-19 pandemic. This research directly suggests that if individuals engage in frequent gratitude recall this can help them, even in such negative circumstances, thus extending previous results on individuals' mental well-being (Geier & Morris, 2022) to behaviours that can also benefit other individuals. Hope was also related to preventative action but only in the longitudinal study on the within-person level, and the effects of the hope recall task were not different than the neutral task in either study. The theoretical implications of these positive emotion effects suggests that gratitude may be a slightly better candidate for fostering social change in this context, but further research is needed to disentangle hope and gratitude's unique effects on preventative action. It would also be useful to examine whether other factors besides the emotion recall tasks were contributing to willingness to engage in preventative action. Furthermore, in terms of these positive emotion recall tasks, further research should aim to examine whether it is the experience of these emotions, associated appraisals or motivational tendencies triggered by the recall tasks that have a positive impact. For example, gratitude interventions have been shown to have an impact in numerous domains, such as wellbeing and prosocial/helping behaviour (Bartlett & DeSteno, 2006; Jans-Beken et al., 2020; McCullough et al., 2008; Paramita et al., 2020), but we do not know what about these tasks have an impact, i.e. emotional, cognitive, or behavioural factors.

Focusing on negative emotions, this research shows that disgust may be counterproductive in facilitating COVID-19 preventative action, whilst fear can be associated with an increase in positive action. This suggests that media campaigns and discourse should focus on reducing disgust. These findings also have theoretical value as they suggest that disgust and fear can be related to different behavioural responses. The findings also allude to the importance of the appraisal of certainty as suggested by the appraisal tendency framework, as fear and disgust differ on the appraisal of certainty, which in this context may have led to different relationships between disgust and fear with preventative action. Cumulatively, the results also stress the important influence that fear can have on our preventative behaviours even independently of a positive emotion recall task. These results are in line with negativity effects highlighted by previous research, whereby negative emotions, as opposed to positive emotions, signal a problem and the need for action (e.g. Schwarz, 1990; Taylor, 1991). Thus, campaigns to change health behaviours, even outside of the COVID-19 pandemic, should examine how to impact levels of fear and disgust. This is important as fear and disgust are likely to have differential influences on health protective responses. Across both studies, it seems important that current gratitude and fear are channeled within health promotion campaigns along with informing individuals of what they can do to cope with the situation (Maddux & Rogers, 1983; Petty, 1995; Tannenbaum et al., 2015). This will lead to feelings of certainty and that change is possible. However, we should still be cautious when focusing on fear, as other research has found that fear can have amplifying effects of the infectious disease and it can lead to stigma (e.g. Ahorsu et al., 2020).

Limitations and future research

Even though the proposed research has implications both in the context of COVID-19 and other societal implications, there are some limitations which need to be highlighted. First, we had a planned strategy and theoretical rationale for the time points used in this study. However, it would have been useful to examine these emotions and behaviours more closely whilst restrictions were being released, i.e. February 2021- August 2021. It may have also been useful to examine if more frequent recalls had a more positive impact, rather than having monthly time points. This seems to be important to test since we did not find large differences between our hope and gratitude recall tasks.

In this research, we used recall tasks to have parallel instructions across conditions. However, recall tasks rely on people being able to recall certain emotions, which may have been more difficult during certain times of the research period, especially in the context of COVID-19 societal events and restrictions. Additionally, even though they were recalling positive experiences some of the events may have been linked to different stressors (Mills & D'Mello, 2014). Another point to consider is that the control condition focused on recalling future plans, while in the main study the emotion recall tasks focused on current emotions and in the follow-up study on future emotions only. Thus, future research should endeavour to disentangle the effects of time and emotion more closely. Emotion recall tasks have been shown to be impactful in numerous contexts (see Mills & D'Mello, 2014 for a review) but may have been less effective in our studies. Hence, it would be useful if future research explores other ways to induce these emotions, such as videos or vignettes that could resemble campaigns delivered at the national level.

This research also relied on self-reports, which can be problematic, as it can be susceptible to social desirability biases and people sometime struggle to accurately reflect on their emotions (Schwarz, 2012). Even though it has been demonstrated that intentions translate into actual action in the context of COVID-19 (Gollwitzer et al., 2021), it would have still been beneficial to measure direct action. However, we used self-report measures to examine these outcomes in an appropriate sample size and across numerous time points. Additionally, it is important to further consider individual differences which may impact participants' emotions and how they engaged in the recall task; for example, it has been found that narcissism impacts how message framing influences willingness to engage in preventative action (Otterbring et al., 2021). Specifically, they found that individuals high in narcissism responded more to a negative framing (than positive framing), resulting in more preventative action. Additionally, contextual factors such as having more family and friends (i.e. more social support), may have impacted participants' engagement with the task. Finally, our sample mostly consisted of women. Previous research (e.g. Brebner, 2003) has shown that gender plays a role in

experienced and reported emotions, such as the experience of gratitude (e.g. Kashdan et al., 2009). Hence, future studies should consider a more gender balance sample and potentially compare gender differences. Though overall the research does suggest which certain emotions, i.e. induced gratitude, hope, and experienced fear, are likely to promote preventative action and when they are most likely to do so.

Conclusion

Contrary to our pre-registered hypothesis a simple gratitude recall task was found to encourage COVID-19 preventative behaviours, more so than neutral events in our main study. We also found positive associations between experienced hope and gratitude with preventative action in the different studies. Across both studies we found experienced fear was positively related with preventative action, while experienced disgust was negatively related to action. This research should hopefully encourage others to think of what they are currently grateful for as this can be a positive social tool, even when faced with adversity and change during the COVID-19 pandemic.

Notes

1. https://osf.io/upb2h/?view_only=6eb16e9373c642f784254972f42b449c
2. There were other measures included, which can be accessed through OSF but that are not considered in this manuscript, https://osf.io/upb2h/?view_only=6eb16e9373c642f784254972f42b449c
3. Since there were more female participants in the sample, we tested the interaction between recall task condition and gender in the first time point on experienced gratitude, and the interaction was not significant. We have tested the interaction between experimental condition and gender in the first time point, and the interaction was not significant ($p = .25$), and neither was the main effect of gender on preventative behaviors ($M_{males} = 6.08$, $M_{females} = 6.03$, $p = .61$).
4. Gender and gratitude were not related in Study 2 either, as there was no difference in experienced gratitude by gender $p = .15$, and if gender was included in our preventative behavior analysis it did not have a large impact on the effect of recall task on preventative behaviors and the effect of the covariate of gender was $p = .054$.
5. Given that the effects in Study 1 were contrary to our original hypothesis, we also examined the post-hoc comparisons, which indicated that the gratitude general condition elicited greater willingness to engage in preventative action in comparison to the neutral condition $p = .02$, and hope COVID-19 condition, $p = .01$. No other comparisons were significant, all $ps > .10$.
6. After removing the final time point from the data set, the model failed to run, because the number of observations (= 1852) was not enough to produce the number of random effects (= 1935) for the random intercept and random slopes for the four predictors, clustered by participants. We have thus decided to exclude gratitude from random effects, because the fixed effects of this variable were not significant on either, *within-* or *between-person level* of the multilevel model. See analysis code for details.

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Ethics statement

All participants in our experiments were treated in accordance with the ethical standards of the British Psychological Society and the American Psychological Association. This research received ethical approval from the University of Surrey.

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Data availability statement

The data that support the findings of this research are openly available in the Open Science Framework (OSF) through this link https://osf.io/upb2h/?view_only = 6eb16e9373c642f784254972f42b449c.

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Appendices

Appendix 1

Future emotions

Effects of emotion recall tasks on future positive emotions

We assessed the success of our manipulation on future emotions examining whether experienced *hope* and *gratitude* were significantly different across conditions and time. For *future hope*, the effect of the emotion recall condition was significant, $t(582.29) = 2.66$, $p = .008$. The values of experienced *future hope* were highest in hope recall condition ($M = 4.24$, $SD = 1.44$), lower in the gratitude recall condition ($M = 4.10$, $SD = 1.48$), and lowest in the neutral recall condition ($M = 3.77$, $SD = 1.55$). Post-hoc comparisons with Tukey correction indicated that the difference between neutral and hope recall conditions was significant (Est = -.46, $SE = .14$, $p = .003$), whereas the difference between hope and gratitude recall conditions was not significant ($p = .50$). The difference between neutral and gratitude recall conditions was marginally significant ($p = .08$). The main effect of time was also significant for *future hope*; $t(1793.44) = 6.29$, $p < .001$, indicating that in general people became more hopeful across time. However, the interaction between time and condition was not significant.

The effect of emotion recall condition was significant for *future gratitude*, $t(545.29) = 3.55$, $p < .001$. For *future gratitude* the highest scores were obtained in the gratitude recall condition ($M = 4.30$, $SD = 1.55$), lower in the hope recall condition ($M = 4.15$, $SD = 1.52$), and the lowest in the neutral recall condition ($M = 3.93$, $SD = 1.68$). Post-hoc differences (Tukey correction) for future gratitude followed the same pattern as for current gratitude. The difference between neutral recall condition and gratitude recall condition was significant (Est = -.39, $SE = -16$, $p = .036$), and as for the remaining contrasts, neither the neutral-hope comparison ($p = .19$) nor the hope-gratitude one ($p = .68$) was significant. The main effect of time was also significant for *future gratitude*, $t(1783.15) = 5.23$, $p < .001$, indicating that in general people became more grateful across time. The interaction between time and recall condition was significant for *future gratitude* as well, $t(1785.34) = -2.55$, $p = .011$, resulting in similar patterns as current gratitude (see Figure A1).

Effects of emotion recall tasks on future negative emotions

We examined whether the hope recall triggered the greatest reduction in experienced *future disgust* and *future fear* (Hypothesis 1); however, only the effect of time was significant, $t(1769) = -3.39$, $p < .001$ for *future disgust*, and $t(1774.59) = -4.10$, $p < .001$ for *future fear*. The means suggesting some fluctuation but in general people felt less fear and disgust at the final time point. Neither the main effect of emotion recall condition (future disgust: $p = .28$, future fear: $p = .70$) nor the interaction between recall condition and time (future disgust: $p = .86$, future fear: $p = .12$) were significant.

The effect of experienced future emotions on preventative behaviours

We ran multilevel models to explore the role of experienced future emotions on preventative behaviours (see all effects in Tables A1 and A2). Time had a negative effect on preventative behaviours ($B = -.05$, $p < .001$), whereas emotion recall condition had a positive significant effect ($B = .10$, $p = .023$). In this model, the only significant predictor of preventative

Table A1. Parameter estimates for multilevel models of preventative behaviours as a function of future-oriented emotions (final time point included).

Fixed effects (intercepts, slopes)	*B*	*SE/SD*	*t*	*β*	*p*	CI LL	CI UL
Intercept	**5.39**	.21	26.10	6.02	<.001	4.98	5.82
Time	**−0.05**	.004	−13.43	−0.05	<.001	−0.06	−0.04
Condition	**0.10**	.04	2.28	0.10	.023	0.01	0.19
Level 1 (within-person)							
Hope	**0.04**	.01	2.73	0.04	.007	0.01	0.07
Gratitude	0.01	.01	0.50	0.01	.618	−0.02	0.03
Fear	0.02	.01	1.25	0.02	.213	−0.01	0.04
Disgust	−0.03	.02	−1.97	−0.03	.051	−0.06	0.00
Level 2 (between-person)							
Hope	0.02	.04	0.56	0.03	.575	−0.06	0.11
Gratitude	0.05	.04	1.38	0.07	.167	−0.03	0.13
Fear	**0.25**	.03	7.35	0.32	<.001	0.18	0.31
Disgust	**−0.24**	.04	−6.65	−0.29	<.001	−0.31	−0.17
Random effects							
Level 1 (within-person)							
Residual	0.22	.47	-	0.22	-	0.45	0.49
Level 2 (between-person)							
Intercept	0.44	.67	-	0.44	-	0.62	0.72
Hope	0.01	.09	-	0.01	-	0.04	0.13
Gratitude	0.00	.06	-	0.00	-	0.01	0.10
Fear	0.01	.08	-	0.01	-	0.03	0.12
Disgust	0.01	.10	-	0.01	-	0.05	0.15

Notes: *B* = unstandardised estimates; *SE* = standard error; *SD* = standard deviation; *β* = standardised estimates; CI = 95% confidence interval; LL = lower limit; UL = upper limit; significant coefficients are in bold ($p < .05$, two-tailed). For fixed effects, *SE* have been reported. For random effects, *SD* have been reported.

Table A2. Parameter estimates for multilevel models of preventative behaviours as a function of future-oriented emotions (final time point not included).

Fixed effects (intercepts, slopes)	*B*	*SE/SD*	*t*	*β*	*p*	CI LL	CI UL
Intercept	**5.27**	.21	25.46	5.81	<.001	4.86	5.65
Time	**0.02**	.01	3.38	0.02	.001	0.01	0.03
Condition	**0.10**	.04	2.28	0.10	.023	0.02	0.19
Level 1 (within-person)							
Hope	**0.03**	.01	2.78	0.03	.006	0.01	0.06
Gratitude	0.01	.01	0.82	0.01	.412	−0.01	0.03
Fear	0.02	.01	1.71	0.02	.088	−0.00	0.04
Disgust	−0.02	.01	−1.23	−0.01	.222	−0.05	0.01
Level 2 (between-person)							
Hope	0.03	.04	0.61	0.03	.540	−0.05	0.11
Gratitude	0.04	.04	1.04	0.05	.300	−0.04	0.11
Fear	**0.24**	.03	7.13	0.31	<.001	0.17	0.30
Disgust	**−0.24**	.04	−6.69	−0.29	<.001	−0.30	−0.17
Random effects							
Level 1 (within-person)							
Residual	0.18	.42	-	0.18	-	0.41	0.44
Level 2 (between-person)							
Intercept	0.45	.67	-	0.45	-	0.62	0.72
Hope	0.00	.03	-	0.00	-	−0.02	0.07
Fear	0.00	.03	-	0.00	-	−0.02	0.05
Disgust	0.01	.09	-	0.01	-	0.04	0.13

Notes: *B* = unstandardised estimates; *SE* = standard error; *SD* = standard deviation; *β* = standardised estimates; CI = 95% confidence interval; LL = lower limit; UL = upper limit; significant coefficients are in bold (p <.05, two-tailed). For fixed effects, *SE* have been reported. For random effects, *SD* have been reported.

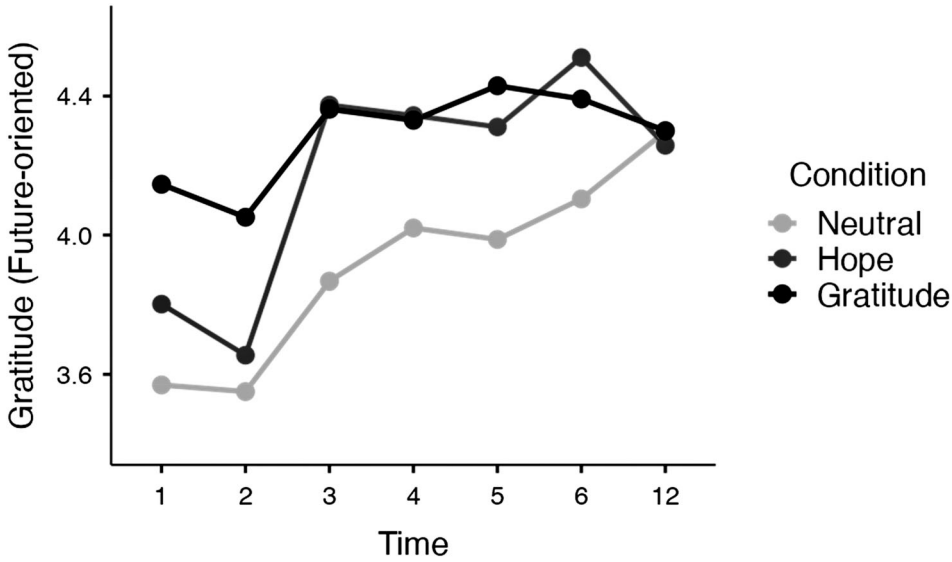

Figure A1. Interaction between time and condition for experienced future-oriented gratitude.

behaviours on a within-person level was *future hope* (B = .04, p = .007). When participants had higher feelings of hope regarding the future of the COVID-19 pandemic, they also reported higher preventative behaviours. *Future disgust* and *future fear* predicted preventative behaviours on a between-person level: Fear positively (B = .25, p <.001); Disgust negatively (B = -.24, p <.001). Participants who had higher average levels of fear during the study run, reported on average higher willingness to engage in preventative behaviours than participants who had lower average levels of fear. Disgust followed the opposite trajectory: Participants who on average reported higher levels of disgust (vs those who reported lower levels) were less willing to engage in preventative behaviours.

Appendix 2

Further manipulation checks with covariates

Separate manipulation checks have been conducted to predict current- and future-oriented experienced emotions hope and gratitude, with covariates included in the models. Four additional multilevel models have been computed in total, predicting the following: current hope, future hope, current gratitude, and future gratitude. Each model contained time, condition, interaction between time and condition, and a covariate which was an experienced emotion in a different time frame than the predicted variable, i.e. when future hope was predicted, current hope was a covariate, whereas when current gratitude was predicted, future gratitude served as a covariate, etc. The covariate was centred before adding to the model. Finally, we added an interaction between condition and a covariate to explore whether its effect may differ by condition.

Hope

In the attempt to predict current hope, the overall effect of condition was significant ($p = .001$), and the post-hoc Bonferroni pairwise comparison revealed that only neutral condition differed significantly from hope condition, in that participants in the former reported lower experiences of current-oriented feelings of hope: $t(386) = -3.72$, $Est = -.51$, $SE = .14$, $p < .001$. Hope and gratitude conditions did not differ, although the difference between neutral and gratitude approached the margin of significance ($p = .09$). The overall effect of time was also significant ($p < .001$), with Bonferroni pairwise comparisons indicating significant differences between time points, most notably the significant decrease in experienced current-oriented hope between time points 1 and 2: $t(1765) = 3.74$, $Est = .22$, $SE = .06$, $p = .004$; and the increase between time point 1 and the follow-up measure: $t(1782) = -3.05$, $Est = -.21$, $SE = .07$, $p = .049$. The interaction effect between time and condition was not significant. The covariate future hope was a positive predictor of current hope, $t(1700) = 32.33$, $p < .001$. The effect of experienced future hope did not differ across conditions, but it did approach statistical significance ($p = .093$)

In the next model, the dependent variable was future hope, whereas the covariate was current hope. The model's findings reflect similar trends as the previous one. Here, the effect of condition was significant ($p = .007$), with the only significant pairwise comparison found between neutral condition and hope, according to the Bonferroni post-hoc correction: $t(385) = -3.10$, $Est = -.44$, $SE = .14$, $p = .006$. The overall effect of time was also significant ($p < .001$), the notable pairwise comparisons show that levels of experienced future hope were significantly higher in all the time points compared to time point 1 ($p < .001$), apart from time point 2 which did not differ significantly. The interaction between time and condition was not significant ($p = .71$). The covariate, current hope, was a significant predictor of future hope, $t(276) = 31.56$, $p < .001$. The effect of the covariate on the dependent variable, however, did not differ significantly across the conditions ($p = .54$).

Gratitude

In the next model, the outcome variable was current gratitude, whilst the covariate was future gratitude. The overall effect of experimental condition was significant ($p = .015$), but the only significant difference was observed between neutral and gratitude condition, higher experiences of current gratitude being observed in the later, $t(384) = -2.84$, $Est = -.45$, $SE = .16$, $p = .014$. The overall effect of time was also significant ($p < .001$), yet the pairwise comparison did not reveal any notable differences. The interaction between time and condition was not significant ($p = .20$). The covariate future gratitude was a positive predictor of current gratitude, $t(304) = 26.64$, $p < .001$. The effect of the covariate did not differ across the conditions ($p = .58$).

The final model included future gratitude as the outcome variable, and current gratitude as the covariate. The overall effect of experimental condition was significant ($p = .04$), and Bonferroni pairwise comparison indicates that the experiences of future-oriented gratitude were statistically higher in gratitude condition, compared to the neutral, $t(384) = -2.50$, $Est = -.38$, $SE = .15$, $p = .038$. The overall effect of time was also significant ($p < .001$), with pairwise comparison revealing significantly higher scores of future gratitude in the final time point compared to time point 1, $t(1734) = -4.48$, $Est = -.33$, $SE = -07$, $p < .001$. The interaction between time and condition was not significant ($p = .89$). Current gratitude was a significant covariate, predicting the outcome variable positively, $t(380) = 32.49$, $p < .001$. The interaction between condition and covariate was not significant ($p = .12$), suggesting that its predictive trend remains consistent across conditions.