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A multi-country test of brief reappraisal interventions on emotions during the COVID-19 pandemic

The COVID-19 pandemic has increased negative emotions and decreased positive emotions globally. Left unchecked, these emotional changes might have a wide array of adverse impacts. To reduce negative emotions and increase positive emotions, we tested the effectiveness of reappraisal, an emotion-regulation strategy that modifies how one thinks about a situation. Participants from 87 countries and regions ($n = 21,644$) were randomly assigned to one of two brief reappraisal interventions (reconstrual or repurposing) or one of two control conditions (active or passive). Results revealed that both reappraisal interventions (versus both control conditions) consistently reduced negative emotions and increased positive emotions across different measures. Reconstrual and repurposing interventions had similar effects. Importantly, planned exploratory analyses indicated that reappraisal interventions did not reduce intentions to practice preventive health behaviours. The findings demonstrate the viability of creating scalable, low-cost interventions for use around the world.

Protocol registration

The stage 1 protocol for this Registered Report was accepted in principle on 12 May 2020. The protocol, as accepted by the journal, can be found at <https://doi.org/10.6084/m9.figshare.c.4878591.v1>

The COVID-19 pandemic is increasing negative emotions and decreasing positive emotions around the globe^{1–10}. Concurrently, individuals are reporting that COVID-19 is having a negative impact on their psychological functioning and mental health^{4,11,12}. For example, individuals report sleeping less, consuming more alcohol or other drugs or substances, having trouble concentrating because their mind is occupied by COVID-19, and having more fights with their partner or loved ones, some escalating to domestic violence^{1,9,13}.

These disturbing trends are caused partly by heightened levels of negative emotion and diminished levels of positive emotion, which have been found to contribute to a number of negative psychological, behavioural and health consequences. These include increased risk of anxiety and depressive disorders as well as other forms of psychopathology¹⁴; impaired social connections¹⁵; increased substance use^{16–18}; compromised immune system functioning^{19–21}; disturbed sleep²²; increased maladaptive eating^{23,24}; increased aggressive behaviour^{25,26}; impaired learning²⁷; worse job performance^{28,29}; and impaired economic decision-making^{30,31}.

As the COVID-19 pandemic unfolds around the world, we believe it is crucial to mitigate expected adverse outcomes by reducing negative emotions and increasing positive emotions. Such a change in emotions is central to increasing psychological resilience, a multifaceted concept that involves adaptive emotional responses in the face of adversity^{32–34}. Reappraisal—an emotion regulation strategy that involves changing how one thinks about a situation with the goal of influencing one's emotional response³⁵—is a promising candidate as an intervention to increase psychological resilience due to its adaptability, simplicity and efficiency^{34,36–38}. In contrast to less effective emotion-regulation strategies such as suppression, reappraisal generally leads to more successful regulation ($d = 0.45$, 95% confidence interval (CI) = [0.35, 0.56] in changing emotion experience in a meta-analysis³⁹; see caveats about interpreting effect sizes in past research in Methods, 'Sampling plan'). In particular, over the

short term, reappraisal leads to decreased reports of negative emotion and increased reports of positive emotion^{40–42}, as well as corresponding changes both in peripheral physiological responses^{43–45} and central physiological responses^{46–53}. Over the longer term, reappraisal is associated with stronger social connections⁵⁴; higher academic achievement^{55,56}; enhanced psychological well-being⁵⁷; fewer psychopathological symptoms^{58,59}; better cardiovascular health^{60,61}, and greater resilience during the COVID-19 pandemic⁶².

Despite these shorter-term and longer-term benefits, most people do not reappraise consistently^{63,64}, which has motivated efforts to teach people to use reappraisal (reviewed in refs. ^{65,66}). For example, in the context of anxiety, reappraisal training led to reduced intrusive memories⁶⁷ and increased emotion-regulation self-efficacy^{68,69}. Reappraisal training also led to long-lasting changes in the neural representation of unpleasant events⁷⁰.

Although demand characteristics are always a concern when examining the effects of reappraisal (given that one is teaching people to change their thinking in order to change how they're feeling, and then asking them how they feel)⁷¹, the wide array of self-report and non-self-report outcomes^{39–53} that show reappraisal effects across studies increases confidence that these effects are real. It is also encouraging to note that reappraisal generally outperforms other types of emotion regulation such as suppression, even though demand characteristics appear comparable across regulation conditions³⁹. In addition, evidence indicates that reappraisal interventions can influence emotional outcomes even in intensely challenging contexts in which people are often unmotivated to regulate their emotions⁷². For example, a brief reappraisal training conducted in the context of the Israeli–Palestinian conflict and replicated in the context of the Colombian conflict⁷³, has been found to contribute to reduced intergroup anger and increased support for conciliatory political policies⁷⁴.

As part of the attempt of the Psychological Science Accelerator (PSA) to address pressing questions related to the psychological

impact of COVID-19, the current study aimed to use reappraisal interventions to enhance psychological resilience in response to the pandemic. To maximize the impact of these interventions, this project had a global reach of large, diverse samples via the PSA's network⁷⁵, and employed highly scalable methods that were translated for use around the world. In order to make stronger and clearer inferences, our design included two reappraisal interventions that were compared with two control conditions, an active control and a passive control.

For our reappraisal interventions, we examined two theoretically defined forms of reappraisal⁷⁶—reconstrual and repurposing. Reconstrual involves changing how a situation was construed or mentally represented in a way that changes the emotional responses related to the situation. Examples of reconstrual in response to COVID-19 include: “Washing hands, avoiding touching my face, keeping a safe distance... There are simple and effective things I can do to protect myself and my loved ones from getting sick and to stop the spread of the virus” and “I know from world history that keeping calm and carrying on gets us through tough times”. Repurposing involves focusing on a potentially positive outcome that could come from the current situation in a way that changes the emotional response to it. Examples of repurposing in response to COVID-19 include: “This situation is helping us realize the importance of meaningful social connections, and helping us understand who the most important people in our lives are” and “Medical systems are now learning to deal with amazing challenges, which will make them much more resilient in the future”. For our active control condition, we asked participants to reflect on their thoughts and feelings as they unfolded. Meta-analyses have revealed that reflecting on one's thoughts and feelings produces small but reliable salutary effects ($d=0.07$, 9% CI = [0.05, 0.17] in improving psychological health, including emotional responses^{77,78}). Examples of reflecting in response to COVID-19 are: “I really wish we could find a vaccine soon” and “This situation is changing so fast, and I don't know how the future will develop”. By asking participants in this condition to actively use a strategy that is likely to have a positive effect, we sought to match expectancy and demand across reappraisal and active control conditions. For our passive control condition, we asked participants to respond as they naturally do, which is a commonly used passive control condition in prior research on emotion regulation (for a meta-analysis, see ref. ³⁹).

In comparing conditions, we chose to distinguish between negative and positive emotional responses, as previous evidence suggests that the two are clearly separable^{79,80}. Specifically, we hypothesized that our reappraisal interventions would lead to reduced negative emotional responses (hypothesis 1) and increased positive emotional responses (hypothesis 2) compared with both control conditions combined. While both reconstrual and repurposing strategies involve changing thinking, we hypothesized that the reconstrual intervention would lead to greater decreases in negative emotional responses than the repurposing intervention (hypothesis 3) and that the repurposing intervention would lead to greater increases in positive emotional responses than the reconstrual intervention (hypothesis 4). We theorized that reconstruing one's situation should primarily decrease negative emotions, because it typically focuses on ameliorating the problem at hand. The reconstrual intervention is most similar to a previously studied subtype of reappraisal called reappraising emotional stimulus, which has been investigated mainly on negative emotions and has a $d=0.38$ and 95% CI = [0.21, 0.55] for changing emotion experience³⁹. Repurposing one's situation, by contrast, should primarily increase positive emotions because it usually calls to mind positive experiences. Repurposing is similar to a few previously examined types of reappraisals, such as benefit finding and positive reappraisal, both of which are primarily associated with positive outcomes^{81,82} (Methods, ‘Sampling plan’ provides further detail).

In testing these hypotheses, we planned to use orthogonal contrasts that make two primary comparisons, while keeping all other comparisons exploratory (Table 1 provides further detail). The first comparison contrasted both the reappraisal conditions combined with both the active control condition and the passive control condition combined for negative (hypothesis 1) and positive (hypothesis 2) emotions. The second comparison contrasted the reconstrual and repurposing interventions for negative (hypothesis 3) and positive (hypothesis 4) emotions. One attractive feature of comparisons between reappraisal conditions is that there is no reason to assume that demand or expectancies would differ across these reappraisal conditions.

One potential concern about the current design was that the emotion-regulation interventions might reduce preventive health behaviours (for example, maintaining social distance and washing hands) that could potentially be motivated by negative emotions. Some research on the connection between emotions and health behaviour suggests that increased negative emotions such as fear do not seem to be a strong motivator for changing one's health behaviour⁸³. Furthermore, positive emotions augmented by the reappraisal interventions may contribute to a greater tendency to undertake health behaviours^{84,85}. For example, positive emotions can lead to higher medication adherence⁸⁶. To ensure that our interventions would not adversely impact any relevant health behaviours, we took two steps. First, during the instructions, we clarified that—in some cases—negative emotions such as fear and sadness may be helpful, and that it is up to each person to determine when an emotion is unhelpful or not and to downregulate only those emotions that are unhelpful. Second, to assess whether our training would lead to reduced vigilance, we specifically measured and examined intentions to follow stay-at-home orders and wash hands in exploratory analyses.

In addition, we conducted other exploratory analyses. These analyses included testing the impact of our reappraisal interventions on negative and positive anticipated emotions and intentions to enact potentially harmful versus beneficial behaviours associated with these emotions (details described in Methods, ‘Measures’), and assessed whether the effects of our reappraisal interventions, if any, were moderated by motivation to use the given strategy⁷¹, belief in the effectiveness of the given strategy⁸⁷, or demographics (gender³⁹, socioeconomic status^{88,89} or country or region⁹⁰ (hereafter country/region) (particularly in light of the differing levels of impact of COVID-19 in any given country/region at any given point in time)).

Results

Final sample size and demographics. We collected 27,989 responses between May 2020 and October 2020. After implementing preregistered exclusions (see detail in <https://doi.org/10.6084/m9.figshare.c.4878591.v1>) and an additional exclusion of nine duplicate IDs, our final sample included 21,644 participants from 87 countries/regions (63.41% female, 35.34% male, 0.45% other genders, 0.56% preferred not to say and 0.24% missing responses to the gender question; participants were aged 31.91 ± 14.52 yr (mean \pm s.d.); see Supplementary Table 1 for sample size per country/region and Supplementary Table 2 for sample size per month). Of the 87 countries/regions represented, 37 had more than 200 participants, surpassing our 95% power criterion based on simulations in our power analysis (see detail in Methods, ‘Power analysis’).

We preregistered two exclusion criteria. First, as planned, we excluded participants who answered both multiple choice manipulation check questions incorrectly, and found that conditions had similar proportions of such participants (0.55%), Holm's adjusted P values > 0.999 . Second, as planned, we excluded participants who completed fewer than 50% of the questions in the study, and found that the passive control condition had fewer such participants (16.17%) than the other three conditions (23.86% in the

Table 1 | Contrast structure of testing hypotheses 1–4 (with unit weighting)

	Active control	Passive control	Reconstrual	Repurposing
Contrast 1 (hypotheses 1–2)	0.5	0.5	–0.5	–0.5
Contrast 2 (hypotheses 3–4)	0	0	0.5	–0.5

active control condition, 24.41% in the reconstrual condition and 23.90% in the repurposing condition), Holm's adjusted $P < 0.001$. One possible explanation for this difference is that the instructions given to participants in the passive control condition were shorter than those given in the other conditions, requiring less cognitive effort to read and less time to complete the study. Applying both exclusion criteria, the overall exclusion rate was significantly lower in the passive control condition (16.71%) than in the other three conditions (24.47% in the active control condition, 24.99% in the reconstrual condition and 24.37% in the repurposing condition), Holm's adjusted $P < 0.001$. To rule out concerns related to differences in exclusion rates, we repeated all preregistered analyses on the full sample. Reassuringly, all patterns, statistical significance and conclusions remained unchanged when analyses were repeated on the full sample (Supplementary Table 3).

Preregistered analyses. We included all 87 countries/regions in all analyses regardless of their sample sizes, except for Fig. 1, Supplementary Fig. 1 and Supplementary Fig. 2, where the 37 countries/regions with $n \geq 200$ were analysed separately by country/region. Effect sizes, frequentist statistics and Bayes factors for each of our hypotheses are presented in Table 2. Raw means and standard deviations for each relevant measure are provided in Table 3. Details of analytical models are described in Methods.

Hypotheses regarding the shared effects of two brief reappraisal interventions. Consistent with the main hypotheses of the study, both reappraisal interventions combined (versus both control conditions combined) significantly decreased negative emotional responses (hypothesis 1) and significantly increased positive emotional responses (hypothesis 2) across all primary outcome measures (emotions in response to the photos related to COVID-19 from various news sources, state emotions after viewing all the photos and emotions about the COVID-19 situation; Table 2, rows 2–7; details of these measures are described in Methods). As shown in Fig. 1, this finding was consistent across the 37 countries/regions in which there were more than 200 participants (although all 87 countries/regions were included in the analysis testing hypotheses regardless of their sample size, only the 37 countries/regions with $n \geq 200$ were analysed separately by country/region for Fig. 1). For example, in comparing participants' immediate negative emotional responses to the photos related to the COVID-19 situation, data from 33 out of the 37 (89%) countries/regions showed significant effects of the reappraisal interventions in the hypothesized direction. None of the 37 countries/regions' data revealed a statistically significant result in the opposite direction.

Hypotheses regarding the unique effects of the two reappraisal interventions. Results revealed little to no support for our hypotheses regarding the differences between reconstrual and repurposing, as neither was reliably better than the other at reducing negative emotions or increasing positive emotions across outcomes (Table 2, rows 8–13; Supplementary Fig. 2). We hypothesized that reconstrual would produce greater decreases in negative emotional responses than

repurposing (hypothesis 3), and data revealed supportive evidence for only one outcome (negative emotions about the COVID-19 situation; Table 2, row 10) out of the three measures of negative emotions. The other two negative emotion outcome measures did not support that hypothesis. One outcome (negative emotions in response to the photos; Table 2, row 8) revealed that repurposing had significantly stronger effects in decreasing negative emotional responses than reconstrual, whereas the Bayes factor indicated inconclusive evidence. Another outcome (negative state emotions; Table 2, row 9) revealed no significant difference between types of reappraisal, and the Bayes factor indicated strong evidence in favour of the null hypothesis.

We also hypothesized that repurposing would produce greater increases in positive emotional responses than reconstrual (hypothesis 4), and data revealed supportive evidence for only one outcome (positive emotions in response to the photos; Table 2, row 11) out of the three measures of positive emotions. The other two outcome measures of positive emotions revealed no significant differences between the two reappraisal conditions. The Bayes factors indicated strong evidence in favour of the null hypothesis for one outcome (positive state emotions; Table 2, row 12) and inconclusive evidence for another outcome (positive emotions about the COVID-19 situation; Table 2, row 13). Overall, there were no consistent differences across outcomes between reconstrual and repurposing in reducing negative emotions or increasing positive emotions in the current experimental context. We examined potential reasons for these findings in the exploratory analyses and in the discussion section.

Exploratory analyses. To better understand the impact of the reappraisal interventions, we conducted four sets of exploratory analyses. First, we examined pairwise comparisons between conditions (each of the reappraisal conditions versus each of the control conditions, and the active control condition versus the passive control condition) for our primary outcomes (emotions in response to the photos, state emotions after viewing all the photos and emotions about the COVID-19 situation). Second, we assessed the effect of reappraisal interventions on four exploratory outcomes (behavioural intentions to practice preventive health behaviours, participants' engagement with emotion regulation strategies, global change in emotions, and anticipated emotions). Third, we assessed four sets of potential moderators of reappraisal interventions' effects (motivation to use the given strategy⁷¹, belief in the effectiveness of the given strategy⁸⁷, demographics^{39,88–90} and lockdown status). Finally, we contextualised reappraisal interventions' effect sizes on negative emotions by comparing them with effect sizes of lockdown status and self-isolation due to symptoms. Details of analytical models are reported in Supplementary Information (Supplementary Tables 4 and 5).

Pairwise comparisons of conditions on primary outcomes. In the first set of exploratory analyses, we examined the extent to which each of the reappraisal conditions differed from each of the control conditions for our primary outcomes (emotions in response to the photos, state emotions after viewing all the photos and emotions about the COVID-19 situation). Pairwise comparisons for all primary outcomes produced results consistent with the pattern of evidence for hypothesis 1 and hypothesis 2. Each of the repurposing and reconstrual conditions (versus each of the control conditions) significantly decreased negative emotional responses and significantly increased positive emotional responses ($P_s < 0.001$; Table 3).

We also examined whether the active and passive control conditions differed from each other at the level of pairwise comparisons. Among the three primary outcome measures of negative emotional responses, one was significantly higher in the active control condition than in the passive control condition (negative emotions

Valence ◆ Negative ◆ Positive Sample size ■ 200 ■ 800 ■ 2,400



Fig. 1 | Effect sizes of both reappraisal interventions combined (versus both control conditions combined) on primary outcomes by country/region.

In almost all of the 37 countries/regions in which there were more than 200 participants, both reappraisal interventions combined (versus both control conditions combined) decreased negative emotional responses and increased positive emotional responses for primary outcome measures (emotions in response to the photos, state emotions after viewing all the photos, and emotions about the COVID-19 situation). Effect sizes are raw mean differences on five-point scales without adjusting for covariates. Confidence intervals are based on the *t* distribution. Countries/regions are ordered by decreasing effect sizes of negative emotions in response to the photos, and larger dots reflect larger samples (Supplementary Fig. 1 presents the countries/regions in alphabetical order.).

Table 2 | Effect sizes, frequentist statistics and Bayes factors for each preregistered hypothesis

Row number	Hypothesis	B (s.e.m.)	Standard deviation of B by country/region	t statistic (d.f.)	Holm's adjusted P value	Cohen's d [95% CI]	log ₁₀ (BF) [under robustness check]	Verbal interpretation ¹² of log ₁₀ (BF)
2	Reappraisal interventions (versus control) would reduce negative emotions in response to the photos (hypothesis 1a).	0.513 (0.021)	0.129	23.973 (52.36)	<0.001	0.392 [0.360, 0.425]	29.41 [29.47]	log(BF) > 2 represents "extreme evidence in favour of H _A "; 2 > log(BF) > 1.5 represents "very strong evidence in favour of H _A "; 1.5 > log(BF) > 1 represents "strong evidence in favour of H _A "; 1 > log(BF) > 0.5 represents "moderate evidence in favour of H _A "; 0.5 > log(BF) > -0.5 represents "inconclusive evidence"; -0.5 > log(BF) > -1 represents "moderate evidence in favour of H ₀ "; -1 > log(BF) > -1.5 represents "strong evidence in favour of H ₀ "; -1.5 > log(BF) > -2 represents "very strong evidence in favour of H ₀ "; -2 > log(BF) represents "extreme evidence in favour of H ₀ ".
3	Reappraisal interventions (versus control) would reduce negative state emotions (hypothesis 1b).	0.185 (0.013)	0.064	14.401 (36.39)	<0.001	0.313 [0.270, 0.357]	15.61 [15.15]	
4	Reappraisal interventions (versus control) would reduce negative emotions about the COVID-19 situation (hypothesis 1c).	0.241 (0.019)	0.082	12.570 (30.67)	<0.001	0.239 [0.201, 0.277]	13.26 [12.92]	
5	Reappraisal interventions (versus control) would increase positive emotions in response to the photos (hypothesis 2a).	0.711 (0.025)	0.166	28.301 (59.18)	<0.001	0.590 [0.549, 0.631]	34.65 [34.80]	
6	Reappraisal interventions (versus control) would increase positive state emotions (hypothesis 2b).	0.178 (0.012)	0.064	14.263 (42.69)	<0.001	0.326 [0.281, 0.372]	15.90 [15.42]	
7	Reappraisal interventions (versus control) would increase positive emotions about the COVID-19 situation (hypothesis 2c).	0.263 (0.018)	0.070	14.809 (31.21)	<0.001	0.266 [0.230, 0.301]	15.48 [15.23]	
8	Reconstrual would lead to greater decreases in negative emotional responses in response to the photos than repurposing (hypothesis 3a).	-0.056 (0.023)	0.107	-2.438 (33.48)	0.041	-0.043 [-0.078, -0.008]	0.25 [-0.47]	
9	Reconstrual would lead to greater decreases in negative state emotions than repurposing (hypothesis 3b).	-0.005 (0.016)	0.069	-0.321 (29.67)	0.751	-0.008 [-0.063, 0.046]	-1.09 [-1.87]	
10	Reconstrual would lead to greater decreases in negative emotions about the COVID-19 situation than repurposing (hypothesis 3c).	0.068 (0.022)	0.045	3.139 (30.61)	0.011	0.067 [0.024, 0.112]	1.02 [0.32]	
11	Repurposing would lead to greater increases in positive emotions in response to the photos than reconstrual (hypothesis 4a).	0.137 (0.022)	0.113	6.176 (46.79)	<0.001	0.114 [0.077, 0.151]	5.37 [4.84]	
12	Repurposing would lead to greater increases in positive state emotions than reconstrual (hypothesis 4b).	-0.006 (0.011)	Random slopes by country/region were not included for the model to converge	-0.526 (20,340)	0.599	-0.011 [-0.049, 0.028]	-1.39 [-2.00]	
13	Repurposing would lead to greater increases in positive emotions about the COVID-19 situation than reconstrual (hypothesis 4c).	-0.047 (0.026)	0.109	-1.781 (37.46)	0.166	-0.047 [-0.100, 0.005]	-0.41 [-0.93]	

All 87 countries/regions were included in the preregistered analyses regardless of their sample sizes. The signs of B, t-statistic and Cohen's d are adjusted such that positive (negative) values indicate being consistent (inconsistent) with the direction specified in a hypothesis. For hypotheses 1-2, B reflects the difference on the original five-point scales between the average of the means of the two control conditions and the average of the means of the two reappraisal/intervention conditions. For hypotheses 3-4, B reflects the difference on the original five-point scales between the mean of the reconstrual condition and the mean of the repurposing condition. Degrees of freedom (d.f.) vary due to random slopes¹³. Cohen's d is calculated as the raw mean difference divided by the square root of the pooled variance of all the random components. H_A, alternative hypothesis; H₀, null hypothesis.

Table 3 | Raw mean and s.d. values for outcomes

Outcome	Reappraisal interventions		Control conditions	
	Reconstrual (n = 5,078)	Repurposing (n = 5,421)	Active control (n = 5,349)	Passive control (n = 5,796)
Primary outcomes				
Negative emotions in response to the photos	2.77 ^a (0.80)	2.71 ^b (0.77)	3.29 ^c (0.83)	3.19 ^d (0.84)
Positive emotions in response to the photos	2.47 ^a (0.81)	2.62 ^b (0.79)	1.86 ^c (0.72)	1.84 ^d (0.73)
Negative state emotions	2.32 ^a (0.90)	2.31 ^a (0.90)	2.52 ^b (0.95)	2.48 ^b (0.95)
Positive state emotions	3.17 ^a (0.88)	3.18 ^a (0.87)	2.99 ^b (0.88)	2.98 ^b (0.90)
Negative emotions about the COVID-19 situation	2.71 ^a (1.08)	2.77 ^b (1.07)	2.99 ^c (1.10)	2.97 ^c (1.10)
Positive emotions about the COVID-19 situation	2.91 ^a (1.05)	2.88 ^a (1.04)	2.65 ^b (1.06)	2.59 ^c (1.06)
Exploratory outcomes				
Intention to follow stay-at-home orders stringently	5.42 ^a (1.79)	5.44 ^a (1.77)	5.41 ^a (1.80)	5.45 ^a (1.77)
Intention to wash hands regularly for at least 20 s	5.82 ^a (1.53)	5.82 ^{ab} (1.50)	5.82 ^{ab} (1.51)	5.76 ^b (1.56)
Frequency of natural response	3.49 ^a (1.35)	3.53 ^b (1.35)	4.00 ^c (1.17)	4.56 ^d (0.79)
Frequency of using reflecting	3.92 ^a (1.11)	3.90 ^a (1.14)	4.25 ^b (0.97)	3.91 ^a (1.20)
Frequency of using reconstrual	3.80 ^a (1.09)	3.73 ^b (1.14)	3.06 ^c (1.27)	2.75 ^d (1.34)
Frequency of using repurposing	3.89 ^a (1.13)	4.15 ^b (1.01)	3.21 ^c (1.31)	3.12 ^d (1.34)
Motivation to use the given strategy	6.14 ^a (1.12)	6.17 ^a (1.12)	6.26 ^b (1.04)	6.43 ^c (1.00)
Belief in the effectiveness of the given strategy	5.00 ^a (1.68)	5.03 ^a (1.69)	4.80 ^b (1.76)	4.44 ^c (1.90)
Global change in negative feelings	2.82 ^a (0.94)	2.75 ^b (0.93)	3.19 ^c (0.92)	3.17 ^c (0.88)
Global change in positive feelings	3.28 ^a (0.91)	3.33 ^a (0.91)	2.92 ^b (0.92)	2.92 ^b (0.89)
Anticipated negative emotions	2.31 ^a (0.90)	2.30 ^a (0.89)	2.45 ^b (0.92)	2.44 ^b (0.94)
Anticipated positive emotions	3.26 ^a (0.88)	3.26 ^a (0.87)	3.13 ^b (0.86)	3.11 ^b (0.89)

Values are displayed as raw mean (s.d.). Sample sizes (*n*) presented in the second row reflect the numbers of participants after preregistered exclusion. Sample sizes vary by outcome because we dropped incomplete cases on an analysis-by-analysis basis. All primary outcomes were assessed on five-point scales. The following four exploratory outcomes were assessed on seven-point scales: intention to follow stay-at-home orders stringently, intention to wash hands regularly for at least 20 s, motivation to use the given strategy, and belief in the effectiveness of the given strategy. The remaining exploratory outcomes were assessed on five-point scales. Within each row, means that do not share a superscript differ at $P < 0.05$; two-tailed, Holm's method for adjustment. For instance, means both marked with ^a do not differ significantly, but means marked with ^a and ^b differ significantly from each other.

in response to the photos: $B = 0.091 \pm 0.015$, $t(20,740) = 6.192$, $P < 0.001$, $d = 0.070$, 95% CI = [0.048, 0.093]), while the other two showed no significant differences (negative state emotions: $B = 0.022 \pm 0.011$, $t(20,400) = 1.933$, $P = 0.053$, $d = 0.037$, 95% CI = [-0.001, 0.075]; negative emotions about the COVID-19 situation: $B = 0.005 \pm 0.022$, $t(26.01) = 0.221$, $P = 0.827$, $d = 0.005$, 95% CI = [-0.040, 0.047]). Among the three primary outcome measures of positive emotional responses, two were significantly higher in the active control condition than in the passive control condition (positive emotions in response to the photos: $B = 0.039 \pm 0.013$, $t(20,740) = 2.918$, $P = 0.004$, $d = 0.033$, 95% CI = [0.011, 0.054]; positive emotions about the COVID-19 situation: $B = 0.053 \pm 0.019$, $t(233.7) = 2.805$, $P = 0.005$, $d = 0.053$, 95% CI = [0.015, 0.091]), while one showed no significant differences (positive state emotions: $B = 0.009 \pm 0.010$, $t(20,350) = 0.858$, $P = 0.391$, $d = 0.017$, 95% CI = [-0.021, 0.054]). Thus, effects produced by the active control condition versus the passive control condition differed infrequently. When they did differ, differences were small in magnitude, inconsistent in direction, and slightly smaller in effect size than was suggested by previous meta-analyses⁷⁷ ($d = 0.07$, 95% CI = [0.05, 0.17]).

Effects of reappraisal interventions on four exploratory outcomes. Details of exploratory outcomes can be found in Methods and Fig. 2. Descriptive statistics and pairwise comparisons for exploratory outcomes can be found in Table 3. Here we focus on the contrast between the two reappraisal interventions combined and the two control conditions combined.

Behavioural intentions to practice preventive health behaviours.

To address the concern that reappraisal interventions might reduce preventive health behaviours (by reducing negative emotions such as fear), we asked about participants' behavioural intentions to follow stay-at-home orders stringently and to wash their hands regularly for at least 20 s the following week. We found that reappraisal interventions (versus both control conditions combined) did not significantly change intentions to follow stay-at-home orders ($B = 0.009 \pm 0.024$, $t(15.04) = 0.38$, $P = 0.709$, $d = 0.005$, 95% CI = [-0.023, 0.032]) or to wash hands ($B = 0.034 \pm 0.020$, $t(20,740) = 1.69$, $P = 0.091$, $d = 0.022$, 95% CI = [-0.004, 0.048]). Pairwise comparisons revealed that the only significant difference was that participants in the reconstrual condition reported higher intentions to wash their hands than those in the passive control condition ($B = 0.077 \pm 0.028$, $t(20,740) = 2.714$, Holm's adjusted $P = 0.040$, $d = 0.051$, 95% CI = [0.014, 0.087]). These results thus provide preliminary evidence that reappraisal interventions did not significantly reduce intentions to practice preventive health behaviours.

Participants' engagement with emotion-regulation strategies. To better understand participants' engagement with emotion-regulation strategies when viewing the photos related to COVID-19, we examined participants' self-reported frequency of using different strategies when viewing the photos, motivation to use their given strategy, and belief in the effectiveness of their given strategy.

Providing confidence in the effectiveness of the manipulation, we found that participants in each of the four conditions reported

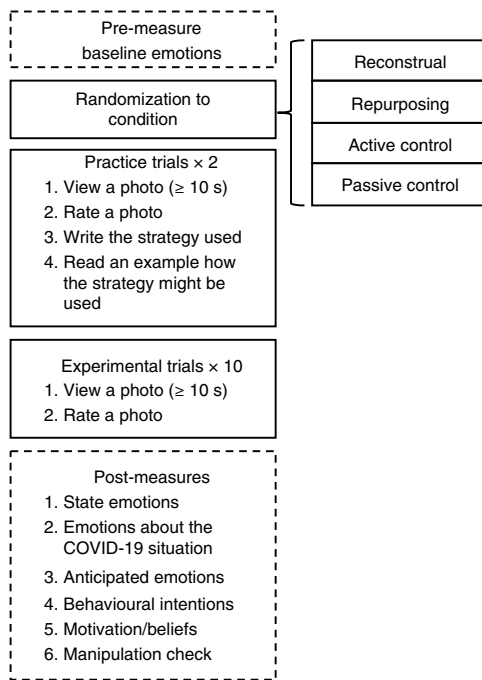


Fig. 2 | Overview of the experiment. Participants in the passive control condition did not have the fourth step in the practice trials.

using the strategy instructed in their condition more frequently than using the other strategies (see Table 3). It is noteworthy that participants in the two reappraisal conditions reported using both reconstrual and repurposing more frequently than those in either control conditions rather than primarily using only the form of reappraisal instructed in their condition. This finding may help explain the lack of differences between the two reappraisal conditions on our primary outcomes.

Next, we examined participants' motivation to follow the given instructions, as well as participants' belief that the given strategy could influence their emotions. We found that participants in the two reappraisal interventions (versus both control conditions combined) reported being significantly less motivated to follow their given instructions while viewing the photos ($B = -0.192 \pm 0.016$, $t(20.87) = -11.62$, $P < 0.001$, $d = -0.183$, 95% CI = $[-0.215, -0.152]$), but reported significantly greater belief in the effectiveness of their given strategy ($B = 0.420 \pm 0.053$, $t(52.05) = 7.97$, $P < 0.001$, $d = 0.233$, 95% CI = $[0.175, 0.290]$). Thus, the reappraisal conditions were effective in changing emotions despite the fact that participants in reappraisal conditions reported being less motivated to follow the instructions than participants in the control conditions.

Global change of emotions. At the end of the study, we asked participants how they felt compared with at the beginning of the study. We found that reappraisal interventions (versus both control conditions combined) significantly reduced global negative feelings ($B = -0.397 \pm 0.026$, $t(45.29) = 15.30$, $P < 0.001$, $d = -0.432$, 95% CI = $[-0.489, -0.377]$) and significantly increased global positive feelings ($B = 0.378 \pm 0.023$, $t(45.49) = 16.75$, $P < 0.001$, $d = 0.423$, 95% CI = $[0.373, 0.473]$). These findings suggest that the effects are not specific to items in the immediate proximity of the manipulations.

Anticipated emotions. To gain insight into the potential longer-term effects of reappraisal interventions, we asked participants how they anticipated they would feel the following week. We found

that reappraisal interventions (versus both control conditions combined) significantly reduced negative anticipated emotions ($B = -0.125 \pm 0.012$, $t(41.99) = -10.27$, $P < 0.001$, $d = -0.205$, 95% CI = $[-0.245, -0.166]$) and significantly increased positive anticipated emotions ($B = 0.125 \pm 0.008$, $t(13.07) = 15.58$, $P < 0.001$, $d = 0.227$, 95% CI = $[0.197, 0.256]$). These findings suggest that participants anticipated that reappraisal strategies would be useful in improving their emotional well-being in the future.

Exploratory moderators of intervention effects. Prior research suggests that emotion-regulation interventions lead to better results when the participants are: motivated to regulate their emotions⁷¹, led to believe in the effectiveness of regulation⁸⁷, female (versus male)³⁹, from lower (versus higher) socioeconomic status^{88,89}, and from Western (versus Eastern) cultures⁹⁰. We examined these as well as lockdown status (as a proxy for differing levels of impact of COVID-19) as potential moderators on our primary outcomes (emotions in response to the photos, state emotions after viewing all the photos, and emotions about the COVID-19 situation).

Controlling for baseline emotions, results of multilevel models revealed that two of the variables moderated intervention effects across all six primary outcomes. Specifically, the higher the scores on motivation to use the given strategy and on belief in the effectiveness of the given strategy were, the more effective the interventions were (Supplementary Figs. 3 and 4 and Supplementary Tables 6 and 7). Two variables (gender and employment status) moderated intervention effects on four of the six primary outcomes: Females (versus males) and individuals who had no employment and no income (versus those who had employment and income or versus those with no employment but with income) showed stronger effects of the intervention (Supplementary Tables 9 and 10). One variable moderated intervention effects on two of the six outcomes: the higher a country/region scored on Hofstede's⁹¹ index of individualism, the more effective the intervention was in increasing positive emotions in response to the photos and increasing positive emotions about the COVID-19 situation among participants from that country/region (Supplementary Table 8). Subjective socioeconomic status, education level, and lockdown status significantly moderated no more than one of the six outcomes, which would be unlikely to hold after correction for multiple comparisons (Supplementary Tables 11–13). Full, detailed results are reported in the Supplementary Information.

Contextualising reappraisal interventions' effect sizes. To facilitate interpretation of reappraisal effect sizes, it is helpful to compare them to effect sizes of other factors that may have also contributed to differences in participants' emotions. One such candidate for comparison is differences in emotional experience as a function of lockdown status and of self-isolation due to symptoms. Assuming that lockdown or self-isolation due to symptoms impacted participants' emotions, emotional changes caused by these factors could be compared to the ones caused by our interventions in order to get a sense of the impact of our intervention.

With negative state emotions as the outcome variable, we examined lockdown status and self-isolation due to symptoms, respectively, as a fixed variable in two separate multilevel models with random by-country/region slopes and random by-country/region intercepts to estimate the pure effect size of each variable (as lockdown status and self-isolation due to symptoms were correlated, entering both variables simultaneously in the same model may generate biased estimates). We found that participants whose areas were in full lockdown reported more negative state emotions than participants whose areas were not in lockdown ($B = 0.154 \pm 0.040$, $t(37.56) = 3.812$, $P < 0.001$, $d = 0.159$, 95% CI = $[0.075, 0.243]$), and participants whose areas were in partial lockdown reported more negative state emotions than participants

whose areas were not in lockdown ($B=0.094 \pm 0.027$, $t(27.25)=3.531$, $P=0.001$, $d=0.097$, 95% CI=[0.041, 0.155]). We also found that participants who were self-isolating due to flu-like or cold-like symptoms reported more negative state emotions than participants who were not self-isolating due to flu-like or cold-like symptoms ($B=0.175 \pm 0.044$, $t(25.83)=3.981$, $P<0.001$, $d=0.183$, 95% CI=[0.092, 0.283]). As shown in Table 2 for hypothesis 1b, participants who were in the two reappraisal conditions reported less negative state emotions than participants who were in the two control conditions ($B=0.185 \pm 0.013$, $t(36.39)=14.401$, $P<0.001$, $d=0.313$, 95% CI=[0.270, 0.357]). In addition, the amount of variance explained by fixed effects in a model with only lockdown status as a fixed variable is marginal⁹² $R^2=0.003$. The amount of variance explained by fixed effects in a model with only self-isolation due to symptoms as a fixed variable is marginal⁹² $R^2=0.001$. The amount of variance explained by fixed effects in a model with only the contrast between the two reappraisal conditions and the two control conditions as the fixed variable is marginal⁹² $R^2=0.013$. Across different measures of effect size, it is notable that the effects of reappraisal interventions on state negative emotions were of similar or even larger magnitude than the effects of lockdown status or self-isolation due to symptoms. This comparison suggests that reappraisal interventions could help to alleviate the emotional toll caused by lockdown and self-isolation. Thus, we believe that the effects of reappraisal interventions are not only statistically significant but also practically meaningful.

Discussion

The current study had two main goals. The first was to examine the shared effects of two brief reappraisal interventions (versus both passive and active control conditions) on negative and positive emotions in response to the COVID-19 pandemic, and to determine whether these effects were similar or different across countries/regions and COVID-19 situations. The second goal was to examine the potentially unique effects of the two reappraisal interventions—reconstrual and repurposing—on negative and positive emotions.

Regarding the first goal, we predicted and found that both reappraisal interventions (versus both control conditions combined) consistently decreased negative emotional responses (hypothesis 1) and consistently increased positive emotional responses (hypothesis 2) across all primary outcome measures: immediate emotions in response to each photo about the COVID-19 situation, state emotions after viewing all the photos related to the COVID-19 situation and overall emotions about the COVID-19 situation. Exploratory analyses suggested that both reappraisal interventions also improved participants' reported emotions compared with at the beginning of the study and the emotions they anticipated feeling in the future.

Further exploratory analyses suggested that despite substantial local variations in how severe the pandemic was at the time data were collected and cultural differences in how people understand and respond to emotions^{90,93}, the intervention effects appeared in almost all of the countries/regions we studied. For example, in comparing participants' immediate negative emotional responses to the photos related to the COVID-19 situation, 33 out of the 37 (89%) countries/regions with high statistical power (over 200 participants) showed statistically significant effects of reappraisal interventions. Although reappraisal interventions tended to have larger effects among females (versus males), and among unemployed individuals without income, the effects were largely unqualified by education level, subjective socioeconomic status, and whether a participant's country/region was under lockdown.

Regarding the second goal, we predicted that reconstrual would be more effective at reducing negative emotions than repurposing (hypothesis 3), but repurposing would be more effective at increasing positive emotions than reconstrual (hypothesis 4). We found little

to no support for these hypotheses, as neither was reliably better than the other at reducing negative emotions or increasing positive emotions across outcomes. The finding that the two forms of reappraisal were similarly effective at regulating emotions in the context of COVID-19 is consistent with the idea that the pandemic offers a wide array of affordances both for construing emotional situations in different ways, thus enabling reconstrual, and for evaluating these situations in light of different goals, thus enabling repurposing⁷⁶. This implies that it may be beneficial to combine both strategies, a hypothesis that future studies can be designed to test. It also remains to be investigated whether reconstrual and repurposing offer similarly comparable benefits in other contexts.

The comparable effectiveness of reconstrual and repurposing in this context raises interesting questions about these two forms of reappraisal. We found that even though participants learned only one form of reappraisal, they reported using both strategies more often than in either control condition. This overlap might have stemmed from insufficient differentiation between the reappraisal instructions used in this study. It may also mean that the distinction between repurposing and reconstrual, although useful theoretically, is not readily accessible to lay people. Alternatively, this overlap may have stemmed from reconstrual and repurposing being mutually associated to a degree that being instructed to use one strategy primes the other strategy. Future research is needed to more directly investigate these possibilities.

After assessing results related to the primary goals, an important question was whether reducing negative emotions and increasing positive emotions in response to the pandemic might inadvertently come at the cost of decreasing intentions to engage in preventive health behaviour (reviewed in ref. ⁹⁴). Reassuringly, the reappraisal interventions improved emotions without significantly reducing intentions to practice preventive health behaviours. This is consistent with recent findings that there are many paths to motivate preventive health behaviours during the COVID-19 pandemic without inducing negative emotions^{95–98}.

Our results highlight the benefits of applying reappraisal interventions at scale to increase psychological resilience and to mitigate the adverse impacts of the COVID-19 pandemic—benefits that could potentially be applied in other contexts that elicit negative emotions. Importantly, the effects of the intervention were not meagre: the extent to which emotions were changed by our reappraisal interventions was comparable in magnitude to the extent to which emotions differed between people who faced extreme hardships (lockdowns or symptom-induced isolations) and people who experienced neither of these hardships. Thus, contextualising the effect sizes of reappraisal interventions in this manner suggests that the interventions are practically meaningful. This practical meaning matters in light of findings that people on average do not appear to fully recover their emotional well-being even after six months into the COVID-19 pandemic⁹⁹, that stress and depression can impair vaccine efficacy¹⁰⁰, and that negative emotions predispose morbidity and mortality via increases in substance use and other risky behaviours¹⁰¹. Essential workers, nurses and doctors, students, patients and many other populations whose work and life are highly affected by the pandemic could potentially benefit from reappraisal interventions, although more research is needed to establish the effectiveness of reappraisal for groups facing distinct challenges. Because these interventions are inexpensive, brief and scalable, they could be implemented through a variety of media and communication mechanisms, such as advertising campaigns¹⁰², speeches, courses, apps and mobile games¹⁰³.

Our results also have important implications for the science of emotion (reviewed in ref. ¹⁰⁴) and for emotion regulation (reviewed in refs. ^{35,39}) in particular. Despite the fact that reappraisal is one of the most researched topics in psychology³⁵, this study is the largest cross-cultural investigation of reappraisal that has been conducted

to date, drawing diverse samples from well beyond the WEIRD (western, educated, industrialized, rich and democratic) societies¹⁰⁵ that have been heavily represented to date in social science. Thus, the findings reveal the generalizability of reappraisal effects across many countries/regions even in the context of substantial, protracted stressors. The present study also extends understanding of how contextual moderators influence reappraisal processes (for example, individualism, lockdown status and demographics) while deepening understanding of distinct forms of reappraisal (that is, comparing them in relation to multiple outcomes). Finally, our study provides a rich dataset for examining many other questions related to emotions, emotion regulation and cultural differences. We look forward to seeing what other insights can be generated from this dataset.

Despite the encouraging findings, several limitations should be noted. One limitation is the use of convenience sampling and a limited set of photos. Our sample was not nationally representative within each country/region, and it appeared to over-represent females, younger people and people with internet access. The photos used in the study, although carefully chosen, might not represent local situations for different groups of participants. Future research is needed to assess generalizability using nationally representative samples and more personally emotionally evocative stimuli. A second limitation is that we cannot fully rule out the influence of demand characteristics and expectancies. Although we attempted to match demand characteristics and expectancies in the reappraisal conditions using our active control condition, we did not quantify the extent to which they were comparable, and we measured perceived strategy effectiveness after participants had used the strategies, which is different from expectancies formed upon reading the instructions but before using the strategies. Future research should assess the influence of demand characteristics and expectancies. A third limitation relates to the fact that the current study examined only the immediate and proximal effects of the interventions. Future research employing longitudinal designs is needed to examine whether the effects persist over time and at what intervals individuals might optimally engage in reappraisal. A fourth limitation is that the current study examined only a limited number of outcomes via self-report measures. More comprehensive evaluations, including assessments of actual behaviours (rather than intentions) and health outcomes, are necessary to determine whether there are any additional benefits or unintended consequences of the interventions. Finally, before implementing reappraisal interventions for practice, more research is needed to better evaluate the intervention (for example, via formal cost-benefit analysis and/or using the ‘reach, efficacy, adoption, implementation and maintenance’ framework^{106,107}).

In conclusion, our findings demonstrated that two brief reappraisal interventions had robust and generalizable effects in reducing negative emotions and increasing positive emotions during the COVID-19 pandemic across countries/regions, without reducing intentions to practice preventive health behaviours. We hope this study will inform efforts to create scalable interventions for use around the world to build resilience during the pandemic and beyond.

Methods

Ethics information and participants. This study is one of three studies in the PSA COVID-19 Rapid Project. The other two studies investigated the effects of loss and gain message framing and self-determination theory-guided message framing, respectively. The other two studies are reported elsewhere. The study was conducted online, and participants clicked a single data collection link that led to either the current study or the other two studies in the COVID-19 Rapid Project. A comprehensive summary of the PSA COVID-19 Rapid Project—including descriptions of the study selection procedure, the other selected studies, the internal peer review process, and implementation plans—can be found at <https://psyarxiv.com/x976j/>.

Participants were recruited by the PSA network. The PSA recruited 186 member laboratories from 55 countries/regions speaking 42 languages. Of the

27,989 participants recruited to complete the current study (not counting participants for the other two studies in the PSA COVID-19 Rapid Project), 4,050 were recruited through semi-representative panelling (on the basis of sex, age and sometimes ethnicity) from the following countries/regions: Egypt, Kenya, Nigeria, South Africa, Mexico, United States, Austria, Romania, Russia, Sweden, Switzerland, United Kingdom, China, Japan and South Korea (270 participants per country/region). The remaining participants were recruited through the research groups by convenience sampling. Each research group obtained approval from their local Ethics Committee or IRB to conduct the study, explicitly indicated that their institution did not require approval for the researchers to conduct this type of task, or explicitly indicated that the current study was covered by a pre-existing approval. Although the specifics of the consent procedure differed across research groups, all participants provided informed consent. The style and the amount of compensation varied with local conventions (a common practice in PSA). More information regarding participant compensation and sample size can be found at <https://psyarxiv.com/x976j/>.

Procedure. An overview of the experiment is depicted in Fig. 2.

Pre-measure. Before reading the instructions, participants reported emotions they felt in the moment (details for all study measures are described in the next section). These ratings constituted a baseline emotional measure.

Randomization to condition. Following the pre-measure, participants were randomly assigned to one of four between-subjects experimental conditions: two reappraisal intervention conditions (reconstrual and repurposing), one active control condition and one passive control condition. Because the study was conducted online, data collection was performed blind to the conditions of the participants. The content of the instructions in each condition differed, but the lengths were matched except for the passive control condition, which had a shorter set of instructions.

Participants in the two reappraisal intervention conditions (reconstrual and repurposing) and the active control condition received the following instructions: “In this study, we will show you photographs related to COVID-19 from various news sources. Our goal is to better understand how people respond to such photos, which may include feelings of fear, anger, and sadness. Sometimes emotions like these are helpful. At other times, however, these emotions can be unhelpful to us. Researchers have found that when people think their emotions are unhelpful, they can take steps to influence their emotions.”

In the reconstrual condition, participants were told that (emphasis in original) “One strategy that some people find helpful for influencing their emotions is *rethinking*. This strategy involves changing one’s thinking in order to change one’s emotions. This strategy is based on the insight that different ways of interpreting or thinking about any situation can lead to different emotions. This means that finding new ways of thinking about a situation can change how you feel about the situation. For example, consider someone who stays at home under lockdown due to COVID-19 and is feeling anxious, sad, or angry. In this case, *rethinking* might involve realizing that the situation is only temporary because dedicated people across the world are working hard to find a vaccine.” Participants were then given four examples of how rethinking might be employed for the COVID-19 situation (Example 1: “I know from world history that keeping calm and carrying on gets us through tough times.”; Example 2: “Scientists across the world are working hard to find treatment and vaccines. Throughout history, humans have been resourceful in finding solutions to new challenges.”; Example 3: “Washing hands, avoiding touching my face, keeping a safe distance... There are simple and effective things I can do to protect myself and my loved ones from getting sick and to stop the spread of the virus.”; Example 4: “In the past, people have overcome many challenges that seemed overwhelming at the time, and we will overcome COVID-19 related challenges too.”).

In the repurposing condition, participants were told that (emphasis in original) “One strategy that some people find helpful for influencing their emotions is *refocusing*. This strategy involves changing one’s thinking in order to change one’s emotions. This strategy is based on the insight that finding something good in even the most challenging situations can lead to different emotional responses. This means that refocusing on whatever good aspects may be found in a situation can change how you feel about the situation. For example, consider someone who stays at home under lockdown due to COVID-19 and is feeling anxious, sad, or angry. In this case, *refocusing* might involve realizing that staying at home gives them time to do things that they may not have been able to do before, like reading, painting, and spending time with family.” Participants were then given four examples of how refocusing might be employed for the COVID-19 situation (Example 1: “This situation is helping us realize the importance of meaningful social connections, and helping us understand who the most important people in our lives are.”; Example 2: “Medical systems are now learning to deal with amazing challenges, which will make them much more resilient in the future.”; Example 3: “Even though we are physically apart, we are finding creative ways to stay connected and our hearts are more connected than ever.”; Example 4: “I have been inspired by the way that frontline health care workers have responded with resilience, generosity, determination, and deep commitment.”).

In the active control condition, participants were asked to reflect on their emotions as they unfold. This condition is inspired by the literature on expressive

writing and experimental disclosure, which shows that asking people to reflect about their very deepest thoughts and feelings can improve psychological health^{77,78}. By having an active control condition, which was likely to lead to some benefit to participants, we can make stronger inferences regarding the impact of reappraisal interventions relative to a potentially useful strategy designed to equate demand characteristics and expectancies. In the instructions, participants were told that (emphasis in original) “One strategy that some people find helpful for influencing their emotions is *reflecting*. This strategy involves allowing oneself to freely experience and reflect on one’s thoughts and feelings. This strategy is based on the insight that reflecting on your thoughts and feelings about any situation can lead to different emotional responses. This means that exploring your thoughts and emotions can change how you feel about the situation. For example, consider someone who stays at home under lockdown due to COVID-19 and is feeling anxious, sad, or angry. In this case, *reflecting* might involve allowing oneself to experience these feelings and be fully immersed in the lockdown experience, reflecting on the meaning this situation has for the person and their loved ones.” Participants were then given four examples of how reflecting might be employed for the COVID-19 situation (Example 1: “This situation is changing so fast, and I don’t know how the future will develop.”; Example 2: “People are struggling to cope with these unprecedented and overwhelming challenges.”; Example 3: “Someone I love might get sick and there might not even be ventilators to help them.”; Example 4: “I really wish we could find a vaccine soon.”).

To reinforce what they had learned, participants in the two reappraisal conditions and the active control condition were then asked to summarize, in one or two sentences, the strategy they had just learned. This text response was collected only for exploratory purposes and was not used in confirmatory analysis.

In the passive control condition, participants received the following instructions: “In this study, we will show you photographs related to COVID-19 from various news sources. Our goal is to better understand how people respond to such photos, which may include feelings of fear, anger, and sadness. As you view these photographs, please respond as you naturally would.” Having a passive control condition allowed us to have clear interpretations in the case that we found no significant difference in our contrast between both the reappraisal conditions combined and both the control conditions combined. If this was the case, we would have compared each reappraisal condition against the passive control condition and compared the active control condition against the passive control condition in the exploratory analysis to determine whether each strategy had a non-zero impact relative to individuals’ natural responses.

Practice trials. After receiving instructions by condition, participants were asked to practice the strategy in two trials designed to facilitate their understanding of the strategy. The practice trials included providing ratings and written responses to two photographs (per prior research¹⁰⁸). The photographs in this study were selected by our research team from major media news sources (CNN, New York Times, The Guardian and Reuters) and present situations in Asia, Europe and North America. They were rated by our team to evoke either sadness or anxiety above the midpoint on a seven-point scale ranging from ‘not at all’ to ‘very’ and to score close to or above the midpoint on a seven-point scale ranging from ‘not at all’ to ‘very’ on the question “How much do you recommend using this picture?” (photographs available at <https://osf.io/8bjnz/>). In each practice trial, participants saw a ‘negative’ photo related to the COVID-19 situation (for example, an exhausted doctor or medical workers in hazmat suits) and a reminder about the photo to use the strategy that was presented to them. In the reconstruction condition, the reminder was “As you view the photo, draw on the examples we gave you earlier in order to interpret the situation in a new way.” In the repurposing condition, the reminder was “As you view the photo, draw on the examples we gave you earlier in order to focus on any good you can find in the situation.” In the active control condition, the reminder was “As you view the photo, draw on the examples we gave you earlier in order to reflect on your thoughts and feelings.” In the passive control condition, the reminder was “As you view the photo, respond as you naturally would.” After 10 s, participants were asked to rate their emotions in response to the photo using two corresponding unipolar five-point Likert scales, one for negative emotion and one for positive emotion. These ratings were designed to familiarize participants with the task, and were not used in the confirmatory analyses. After each photo, participants in the two reappraisal conditions and the active control condition were asked to write (in text) how they applied the strategy while observing the photo. Participants in the passive control condition were asked to write (in text) anything that comes naturally to their mind about the photo. The text response was also collected only for exploratory purposes and was not used in the confirmatory analysis. Participants in the two reappraisal conditions and the active control condition were then given one example of how the photo might be viewed (examples varied by condition). Note that the two reappraisal conditions and the active control condition were designed to be matched for demand characteristics and expectancy.

Experimental trials. Following the two practice trials, participants viewed additional photos related to the COVID-19 situation in ten experimental trials. Participants in the two reappraisal conditions and the active control condition were asked to use the strategy that they practiced, and participants in the passive control condition were asked to respond naturally. All participants saw exactly

the same ten photos, but the order of the presentation was randomized across the ten experimental trials. Each photo was presented to participants with the same reminder used in the practice trials. After observing each photo for ten seconds, participants were asked to rate both their negative and positive emotions in response to the photo using the same five-point Likert scales from the practice trials.

Post-measures. In the final section of the study, participants completed several measures, including (1) negative and positive state emotions, (2) negative and positive emotions about the COVID-19 situation, (3) negative and positive anticipated emotions, (4) behavioural intentions, (5) motivation/beliefs, and (6) manipulation check.

Measures. Demographics. At the beginning of the study, participants completed a general survey that included demographic questions and some questions related to COVID-19 shared by all three studies in the PSA COVID-19 Rapid Project. Details about the general survey can be found at <https://osf.io/7axc4/>. While we originally planned for the general survey to appear at the end of the study, it was necessary for recruitment purposes (selecting representative panels) that it appear at the beginning of the study.

Baseline emotions. To assess baseline emotion, we asked participants how they were feeling right now at the beginning of the session on a five-point scale ranging from 1 (not at all) to 5 (extremely) (all response options were labelled and numbers were not displayed to participants for clarity). For negative baseline emotions, we measured five items on fear, anger, sadness, distrust and stress from the modified differential emotions scale¹⁰⁹. For positive baseline emotions, we measured five items on hope, gratitude, love, inspiration and serenity from the modified differential emotions scale¹⁰⁹ (details for all scoring rules are described in ‘Analysis plan’). We also measured three items on loneliness¹¹⁰ and three items on social connectedness¹¹¹. These six items also were included in the assessment of post-photo state emotions and in the assessment of anticipated emotions (at each assessment point, these six items were used in exploratory analyses).

Negative emotional responses. In order to capture descriptively rich, nuanced data, we measured negative emotional responses in four ways. The first way is to measure negative emotions in response to the photos. For each photo, we asked participants how negative the photo made them feel using a unipolar scale ranging from 1 (not at all) to 5 (extremely). The second way is to measure negative state emotions after viewing all ten photos. We asked participants “how you are feeling right now” with the same set of items used to measure baseline emotions, which included five negative state emotions of fear, anger, sadness, distrust and stress. The third way is to measure negative emotions about the COVID-19 situation. We asked participants how negative/hopeless they were feeling about the COVID-19 situation right now on a unipolar scale ranging from 1 (not at all) to 5 (extremely). The fourth way is to measure negative anticipated emotions, which were an exploratory outcome. We asked participants “In the next week, to what extent, if at all, do you think you will feel each of the following?” with the same set of items used to measure baseline emotions, which included five negative anticipated emotions of fear, anger, sadness, distrust and stress.

Positive emotional responses. Following a parallel procedure, we measured positive emotional responses in four ways. The first way is to measure positive emotions in response to the photos. For each photo, we asked participants how positive the photo made them feel using a unipolar scale ranging from 1 (not at all) to 5 (extremely). The second way is to measure positive state emotions after viewing all ten photos. We asked participants “how you are feeling right now” with the same set of items used to measure baseline emotions, which included five positive state emotions of hope, gratitude, love, inspiration, and serenity. The third way is to measure positive emotions about the COVID-19 situation. We asked participants how positive/hopeful they were feeling about the COVID-19 situation right now on a unipolar scale ranging from 1 (not at all) to 5 (extremely). The fourth way is to measure positive anticipated emotions, which were an exploratory outcome. We asked participants “In the next week, to what extent, if at all, do you think you will feel each of the following?” with the same set of items used to measure baseline emotions, which included five positive anticipated emotions of hope, gratitude, love, inspiration and serenity.

Behavioural intentions. In addition to the emotional responses that are central to our four confirmatory hypotheses in this study, we also examined exploratory outcomes concerning behavioural intentions. Such intentions matter because they have been shown to predict actual behaviours^{112,113}. Following protocols from Fishbein and Ajzen¹¹⁴, we asked participants to indicate on a 7-point scale ranging from 1 (extremely unlikely) to 7 (extremely likely) their intentions to engage in each of 10 different behaviours within the next week. Five of the items concern potentially harmful behaviour, which we chose based on documented links between negative emotions and substance use, aggressive behaviour and excessive information seeking^{17,25,115}. Items included: drinking too much alcohol, using too much tobacco (for example, smoking or vaping) or other recreational drugs, yelling at someone, taking anger out online and spending too much time on media.

The other five items concerned beneficial behaviour, which we chose based on evidence that positive emotions contribute to more health behaviours^{84,85}. Items include: eating healthy food, getting enough physical activity, practicing healthy sleep habits (for example, going to bed and waking at regular hours), washing hands regularly for at least 20 s, and following a stay-at-home order stringently (if there isn't an order in your region now, assume that one is imposed).

Motivation and beliefs. We measured both the motivation to use the emotion regulatory strategy and the belief in the effectiveness of the emotion regulatory strategy as exploratory moderators^{71,87}. We asked “Recall the instructions we gave you for viewing the photos. To what extent, if at all, do you agree or disagree with the following statements?” Motivation to use the emotion regulatory strategy was measured with the item: “I tried my hardest to follow the instructions I was given while viewing the photos.” Belief in the effectiveness of the emotion regulatory strategy employed by participants was measured with the item “I believed that following the instructions would influence my emotions.” Participants rated their answers using a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree).

Manipulation check. We planned to evaluate participants' attention to our instructions and photos using two multiple-choice questions. The first question asked participants to choose the instructions they had at the beginning of the survey from among four options. The second question asked participants to choose the photo that was not shown to them in the survey from among three options.

For exploratory purposes, we also asked how often participants actually used each approach when viewing the photographs and their global change of emotions compared to the beginning of the study. Participants were asked, “When viewing the ten photographs related to COVID-19 earlier, how often did you use each of the following approaches?” and rated four approaches: “responding as I naturally would,” “reflecting on my thoughts and feelings,” “interpreting the situation in a new way,” and “focusing on any good I could find in the situation.” Participants rated their answers using a 5-point scale ranging from 1 (never) to 5 (always). To measure global change of emotion, participants were asked, “Overall, compared to the beginning of this study, how negative do you feel right now?” using a 5-point scale ranging from 1 (much more negative) to 5 (much less negative) and “Overall, compared to the beginning of this study, how positive do you feel right now?” using a 5-point scale ranging from 1 (much more positive) to 5 (much less positive).

Order of items. For measures above, items belonging to the negative category (that is, negative emotional responses and intentions for harmful behaviour) and to the positive category (that is, positive emotional responses and intentions for beneficial behaviour) were presented in a counterbalanced order within each measure across participants. In other words, half of the participants always rated an item from the negative category first and then an item from the positive category, whereas the other half always rated an item from the positive category first and then an item from the negative category. For measures that have multiple items, items belonging to the negative category were randomized within the negative category, and items belonging to the positive category were randomized within the positive category. When the same set of items used to measure baseline emotions was repeated, the set had the same order for every given participant.

Analysis plan. Pre-processing. Exclusion. We planned to exclude (1) participants who answered both multiple-choice manipulation check questions incorrectly, and (2) participants who completed fewer than 50% of the questions in the study.

Reliability of measures. For items from the modified differential emotions scale¹⁰⁹, we planned to create overall negative emotion scores at each time point by averaging the five negative emotions (fear, anger, sadness, distrust and stress) and overall positive emotion scores at each time point by averaging the five positive emotions (hope, gratitude, love, inspiration and serenity) if the average inter-item correlation was above 0.40 for negative emotions and for positive emotions, respectively. If the average inter-item correlation was below 0.40, we would conduct an exploratory factor analysis with oblique rotation and maintain factors with an eigenvalue above 1.00. If no factors had an eigenvalue above 1, we would report results by item rather than as a composite. The actual average inter-item correlation was 0.50 for negative baseline emotions and 0.48 for positive baseline emotions. Therefore, we created overall negative emotion scores at each time point by averaging the five negative emotions and overall positive emotion scores at each time point by averaging the five positive emotions.

Missing data. We dropped incomplete cases on an analysis-by-analysis basis. Given our sampling plan described below, we should have power of 0.95 or above.

Outliers. In order to be maximally conservative, we did not define or identify outliers.

Analytic plan for hypotheses. Since negative emotional responses and positive emotional responses are separable^{79,80}, we examined negative emotional responses and positive emotional responses separately. To control family-wise error rates in

multiple comparisons, we used the Holm–Bonferroni method within each of the four hypotheses separately. For all analyses testing negative emotional responses (hypothesis 1 and hypothesis 3), we planned to control for the participants' negative baseline emotions. As originally intended by the scale¹⁰⁹, we planned to create an overall negative baseline emotion score by averaging the five negative emotions (fear, anger, sadness, distrust and stress). For all analyses testing positive emotional responses (hypothesis 2 and hypothesis 4), we planned to control for the participants' positive baseline emotions. As originally intended by the scale¹⁰⁹, we planned to create an overall positive baseline emotion score by averaging the five positive emotions (hope, gratitude, love, inspiration and serenity). To account for the nested structure in our data (for example, participant nested by country/region), we fitted multilevel models with the condition using the contrast in Table 1, random by-country/region slopes, and random by-country/region intercepts. If a model failed to converge, we planned to explore other reasonable models¹¹³ and report results of all explored models in an appendix. We visually assessed assumptions of heteroscedasticity and normality of residuals and found no severe deviations. All tests were two-tailed.

Although we used the frequentist approach for confirmatory analyses, we also reported Bayes factors for every result to gain information about the strength of evidence provided by the data comparing the null and alternative hypotheses¹¹⁶. If we obtained non-significant results from the frequentist approach, we used Bayes factors to help us interpret non-significant results and differentiate between insensitive results and those that reveal good enough evidence supporting the null hypothesis. We set these evidence thresholds to $BF_{10} > 10$ for H_1 and $BF_{10} < 0.1$ for H_0 . If Bayes factors did not cross the evidence thresholds, we think our sample size is sufficiently large that inconclusive results at this sample size would be an important message for the field. We used informed priors for the alternative model: a one-tailed Cauchy distribution with a mode of zero and a scale $r = 0.18$ (hypotheses 1 and 2), $r = 0.17$ (hypothesis 3) and $r = 0.25$ (hypothesis 4) on the standardized effect size. These priors were based on the lowest available estimates of effect sizes in past research (more information in ‘Sampling plan’). At stage 1, we wrote the code for the Bayesian part of our analysis plan using the BayesFactor package¹¹⁷ in R. We also planned to investigate the sensitivity of our conclusions to priors using robustness regions¹¹⁸, which involves calculating a Bayes factor under a large number of different priors to see how the Bayes factor changes. After we collected our data, we made the following adjustments to our plans for our Bayesian analysis. First, to estimate the Bayesian models, we switched from the BayesFactor package to the brms package¹¹⁹ because of its superior handling of random effects. Our brms models used four chains, each with 1,000 warm-up samples, 10,000 post-warm-up samples and a thinning rate of 1. To calculate Bayes factors, we used bridge sampling, as implemented in the bayestestR¹²⁰ and bridgesampling¹²¹ packages, to compare the marginal likelihoods of the full model versus a null model that does not contain one of our two focal contrasts. Second, we discovered that the Bayesian versions of our models involving emotional responses to the photos had high computational requirements due to the inclusion of two sources of random effect (country/region and participant) rather than one. To make these models more computationally manageable we simplified the dataset by computing the average emotional response to each photo for each participant and using this as the outcome variable. This allowed us to omit the by-participant random effect in these models and drastically reduce the resource requirements and compute time. Although these simplified models do not separate participant-specific variance from error variance, our analysis plan had no plans to interpret these sources of variation separately, so we reasoned this simplification was a fair way to obtain the same mathematical results as required by our analysis plan at a lower computational cost. Finally, we simplified the robustness analyses by only investigating how the Bayes factors change with one very large prior ($r = 1.0$) rather than computing full robustness regions. We made this last change to once again reduce the compute time to manageable levels. If the Bayes factors under the large prior are in line with those generated by the pre-registered priors (which are already very small), the results should be robust to other reasonable priors.

Tests for hypotheses 1 and 3. Overall, we expected that reappraisal interventions (versus control) would reduce negative emotional responses (hypothesis 1), and that reconstrual would lead to greater decreases in negative emotional responses than repurposing (hypothesis 3). We tested hypothesis 1 and hypothesis 3 using two orthogonal contrasts (Table 1). The first contrast is between both reappraisal conditions combined and both control conditions combined for hypothesis 1. The second contrast is between the reconstrual condition and the repurposing condition for hypothesis 3. Negative emotional responses were measured in four ways (negative emotions in response to the photos, negative state emotions after viewing the photos, negative emotions about the COVID-19 situation, and negative anticipated emotions). We had confirmatory hypotheses regarding the first three outcomes and examined negative anticipated emotions in the exploratory analysis. Therefore, hypothesis 1 can be subdivided into hypotheses 1a to 1c, and hypothesis 3 can be subdivided into hypotheses 3a to 3c. We planned to consider a hypothesis to be supported if at least 1 of the 3 sub-hypotheses is significant after Holm–Bonferroni correction (controlling for 3 comparisons within each hypothesis). If we found non-significant results for any sub-hypothesis, we compared each reappraisal condition against the passive control condition and compared the active control condition against the passive control condition in the exploratory analysis

to determine whether each strategy had a non-zero impact relative to individuals' natural responses.

Testing effects on negative emotions in response to the photos. We expected that reappraisal interventions (versus control) would reduce negative emotions in response to the photos (hypothesis 1a), and reconstrual would lead to greater decreases in negative emotional responses in response to the photos than repurposing (hypothesis 3a). We modelled ratings of negativity in response to each photo in the experimental trials as a function of the fixed effects of condition using our contrast. We included by-participant random intercepts, by-country/region random intercepts, as well as by-country/region random slopes for each contrast.

Testing effects on negative state emotions. We expected that reappraisal interventions (versus control) would reduce negative state emotions (hypothesis 1b) and reconstrual would lead to greater decreases in negative state emotions than repurposing (hypothesis 3b). Similar to creating the overall negative baseline emotion score, we planned to create an overall negative state emotion score by averaging the five negative emotions (fear, anger, sadness, distrust and stress). We modelled the overall negative state emotion score as a function of the fixed effects of condition using our contrast. We included by-country/region random intercepts, as well as by-country/region random slopes for each contrast.

Testing effects on negative emotions about the COVID-19 situation. We expected that reappraisal interventions (versus control) would reduce negative emotions about the COVID-19 situation (hypothesis 1c), and reconstrual would lead to greater decreases in negative emotions about the COVID-19 situation than repurposing (hypothesis 3c). We modelled negative emotions about the COVID-19 situation as a function of the fixed effects of condition using our contrast. We included by-country/region random intercepts, as well as by-country/region random slopes for each contrast.

Tests for hypotheses 2 and 4. Overall, we expected that reappraisal interventions (versus control) would increase positive emotional responses (hypothesis 2), and repurposing would lead to greater increases in positive emotional responses than reconstrual (hypothesis 4). We tested hypothesis 2 and hypothesis 4 using two orthogonal contrasts (Table 1). The first contrast is between both reappraisal conditions combined and both control conditions combined for hypothesis 2. The second contrast is between the reconstrual condition and the repurposing condition for hypothesis 4. Positive emotional responses were measured in four ways (positive emotions in response to the photos, positive state emotions after viewing the photos, positive emotions about the COVID-19 situation, and positive anticipated emotions). We had confirmatory hypotheses regarding the first three outcomes and examined positive anticipated emotions in an exploratory analysis. Therefore, hypothesis 2 can be subdivided into hypotheses 2a to 2c, and hypothesis 4 can be subdivided into hypotheses 4a to 4c. We planned to consider a hypothesis to be supported if at least 1 of the 3 sub-hypotheses is significant after Holm-Bonferroni correction (controlling for 3 comparisons within each hypothesis). If we found non-significant results for any sub-hypothesis, we would compare each reappraisal condition against the passive control condition and compare the active control condition against the passive control condition in the exploratory analysis to determine whether each strategy had a non-zero impact relative to individuals' natural responses.

Testing effects on positive emotions in response to the photos. We expected that reappraisal interventions (versus control) would increase positive emotions in response to the photos (hypothesis 2a), and that repurposing would lead to greater increases in positive emotions in response to the photos than reconstrual (hypothesis 4a). We modelled ratings of positivity in response to each photo in the experimental trials as a function of the fixed effects of condition using our contrast. We included by-participant random intercepts, by-country/region random intercepts, as well as by-country/region random slopes for each contrast.

Testing effects on positive state emotions. We expected that reappraisal interventions (versus control) would increase positive state emotions (hypothesis 2b), and repurposing would lead to greater increases in positive state emotions in response to the photos than reconstrual (hypothesis 4b). Similar to creating the overall positive baseline emotion score, we planned to create an overall positive state emotion score by averaging the five positive emotions (hope, gratitude, love, inspiration and serenity). We modelled the overall positive state emotion score as a function of the fixed effects of condition using our contrast. We planned to include by-country/region random intercepts, as well as by-country/region random slopes for each contrast. However, the model could not converge when we included by-country/region random slopes for contrast 2. To make the model converge, we did not include by-country/region random slopes for contrast 2.

Testing effects on positive emotions about the COVID-19 situation. We expected that reappraisal interventions (versus control) would increase positive emotions about the COVID-19 situation (hypothesis 2c), and repurposing would lead to greater increases in positive emotions about the COVID-19 situation than reconstrual (hypothesis 4c). We modelled positive emotions about the COVID-19

situation as a function of the fixed effects of condition using our contrast. We included by-country/region random intercepts, as well as by-country/region random slopes for each contrast.

Exploratory analyses. We conducted a series of exploratory analyses to address supplemental questions regarding our hypotheses, including, but not limited to: (1) Were there any differences in other pairwise comparisons in testing hypotheses 1–2? (2) Were there emotion-specific effects of reappraisal¹²²? (3) Were the effects on emotions subjectively detectable by participants¹²³? Did the effects of strategy use vary by (4) motivation to use the strategy⁷¹; (5) beliefs in the strategy's effectiveness⁸⁷; or (6) the participant's country of residence⁸⁰?

We investigated the impacts of strategy use on other outcomes, including, but not limited to: (1) positive and negative anticipated emotions; (2) intentions to enact potentially harmful versus beneficial behaviours (results in Supplementary Table 14); and (3) loneliness and social connectedness (results in Supplementary Table 15).

Sampling plan. Expected effect sizes. In order to compare effect sizes across studies, below we report values of Cohen's d , which in some cases were transformed or calculated from the results reported in the original studies (see Supplementary Table 16 for details). Several caveats are in order regarding the effect sizes that follow. First, meta-analyses tend to overestimate effect sizes, although the size of overestimation varies considerably across studies and sometimes shows no overestimation¹²⁴. Second, most previous studies were conducted in the laboratory, whereas the current study was conducted online. Third, the current crisis is likely to lead to strong emotional responses, especially for participants who are facing financial or health-related setbacks, although strong negative emotions also motivate people to regulate emotions more⁶⁴. These caveats suggest uncertainty in effect sizes.

In general, reappraisal has an average effect size of $d=0.45$, 95% CI = [0.35, 0.56] in changing emotion experience relative to passive control conditions (that is, no instruction, instructions to experience naturally, instructions to not regulate in a certain manner, or instructions to enhance or maintain the focal emotion) (a meta-analysis³⁹ finds no evidence of publication bias). Experimental disclosure and expressive writing, which inspired the instruction in the active control condition, have an average effect size of $d=0.07$, 95% CI = [0.05, 0.17] in improving psychological health (including emotional responses), relative to engaging in non-treatment neutral activities (for example, describing what they have done in the past 24 h) or no activities (a meta-analysis⁷⁷ finds evidence of publication bias). These works suggest the lowest available estimate of the effect size to be $d=0.18$ (subtracting the upper bound of 95% CI $d=0.17$ for experimental disclosure and expressive writing from the lower bound of 95% CI of $d=0.35$ for the reappraisal interventions) between our reappraisal interventions and the control conditions for hypothesis 1 and hypothesis 2.

In relation to the comparison between reconstrual and repurposing, although prior research has not used the same theoretical framework⁶⁶ to empirically contrast reconstrual and repurposing as we did in the current study, research on closely related constructs can provide estimates of effect sizes. Reconstrual is most similar to a previously studied subtype of reappraisal called 'reappraising emotional stimulus' in Webb, Miles and Sheeran's meta-analysis³⁹, which has a $d=0.38$, 95% CI = [0.21, 0.55] in changing emotion experience (this effect size is primarily for negative emotions, as all but one study examined negative emotions). Repurposing is similar to the construct 'benefit finding' (perceiving positive consequences that resulted from a traumatic event), which is associated with positive well-being, $d=0.45$, 95% CI = [0.37, 0.52], but not global distress, $d=0.00$, 95% CI = [-0.04, 0.04] (meta-analysis⁸⁰). Repurposing is also similar to the subtype of reappraisal called 'positive reappraisal', which is more effective in increasing positive thoughts than other types of reappraisals, $d=0.49$, 95% CI = [0.25, 0.72] relative to detached reappraisal¹²⁵. These works suggest the lowest available estimate of the effect size to be $d=0.17$ (subtracting the upper bound of 95% CI $d=0.04$ for the association between benefit finding and global distress from the lower bound of 95% CI of $d=0.21$ for 'reappraising emotional stimulus'³⁹ between reconstrual and repurposing in changing negative emotions for hypothesis 3), and $d=0.25$ (the lower bound of 95% CI of positive reappraisal in increasing positive thoughts than detached reappraisal¹²⁵) between reconstrual and repurposing in changing positive emotions for hypothesis 4.

Sample size. For practical reasons, sample size was decided primarily on the basis of the availability of resources among members of the PSA.

Adjusted alpha levels. The tests of each hypothesis involved three comparisons, with α for the smallest P value being 0.017 (that is, 0.05/3), α for the second-smallest P value being 0.025 (that is, 0.05/2), and α for the largest P value being 0.05 (Holm-Bonferroni corrections).

Power analysis. We conducted a simulation study to estimate power for a variety of potential effect sizes ($|d|=0.05$ to 0.29, separated by increments of 0.02), number of countries/regions ($N_{\text{country/region}} = 30, 35, 40, 45, 50, 55, 60$), within-country/region sample sizes ($N = 200, 400, 600, 800$), by-country/region intercept

variances ($\sigma^2_{\text{intercept}} = 0.05, 0.30, 0.55, 0.80$), and by-country/region slope variances ($\sigma^2_{\text{slope}} = 0.0, 0.02, 0.03, 0.04$) at $\alpha = .017$. The lowest level of intercept variances in our simulation was chosen on the basis of an ongoing multi-country/region project tracking rates of depression ($\sigma^2_{\text{intercept}} = 0.04$) and worries about the COVID-19 ($\sigma^2_{\text{intercept}} = 0.06$) across countries/regions during the COVID-19 outbreak¹²⁶ (details in Supplementary Table 16). The lowest level of slope variances in our simulation was chosen on the basis of the average slope variance ($\sigma^2_{\text{slope}} < 0.01$) in a large multi-site, multi-country/region project involving 28 psychological manipulations¹²⁷. The slope variances capture the variability of the effect of psychological manipulations, and there is no apparent reason to expect that the effect of reappraisal interventions on emotions is more variable than most other psychological manipulations reported in Klein et al.¹²⁷. In fact, appraisal theories of emotion argue that the relationship between appraisals and emotions is culturally universal¹²⁸, suggesting low variability. As one example to show that similar appraisals associate with similar emotional experiences, we found the associations varied little across countries/regions between perceived insufficient government response and depression ($\sigma^2_{\text{slope}} = 0.003$) and between perceived insufficient government response and worries ($\sigma^2_{\text{slope}} = 0.003$) during the COVID-19 pandemic¹²⁶ (details in Supplementary Table 16), consistent with the observation of low slope variances ($\sigma^2_{\text{slope}} < 0.01$) in Klein et al.¹²⁷. Despite expecting low variability from empirical findings and theories, we tested a variety of intercept variances and slope variances in our power simulation, some of which were much higher than those reported in refs.^{127,126} to be maximally conservative. We conducted 1,000 simulations for each set of simulation parameters using the *simr* package¹²⁹ using computing power harnessed through the Open Science Grid^{130,131}.

We show comprehensive results for our simulation study at <https://osf.io/mf5z4/>. In our final sample after pre-registered exclusion, 37 countries/regions had over 200 participants, surpassing the 95% power criterion based on simulations.

Reporting Summary. Further information on research design is available in the Nature Research Reporting Summary linked to this article.

Data availability

The analytic dataset is available at <https://osf.io/jeu73/>. Materials are available at <https://osf.io/4yf9d/>, with additional relevant materials for the PSA's rapid-response COVID-19 projects at <https://osf.io/s4hj2/>.

Code availability

All analysis code (completed in R) is available at <https://osf.io/jeu73/>.

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Author contributions

Conceptualization: K. Wang, A. Goldenberg, C.A.D., A. Uusberg, J.S.L. and J.J.G. Data curation: E.M.B. and P.S.F. Formal analysis: K. Wang, P.S.F. and B. Palfi. Funding acquisition: C.R.C., E.M.B., P.S.F. and H.I. Investigation: J.K.M., L.E., D.H.O., E.A.J., E.O.L.G., J.P.W., K. Desai, E.K., M. Pantazi, N. Pilecka, G.M.M., E.A., M. Adamkovič, M. Roczniewska, C. Reyna, A.P.K., M. Westerlund, L.A., S.P., A.I.A., N.C.A., C.E.O., I.L.G.N., I. Dalgar, P.M.M., F.F., M. Willis, A.C.S., A. Mokady, N.R., M.R.V., N.L.N., M. Parzuchowski, M.F.E.B., M. Vranka, M.B.K., I.R., M. Harutyunyan, E.Y., M. Becker, E. Manunta, G.K., D. Marko, K.E., D.M.G.L., A. Findor, K.P., A.T.L., J.J.B.A., M.S. Ortiz, Z.V., E.P., M. Voracek, C.L., M.G., J.V.V., G.M., N. Cellini, S.-C.C., J.Z., K.M., N.L., A. Karababa, L. Boucher, W.M.C., J. Bavalor, R.M.R., I.D.S., T.J.H., S. Azouaghe, R.M., C.G., C.S.S., G.A., W.J.-L., M. Bradford, L.C.P., J.E.C.V., J.C.V.N., A. Arvanitis, Q.X., R.C., S.Z., Z. Tajchman, I.V., J.M.P., J.R.K., M. Atari, M. Hricova, P.K., J.S., R.-M.R., S.F.M., I. Zakharov, M. A. Koehn, C.E.-S., R.J.C.-J., A.J.K., E.S., J. Urban, J.R.S., M. Martončík, S.B.O., D. Šakan, A.O.K., J.M.D., I.A.T.A., A. Ferreira, L.B.L., H. Manley, D.Z.R., R.P.M.,

- E. Musser, W.C., H.G., S.R.-F., C. Reeck, C. Batres, D.S.A., M.M.B., Z.C., F.V., I. Ziano, M. Tümer, A.C.A.C., D. Dubrov, M.d.C.M.C.T.R., C.A., A. Sacakli, C.D.C., K.L.R., G.S., J.T.P., T.B., H.D., M. Hruška, D. Sousa, K.B., A.N.Z., M.P.-C., M. Bialek, M. Kowal, A. Sorokowska, M. Misiak, D. Mola, M.V.O., P.S.C., A. Belaus, P.A., R.O., L.A.V., P. Szwed, M. Kossowska, J. Kielnińska, B. Antazo, G.N., N. Simonovic, J.T., A.G.-K., A.D., K.I., A. Urooj, T.G., A.A., N.A.-A., H.B.K., B.G., T.H., M.V.J., J.B.B., W.J.C., S.Ç., M. Seehuus, A. Khaoudi, A. Bokkour, K.A.E.A., I. Djamai, A. Iyer, N. Parashar, A. Adiguzel, H.E.K., C.B., J.O.N., M.P.-P., A.d.I.R.-G., V.A., N.B., D.G., A. Ivanov, I.P., M. Romanova, I.S., M. Terskova, E.H., A.J., V.S., T.E.S., A.D.A., N.O., N. Say, M. Khosla, A.G.T., F.Y.H.K., G. Bijlstra, F. Mosannenzadeh, B.B.B., U.-D.R., E. Baskin, J.C.-C., B.J.W.D., D. Moreau, C.A.M.S., C.N., H.F., M. Anne, S.M.J.J., N.M.M., Y.K., K.Y., S.D., A.H., M. Vdovic, P.A.G.F., J. Kamburidis, E. Marinova, M.N.-D., N.R.R., A. Stoyanova, K.S., S. Lins, I.R.P., M.K.-T., T.J., J.K.O., O.B., M. Marszalek, S.T., R.A., W.L., J.A., N.V.D., J.A.S., R.S., J. Miranda, K. Damjanović, S.K.Y., B. Jaeger, D.R., G.P., K. Klevjer, N.S.C.-F., M.F.-A., M.Y.L., A.O.T., M. Toro, L.G.J.D., D.L.G.J.D., S.A.S., R.V., S.M., T.F., A. Bran, D.C.V., L. Vieira, G.L.d.H.C., A. Greenburgh, C.M.W., A.M.T., L. Volz, C. Karaarslan, E.S., T.B.A., M.F.C., T.J.S.L., M.F.F.R., M. Karekla, C. Karashiali, N. Sunami, L.M.J., D. Storage, A. Studzinska, P.H.P.H., D.L.H., M. Sirota, K. Wolfe, F.C., A.T., E.R.A., Y.L., E.C.W., H. Brohmer, G.H., O.D., K.V., G.F., G.A.T., A. Ahmed, M.L., N.T., H. Bai, M. Manavalan, X.S., R.B.W., P.Z., A.D.R., L. Kozma, P.B., G. Banik, M.A.C.V., J. Uttley, B.B., S.N.G., J.K.V., U.S.T., M.C.M., P. Sorokowski, A.G.-B., T.R., J.C., A.A.Ö., J.A.J.-G., M.V.H., T.I., A.L.W., J.P.R., T.O., W.E.D., H.L.U., E.M.B., M.A.P., H.I. and P.S.F. Methodology: K. Wang, A. Goldenberg, C.A.D., A. Uusberg, J.S.L., J.J.G., I.R., F.A., B. Aczel, P. Arriaga, A.G.T., M.A.S., M.C.M., H.L.U., D.M.B.-B. and P.S.F. Project administration: J.K.M., C.Z., S.M.D., M.O., A. Szabelska, G.M.M., A.P.K., I. Dalgur, S.L., N.R., M.R.V., M. Vranka, M. Becker, G.K., E.P., N. Cellini, H. Azab, J.L.B., A.L.T., V.K., M.H.S., E.Š., M. Martončík, D. Dunleavy, K. Kirgizova, F.A., B. Palfi, M.A.M., I.L.P., B. Aczel, P.A., A.G.-K., Y.Y., A. Urooj, L. Bylinina, A.A., B.G., A.D.A., C.A.L., B.I., H.C.-P., J.W.S., J.A., B. Paris, L. Volz, T.B.A., P.H.P.H., F.C., A. Ahmed, L. Kozma, J.E.B., K.K.T., M.A.S., S.M.I., C.R.E., C.R.C., P.R.M., H.L.U., E.M.B., N.A.C., M.A.P., D.M.B.-B., H.I., P.S.F. and H. Moshontz. Resources: B.B.A., M. Bernardo, O.C., K.G., S.M.D., A.P.J., K.R., M. Antoniadis, Z.G., E.K., K.N., O.N.B., M.O., M. Pantazi, N. Pilecka, A. Szabelska, I.M.M.v.S., K.F., A.I.B., G.M.M., M. Adamkovič, M. Roczniewska, A.P.K., M. Westerlund, L.A., S.P., G.A.A., P.D., I. Dalgur, H. 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Kurfali, A.A., E. Baklanova, B.G., J.B.B., S.Ç., A. Khaoudi, A. Bokkour, K.A.E.A., I. Djamai, A. Adiguzel, H.E.K., N.B., E.H., V.H.K., V.S., T.E.S., A.D.A., L.M.S.P., D. Krupić, C.A.L., N.J., N. Say, S. Sinkolova, K.J., M. Stojanovska, D. Stojanovska, F. Mosannenzadeh, U.-D.R., B.I., J.C.-C., H.C.-P., M. Topor, Y.K., M. Vdovic, L.A.-B., J. Kamburidis, E. Marinova, M.N.-D., N.R.R., A. Stoyanova, M.K.-T., T.J., O.B., M. Marszalek, W.L., J.A., B.Ž., D. Krupić, K.H., K. Klevjer, D.V., R.V., S.M., A. Bran, L. Vieira, B. Paris, M. Capizzi, G.L.d.H.C., X.D., L. Volz, M.J.B., C. Karaarslan, E.S., T.B.A., M. Korbmacher, J.P.H.V., N. Sunami, S.H., A. Studzinska, P.H.P.H., F.C., O.D., K.V., G.A.T., A. Ahmed, J. Bosch, M. Friedemann, A.D.R., L. Kozma, S.G.A., R.C.C., G. Banik, L.M.R.-B., J.E.B., K.K.T., M.A.S., P.L.G.M., S.M.I., A.G.-B., V.C.A., T.I., L. Suter, M. Bernardo and E.M.B. Supervision: J.K.M., A.L.T., M.H.S., J.W.S., K.K.T., C.R.E., C.R.C., P.R.M., H.L.U., E.M.B., N.A.C., M.A.P., D.M.B.-B., H.I., P.S.F. and H. Moshontz. Visualization: K. Wang, A. Uusberg, A. Goldenberg, C.A.D., J.S.L. and J.J.G. Writing, original draft: K. Wang. Writing, review and editing: K. Wang, A. Goldenberg, C.A.D., A. Uusberg, J.S.L., J.J.G., A. Uusberg, J.K.M., C.Z., B.B.A., M. Bernardo, O.C., L.E., K.G., D.H.O., E.A.J., E.O.L.G., S.M.D., A.P.J., K.R., J.P.W., M. Antoniadis, K. Desai, Z.G., E.K., K.N., O.N.B., M.O., M. Pantazi, N. Pilecka, A. Szabelska, I.M.M.v.S., K.F., A.I.B., G.M.M., E.A., M. Adamkovič, M. Roczniewska, C. Reyna, A.P.K., M. Westerlund, L.A., S.P., G.A.A., P.D., A.I.A., N.C.A., C.E.O., I.L.G.N., I. Dalgur, H. Akkas, P.M.M., S.L., I.M.-O., F.F., M. Willis, A.C.S., A. Mokady, N.R., M.A. Kurfali, M.R.V., N.L.N., M. Parzuchowski, M.F.E.B., M. Vranka, M.B.K., I.R., M. Harutyunyan, C. Wang, E.Y., M. Becker, E. Manunta, G.K., D. Marko, K.E., D.M.G.L., A. 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Manavalan, X.S., R.B.W., P.Z., M. Friedemann, A.D.R., L. Kozma, S.G.A., S. Lins, I.R.P., R.C.C., P.B., G. Banik, L.M.R.-B., M.A.C.V., J. Uttley, J.E.B., K.K.T., B.B., S.N.G., M.A.S., P.L.G.M., J.K.V., U.S.T., S.M.I., M.C.M., P. Sorokowski, A.G.-B., T. Radtke, V.C.A., J.C., A.A.Ö., J.A.J.-G., M.V.H., T.I., A.L.W., J.P.R., T.O., W.E.D., L. Suter, M. Bernardo, C.R.E., C.R.C., P.R.M., H.L.U., E.M.B., N.A.C., M.A.P., D.M.B.-B., H.I., P.S.F. and H. Moshontz.

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Correspondence and requests for materials should be addressed to J.K.M.

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Ke Wang¹, Amit Goldenberg², Charles A. Dorison³, Jeremy K. Miller⁴✉, Andero Uusberg⁵, Jennifer S. Lerner⁶, James J. Gross⁷, Bamikole Bamikole Agesin⁸, Márcia Bernardo⁹, Olatz Campos¹⁰, Luis Eudave¹¹, Karolina Grzech^{12,13}, Daphna Hausman Ozery¹⁴, Emily A. Jackson¹⁵, Elkin Oswaldo Luis Garcia¹⁶, Shira Meir Drexler¹⁷, Anita Penić Jurković¹⁸, Kafeel Rana¹⁹, John Paul Wilson²⁰, Maria Antoniadi²¹, Kermeka Desai²², Zoi Gialitaki²³, Elizaveta Kushnir²⁴, Khaoula Nadif²⁵, Olalla Niño Bravo²⁶, Rafia Nauman²⁷, Marlies Oosterlinck²⁸, Myrto Pantazi²⁹, Natalia Pilecka³⁰, Anna Szabelska³¹, I. M. M. van Steenkiste³², Katarzyna Filip³³, Andreea Ioana Bozdoc³⁴, Gabriela Mariana Marcu^{34,35}, Elena Agadullina³⁶, Matúš Adamkovič^{37,38}, Marta Roczniowska^{39,40}, Cecilia Reyna⁴¹, Angelos P. Kassianos^{42,43}, Minja Westerlund⁴⁴, Lina Ahlgren⁴⁵, Sara Pöntinen⁴⁵, Gabriel Agboola Adetula⁴⁶, Pinar Dursun⁴⁷, Azuka Ikechukwu Arinze⁴⁸, Nwadiogo Chisom Arinze⁴⁸, Chisom Esther Ogbonnaya⁴⁸, Izuchukwu L. G. Ndukaihe⁴⁸, Ilker Dalgat⁴⁹, Handan Akkas⁵⁰, Paulo Manuel Macapagal⁵¹, Savannah Lewis⁵², Irem Metin-Orta⁵³, Francesco Foroni⁵⁴, Megan Willis⁵⁵, Anabela Caetano Santos^{56,57,58}, Aviv Mokady⁵⁹, Niv Reggev⁶⁰, Merve A. Kurfali⁶¹, Martin R. Vasilev⁶², Nora L. Nock⁶³, Michal Parzuchowski⁶⁴, Mauricio F. Espinoza Barría⁶⁵, Marek Vranka⁶⁶, Markéta Braun Kohlová⁶⁷, Ivan Ropovik^{68,69}, Mikayel Harutyunyan⁷⁰, Chunhui Wang⁷¹, Elvin Yao⁷², Maja Becker⁷³, Efisio Manunta⁷³, Gwenael Kaminski⁷³, Dafne Marko⁷⁴, Kortnee Evans⁷⁵, David M. G. Lewis^{75,76}, Andrej Findor⁷⁷, Anais Thibault Landry⁷⁸, John Jamir Benzon Aruta⁷⁹, Manuel S. Ortiz⁸⁰, Zahir Vally^{81,82}, Ekaterina Pronizius⁸³, Martin Voracek⁸³, Claus Lamm⁸³, Maurice Grinberg⁸⁴, Ranran Li⁸⁵, Jaroslava Varella Valentova⁸⁶, Giovanna Mioni⁸⁷, Nicola Cellini^{87,88,89,90}, Sau-Chin Chen⁹¹, Janis Zickfeld⁹², Karis Moon⁹³, Habiba Azab⁹⁴, Neil Levy⁹⁵, Alper Karababa⁹⁶, Jennifer L. Beaudry⁹⁷, Leanne Boucher⁹⁸, W. Matthew Collins⁹⁹, Anna Louise Todsén¹⁰⁰, Kevin van Schie^{101,102}, Jáchym Vintř¹⁰³, Jozef Bavolar¹⁰⁴, Lada Kaliska¹⁰⁵, Valerija Križanić¹⁰⁶, Lara Samojlenko¹⁰⁷, Razieh Pourafshari¹⁰⁸, Sandra J. Geiger¹⁰⁹, Julia Beitner¹¹⁰, Lara Warmelink¹¹¹, Robert M. Ross¹¹², Ian D. Stephen¹¹², Thomas J. Hostler¹¹³, Soufian Azouaghe^{114,115}, Randy McCarthy¹¹⁶, Anna Szala¹¹⁷, Caterina Grano¹¹⁸, Claudio Singh Solorzano¹¹⁸, Gulnaz Anjum^{119,120}, William Jimenez-Leal¹²¹, Maria Bradford¹²¹, Laura Calderón Pérez¹²¹, Julio E. Cruz Vásquez¹²¹, Oscar J. Galindo-Caballero¹²¹, Juan Camilo Vargas-Nieto¹²¹, Ondřej Kácha¹²², Alexios Arvanitis¹²³, Qinyu Xiao¹²⁴, Rodrigo Cárcamo¹²⁵, Saša Zorjan¹²⁶, Zuzanna Tajchman¹²⁷, Iris Vilares¹²⁷, Jeffrey M. Pavlacić¹²⁸, Jonas R. Kunst¹²⁹, Christian K. Tamnes¹²⁹, Claudia C. von Bastian¹³⁰, Mohammad Atari¹³¹, MohammadHasan Sharifian¹³², Monika Hricova¹⁰⁴, Pavol Kačmár¹⁰⁴, Jana Schrötter¹⁰⁴, Rima-Maria Rahal¹³³, Noga Cohen¹³⁴, Saiedeh FatahModarres¹³⁵, Miha Zrimsek¹³⁶, Ilya Zakharov¹³⁷, Monica A. Koehn¹³⁸, Celia Esteban-Serna¹³⁹, Robert J. Calin-Jageman¹⁴⁰, Anthony J. Krafnick¹⁴⁰, Eva Štrukelj¹⁴¹, Peder Mortvedt Isager¹⁴², Jan Urban¹⁴³, Jaime R. Silva^{144,145,146}, Marcel Martončík¹⁴⁷, Sanja Batić Očovaj^{148,149}, Dušana Šakan^{148,149}, Anna O. Kuzminska¹⁵⁰, Jasna Milosevic Djordjevic¹⁵¹, Inês A. T. Almeida¹⁵², Ana Ferreira¹⁵², Ljiljana B. Lazarevic¹⁵³, Harry Manley¹⁵⁴, Danilo Zambrano Ricaurte¹⁵⁵, Renan P. Monteiro¹⁵⁶, Zahra Etabari¹⁵⁷, Erica Musser¹⁵⁸, Daniel Dunleavy¹⁵⁹, Weilun Chou¹⁶⁰, Hendrik Godbersen¹⁶¹, Susana Ruiz-Fernández^{161,162,163}, Crystal Reeck¹⁶⁴, Carlota Batres¹⁶⁵, Komila Kirgizova¹⁶⁶, Abdumalik Muminov¹⁶⁷, Flavio Azevedo¹⁶⁸, Daniela Serrato Alvarez¹⁶⁹, Muhammad Mussaffa Butt¹⁷⁰, Jeong Min Lee¹⁷¹, Zhang Chen¹⁷², Frederick Verbruggen¹⁷², Ignazio Ziano¹⁷³, Murat Tümer¹⁷⁴,

Abdelilah C. A. Charyate ¹⁷⁵, Dmitrii Dubrov ³⁶, María del Carmen M. C. Tejada Rivera ¹⁷⁶, Christopher Abersson ¹⁷⁷, Bence Pálfi ¹⁷⁸, Mónica Alarcón Maldonado ¹⁷⁹, Barbora Hubena ⁶⁶, Asli Sacakli ¹⁸⁰, Chris D. Ceary ¹⁵, Karley L. Richard ¹⁵, Gage Singer ¹⁸¹, Jennifer T. Perillo ¹⁸², Tonia Ballantyne ¹⁸³, Wilson Cyrus-Lai ¹⁸⁴, Maksim Fedotov ¹⁸⁵, Hongfei Du ¹⁸⁶, Magdalena Wielgus ¹⁸⁷, Ilse L. Pit ^{188,189}, Matej Hruška ¹⁹⁰, Daniela Sousa ¹⁹¹, Balazs Aczel ¹⁹², Barnabas Szaszi ¹⁹², Sylwia Adamus ³³, Krystian Barzykowski ³³, Leticia Micheli ¹⁹³, Nadya-Daniela Schmidt ¹⁹⁴, Andras N. Zsido ¹⁹⁵, Mariola Paruzel-Czachura ¹⁹⁶, Michal Bialek ¹⁹⁷, Marta Kowal ¹⁹⁷, Agnieszka Sorokowska ¹⁹⁷, Michal Misiak ^{197,198}, Débora Mola ¹⁹⁹, María Victoria Ortiz ^{199,200}, Pablo Sebastián Correa ¹⁹⁹, Anabel Belaus ¹⁹⁹, Fany Muchembled ²⁰¹, Rafael R. Ribeiro ²⁰², Patricia Arriaga ²⁰², Raquel Oliveira ^{202,203}, Leigh Ann Vaughn ²⁰⁴, Paulina Szwed ²⁰⁵, Małgorzata Kossowska ²⁰⁶, Gabriela Czarnek ²⁰⁷, Julita Kiełńska ²⁰⁷, Benedict Antazo ²⁰⁸, Ruben Betlehem ²⁰⁹, Stefan Stieger ²¹⁰, Gustav Nilsson ^{211,212}, Nicolle Simonovic ²¹³, Jennifer Taber ²¹³, Amélie Gourdon-Kanhukamwe ²¹⁴, Artur Domurat ²¹⁵, Keiko Ihaya ²¹⁶, Yuki Yamada ²¹⁷, Anum Urooj ²¹⁸, Tripat Gill ²¹⁹, Martin Čadek ²²⁰, Lisa Bylinina ²²¹, Johanna Messerschmidt ²²², Murathan Kurfali ²²³, Adeyemi Adetula ^{115,224}, Ekaterina Baklanova ²²⁵, Nihan Albayrak-Aydemir ²²⁶, Heather B. Kappes ²²⁷, Biljana Gjoneska ²²⁸, Thea House ^{229,230}, Marc V. Jones ¹¹³, Jana B. Berkessel ²³¹, William J. Chopik ²³², Sami Çoksan ²³³, Martin Seehuus ²³⁴, Ahmed Khaoudi ²³⁵, Ahmed Bokkour ²³⁵, Kanza Ait El Arabi ²³⁵, Ikhlas Djamai ²³⁵, Aishwarya Iyer ²³⁶, Neha Parashar ²³⁶, Arca Adiguzel ²³⁷, Halil Emre Kocalar ²³⁷, Carsten Bundt ^{238,239}, James O. Norton ²⁴⁰, Marietta Papadatou-Pastou ²⁴¹, Anabel De la Rosa-Gomez ²⁴², Vladislav Ankushev ³⁶, Natalia Bogatyreva ³⁶, Dmitry Grigoryev ³⁶, Aleksandr Ivanov ³⁶, Irina Prusova ³⁶, Marina Romanova ³⁶, Irena Sarieva ³⁶, Maria Terskova ²⁴³, Evgeniya Hristova ²⁴⁴, Veselina Hristova Kadreva ²⁴⁴, Allison Janak ²⁴⁵, Vidar Schei ²⁴⁶, Therese E. Sverdrup ²⁴⁶, Adrian Dahl Askelund ²⁴⁷, Lina Maria Sanabria Pineda ²⁴⁸, Dajana Krupić ²⁴⁹, Carmel A. Levitan ²⁵⁰, Niklas Johannes ²⁹, Nihal Ouherrou ²⁵¹, Nicolas Say ²⁵², Sladjana Sinkolova ²⁵³, Kristina Janjić ²⁵³, Marija Stojanovska ²⁵³, Dragana Stojanovska ²⁵³, Meetu Khosla ²⁵⁴, Andrew G. Thomas ²⁵⁵, Franki Y. H. Kung ²⁵⁶, Gijsbert Bijlstra ²⁵⁷, Farnaz Mosannenzadeh ²⁵⁸, Busra Bahar Balci ^{259,260}, Ulf-Dietrich Reips ²⁶¹, Ernest Baskin ²⁶², Byurakn Ishkhanyan ^{263,264}, Johanna Czamanski-Cohen ^{265,266}, Barnaby James Wyld Dixson ²⁶⁷, David Moreau ²⁶⁸, Clare A. M. Sutherland ^{269,270}, Hu Chuan-Peng ²⁷¹, Chris Noone ²⁷², Heather Flowe ²⁷³, Michele Anne ²⁷⁴, Steve M. J. Janssen ²⁷⁵, Marta Topor ²⁷⁶, Nadyanna M. Majeed ²⁷⁷, Yoshihiko Kunisato ²⁷⁸, Karen Yu ²⁷⁹, Shimrit Daches ²⁸⁰, Andree Hartanto ²⁷⁷, Milica Vdovic ²⁸¹, Lisa Anton-Boicuk ²⁸², Paul A. G. Forbes ²⁸², Julia Kamburidis ²⁸³, Evelina Marinova ²⁸³, Mina Nedelcheva-Datsova ²⁸³, Nikolay R. Rachev ²⁸³, Alina Stoyanova ²⁸³, Kathleen Schmidt ²⁸⁴, Jordan W. Suchow ²⁸⁵, Maria Koptjevskaja-Tamm ²⁸⁶, Teodor Jernsäter ²¹², Jonas K. Olofsson ²¹², Olga Bialobrzaska ²⁸⁷, Magdalena Marszalek ²⁸⁸, Srinivasan Tatachari ²⁸⁹, Reza Afhami ²⁹⁰, Wilbert Law ²⁹¹, Jan Antfolk ²⁹², Barbara Žuro ²⁹³, Natalia Van Doren ²⁹⁴, Jose A. Soto ²⁹⁴, Rachel Searston ²⁹⁵, Jacob Miranda ²⁹⁶, Kaja Damnjanović ²⁹⁷, Siu Kit Yeung ²⁹⁸, Dino Krupić ²⁹⁹, Karlijn Hoyer ³⁰⁰, Bastian Jaeger ³⁰⁰, Dongning Ren ³⁰¹, Gerit Pfuhl ³⁰², Kristoffer Klevjer ³⁰², Nadia S. Corral-Frías ³⁰³, Martha Frías-Armenta ³⁰³, Marc Y. Lucas ³⁰⁴, Adriana Olaya Torres ¹⁷⁶, Mónica Toro ³⁰⁵, Lady Grey Javela Delgado ³⁰⁶, Diego Vega ³⁰⁷, Sara Álvarez Solas ³⁰⁸, Roosevelt Vilar ³⁰⁹, Sébastien Massoni ³¹⁰, Thomas Frizzo ³¹⁰,

Alexandre Bran³¹¹, David C. Vaidis³¹¹, Luc Vieira³¹², Bastien Paris³¹³, Mariagrazia Capizzi³¹⁴, Gabriel Lins de Holanda Coelho³¹⁵, Anna Greenburgh³¹⁶, Cassie M. Whitt³¹⁷, Alexa M. Tullett³¹⁸, Xinkai Du³¹⁹, Leonhard Volz³¹⁹, Minke Jasmijn Bosma³²⁰, Cemre Karaarslan³²¹, Eylül Sarioğuz³²², Tara Bulut Allred³²³, Max Korbmacher³²⁴, Melissa F. Colloff³²⁵, Tiago J. S. Lima³²⁶, Matheus Fernando Felix Ribeiro³²⁷, Jeroen P. H. Verharen³²⁸, Maria Karekla³²⁹, Christiana Karashiali³³⁰, Naoyuki Sunami³³¹, Lisa M. Jaremka³³¹, Daniel Storage³³², Sumaiya Habib³³³, Anna Studzinska³³⁴, Paul H. P. Hanel³³⁵, Dawn Liu Holford³³⁵, Miroslav Sirota³³⁵, Kelly Wolfe³³⁵, Faith Chiu³³⁶, Andriana Theodoropoulou³³⁷, El Rim Ahn³³⁸, Yijun Lin³³⁹, Erin C. Westgate³³⁸, Hilmar Brohmer³⁴⁰, Gabriela Hofer³⁴⁰, Olivier Dujols³⁴¹, Kevin Vezirian³⁴¹, Gilad Feldman³⁴¹, Giovan³⁴² A. Travaglino³⁴², Afroja Ahmed³⁴³, Manyu Li³⁴⁴, Jasmijn Bosch³⁴⁵, Nathan Torunsky³⁴⁶, Hui Bai³⁴⁷, Mathi Manavalan³⁴⁸, Xin Song³⁴⁸, Radoslaw B. Walczak³⁴⁹, Przemysław Zdybek³⁴⁹, Maja Friedemann³⁵⁰, Anna Dalla Rosa³⁵¹, Luca Kozma³⁵¹, Sara G. Alves³⁵², Samuel Lins³⁵², Isabel R. Pinto³⁵², Rita C. Correia³⁵³, Peter Babinčák³⁵⁴, Gabriel Banik³⁵⁵, Luis Miguel Rojas-Berscia^{356,357}, Marco A. C. Varella³⁵⁶, Jim Uttley³⁵⁸, Julie E. Beshears³⁵⁹, Katrine Krabbe Thommesen³⁶⁰, Behzad Behzadnia³⁶⁰, Shawn N. Geniole³⁶¹, Miguel A. Silan³⁶², Princess Lovella G. Maturan³⁶³, Johannes K. Vilsmeier³⁶⁴, Ulrich S. Tran³⁶⁵, Sara Morales Izquierdo³⁶⁶, Michael C. Mensink³⁶⁷, Piotr Sorokowski³⁶⁷, Agata Groyecka-Bernard^{368,369}, Theda Radtke³⁷⁰, Vera Cubela Adoric³⁷¹, Joelle Carpentier³⁷², Asil Ali Özdoğru³⁷³, Jennifer A. Joy-Gaba³⁷⁴, Mattie V. Hedgebeth³⁷⁴, Tatsunori Ishii³⁷⁵, Aaron L. Wichman³⁷⁶, Jan Philipp Röer³⁷⁷, Thomas Ostermann³⁷⁷, William E. Davis³⁷⁸, Lilian Suter³⁷⁹, Konstantinos Papachristopoulos³⁸⁰, Chelsea Zabel³⁸¹, Charles R. Ebersole³⁸¹, Christopher R. Chartier³⁸², Peter R. Mallik³⁸³, Heather L. Urry³⁸⁴, Erin M. Buchanan³⁸⁵, Nicholas A. Coles³⁸⁶, Maximilian A. Primbs³⁸⁶, Dana M. Basnight-Brown³⁸⁷, Hans IJzerman³⁸⁸, Patrick S. Forscher³⁸⁹ and Hannah Moshontz³⁸⁹

¹Harvard Kennedy School, Harvard University, Cambridge, MA, USA. ²Harvard Business School, Harvard University, Cambridge, MA, USA. ³Kellogg School of Management, Northwestern University, Evanston, IL, USA. ⁴Department of Psychology, Willamette University, Salem, OR, USA. ⁵Institute of Psychology, University of Tartu, Tartu, Estonia. ⁶Harvard Kennedy School and Department of Psychology, Harvard University, Cambridge, MA, USA. ⁷Department of Psychology, Stanford University, Stanford, CA, USA. ⁸Adekunle Ajasin University, Akungba Akoko, Nigeria. ⁹Faculdade de Psicologia e Ciências da Educação, Universidade do Porto, Porto, Portugal. ¹⁰University of Deusto, Barakaldo, Spain. ¹¹University of Navarra, Pamplona, Spain. ¹²University of Valencia, Valencia, Spain. ¹³Stockholm University, Stockholm, Sweden. ¹⁴California State University, Northridge, Los Angeles, CA, USA. ¹⁵Indiana University of Pennsylvania, Indiana, PA, USA. ¹⁶Universidad de Navarra, Pamplona, Spain. ¹⁷Department of Cognitive Psychology, Institute of Cognitive Neuroscience, Ruhr University Bochum, Bochum, Germany. ¹⁸Kindergarten Kustošija, Zagreb, Croatia. ¹⁹GC University Lahore, Lahore, Pakistan. ²⁰Montclair State University, Jersey City, NJ, USA. ²¹European University of Cyprus, Nicosia, Cyprus. ²²Indiana University of Pennsylvania, Akron, PA, USA. ²³Leiden University, Culemborg, The Netherlands. ²⁴Stockholm, Sweden. ²⁵Poggio Imperiale, Italy. ²⁶Barakaldo, Spain. ²⁷Islamabad, Pakistan. ²⁸Gent, Belgium. ²⁹Oxford Internet Institute, University of Oxford, Oxford, UK. ³⁰Warsaw, Poland. ³¹Queen's University Belfast, Belfast, Ireland. ³²Universiteit Leiden, Leiden, The Netherlands. ³³Institute of Psychology, Jagiellonian University, Krakow, Poland. ³⁴Department of Psychology, Lucian Blaga University of Sibiu, Sibiu, Romania. ³⁵Carol Davila University of Medicine and Pharmacy, Bucharest, Romania. ³⁶National Research University Higher School of Economics, Moscow, Russia. ³⁷Institute of Psychology, Faculty of Arts, University of Presov, Presov, Slovakia. ³⁸Institute of Social Sciences, CSPS Slovak Academy of Sciences, Košice, Slovakia. ³⁹Department of Psychology, SWPS University of Social Sciences and Humanities, Sopot, Poland. ⁴⁰Department of Learning, Informatics, Management and Ethics, Karolinska Institutet, Stockholm, Sweden. ⁴¹Instituto de Investigaciones Psicológicas (IIPSI), Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET)-UNC, Córdoba, Argentina. ⁴²Department of Psychology, University of Cyprus, Nicosia, Cyprus. ⁴³Department of Applied Health Research, University College London, London, UK. ⁴⁴Åbo Akademi University, Turku, Finland. ⁴⁵Faculty of Arts, Psychology and Theology, Åbo Akademi University, Turku, Finland. ⁴⁶Department of Pure and Applied Psychology, Faculty of Social and Management Sciences, Adekunle Ajasin University, Akungba, Nigeria. ⁴⁷Department of Psychology, Afyon Kocatepe University, Afyonkarahisar, Turkey. ⁴⁸Alex Ekwueme Federal University Ndufu-Alike, Ndufu-Alike, Nigeria. ⁴⁹Department of Psychology, Ankara Medipol University, Ankara, Turkey. ⁵⁰MIS Department, Ankara Science University, Ankara, Turkey. ⁵¹School of Psychology, Arellano University, Manila, Philippines. ⁵²Ashland University, Ashland, OH, USA. ⁵³Department of Psychology, Atilim University, Ankara, Turkey. ⁵⁴Australian Catholic University, North Sydney, New South Wales, Australia. ⁵⁵School of Behavioural and Health Sciences, Australian Catholic University, North Sydney, New South Wales, Australia. ⁵⁶Aventura Social and DESSH, Faculty of Human Kinetics, University of Lisbon, Lisbon, Portugal. ⁵⁷Institute of Environmental Health, Medicine Faculty, University of Lisbon, Lisbon, Portugal. ⁵⁸ISCTE, Instituto Universitário de Lisboa, Lisbon, Portugal. ⁵⁹Department of Psychology, Ben Gurion University, Beersheba, Israel. ⁶⁰Department of Psychology and Zlotowski Center for Neuroscience, Ben Gurion University, Beersheba, Israel. ⁶¹Department of Political Science, Bilkent University, Ankara, Turkey. ⁶²Department of Psychology, Bournemouth University, Poole, UK. ⁶³Case Western Reserve University, Cleveland, OH, USA. ⁶⁴Center for Research on Cognition and Behavior, SWPS University of Social Sciences and Humanities in Sopot, Sopot, Poland. ⁶⁵Centre of Attachment and Emotional Regulation (CARE), Universidad del Desarrollo, Las Condes, Chile. ⁶⁶Charles University, Prague, Czechia. ⁶⁷Environment Center, Charles University, Prague, Czechia. ⁶⁸Institute for Research and Development of Education, Faculty of Education, Charles University, Prague, Czechia. ⁶⁹Faculty of Education, University of Prešov, Prešov, Slovakia. ⁷⁰Institute of Economic Studies, Charles University, Prague, Czechia. ⁷¹Chinese Center of Disease Prevention and Control, Beijing, China. ⁷²Claremont Graduate University, Claremont, CA, USA. ⁷³CLLE, Université de Toulouse, Toulouse, France. ⁷⁴Cognitive Science, Faculty of Education, University of Ljubljana, Ljubljana, Slovenia. ⁷⁵College of Science, Health, Engineering and Education, Murdoch University, Perth, Western Australia, Australia. ⁷⁶Centre for Healthy Ageing, Health Futures Institute, Murdoch University, Perth, Western Australia, Australia. ⁷⁷Faculty of Social and Economic Sciences, Comenius University in Bratislava, Bratislava, Slovakia. ⁷⁸Concordia University, Montreal, Quebec, Canada. ⁷⁹De La Salle University, Manila, Philippines. ⁸⁰Departamento de Psicología, Laboratorio de Estrés y Salud, Universidad de La Frontera, Temuco, Chile. ⁸¹Department of Clinical Psychology, United Arab Emirates University, Al Ain, UAE. ⁸²Wolfson College, University of Oxford, Oxford, UK. ⁸³Department of Cognition, Emotion and Methods in Psychology, Faculty of Psychology, University of Vienna, Vienna, Austria. ⁸⁴Department of Cognitive Science and Psychology, Research Center for Cognitive Science, New Bulgarian University, Sofia, Bulgaria. ⁸⁵Department of Experimental and Applied Psychology, Vrije Universiteit Amsterdam, Amsterdam, The Netherlands. ⁸⁶Department of Experimental Psychology, Institute of Psychology, University of São Paulo, São Paulo, Brazil. ⁸⁷Department of General Psychology, University of Padua, Padua, Italy. ⁸⁸Department of Biomedical Sciences, University of Padua, Padua, Italy. ⁸⁹Padova Neuroscience Center, University of Padua, Padua, Italy. ⁹⁰Human Inspired Technology Center, University of Padua, Padua, Italy. ⁹¹Department of Human Development and Psychology, Tzu-Chi University, Hualien, Taiwan. ⁹²Department of Management, Aarhus University, Aarhus, Denmark. ⁹³Department of Management, Kingston University London, Kingston, UK. ⁹⁴Department of Neurosurgery, Baylor College of Medicine, Houston, TX, USA. ⁹⁵Department of Philosophy, Macquarie University, Sydney, New South Wales, Australia. ⁹⁶Department of Psychological Counselling and Guidance, Faculty of Education, Muğla Sıtkı Koçman University, Muğla, Turkey. ⁹⁷Department of Psychological Sciences, Swinburne University of Technology, Melbourne, Victoria, Australia. ⁹⁸Department of Psychology and Neuroscience, Nova Southeastern University, Pembroke Pines, FL, USA. ⁹⁹Department of Psychology and Neuroscience, Nova Southeastern University, Fort Lauderdale, FL, USA. ¹⁰⁰School of Psychology and Neuroscience, University of St Andrews, St Andrews, UK. ¹⁰¹Department of Psychology, Education and Child Studies, Erasmus School of Social and Behavioural Sciences, Erasmus University, Rotterdam, The Netherlands. ¹⁰²MRC Cognition and Brain Sciences Unit, University of Cambridge, Cambridge, UK. ¹⁰³Department of Psychology, Faculty of Arts, Charles University, Prague, Czechia. ¹⁰⁴Department of Psychology, Faculty of Arts, Pavol Jozef Šafárik University in Košice, Košice, Slovakia. ¹⁰⁵Department of Psychology, Faculty of Education, Matej Bel University, Banská Bystrica, Slovakia. ¹⁰⁶Department of Psychology, Faculty of Humanities and Social Sciences, J. J. Strossmayer University of Osijek, Osijek, Croatia. ¹⁰⁷Department of Psychology, Faculty of Mathematics, Natural Sciences and Information Technologies, University of Primorska, Koper, Slovenia. ¹⁰⁸Department of Psychology, Faculty of Psychology and Education, University of Tehran, Tehran, Iran. ¹⁰⁹Department of Psychology, Faculty of Social and Behavioural Sciences, University of Amsterdam, Amsterdam, The Netherlands. ¹¹⁰Department of Psychology, Goethe University Frankfurt, Frankfurt, Germany. ¹¹¹Department of Psychology, Lancaster University, Lancaster, UK. ¹¹²Department of Psychology, Macquarie University, Sydney, New South Wales, Australia. ¹¹³Department of Psychology, Manchester Metropolitan University, Manchester, UK. ¹¹⁴Department of Psychology, Mohammed V University in Rabat, Rabat, Morocco. ¹¹⁵LIP/PC2S, Université Grenoble Alpes, Grenoble, France. ¹¹⁶Department of Psychology, Northern Illinois University, DeKalb, IL, USA. ¹¹⁷Department of Psychology, Oakland University, Oakland County, MI, USA. ¹¹⁸Department of Psychology, Sapienza University, Rome, Italy. ¹¹⁹Department of Psychology, Simon Fraser University, Burnaby, British Columbia, Canada. ¹²⁰Department of Social Sciences and Liberal Arts, Institute of Business Administration, Simon Fraser University, Burnaby, British Columbia, Canada. ¹²¹Department of Psychology, Universidad de los Andes, Bogotá, Colombia. ¹²²Department of Psychology, University of Cambridge, Cambridge, UK. ¹²³Department of Psychology, University of Crete, Rethymno, Greece. ¹²⁴Department of Psychology, University of Hong Kong, Hong Kong, Hong Kong. ¹²⁵Department of Psychology, University of Magallanes, Punta Arenas, Chile. ¹²⁶Department of Psychology, University of Maribor, Maribor, Slovenia. ¹²⁷Department of Psychology, University of Minnesota, Minneapolis, MN, USA. ¹²⁸Department of Psychology, University of Mississippi, Oxford, MS, USA. ¹²⁹Department of Psychology, University of Oslo, Oslo, Norway. ¹³⁰Department of Psychology, University of Sheffield, Sheffield, UK. ¹³¹Department of Psychology, University of Southern California, Los Angeles, CA, USA. ¹³²Department of Psychology, University of Tehran, Tehran, Iran. ¹³³Department of Social Psychology, Tilburg University, Bonn, Germany. ¹³⁴Department of Special Education and The Edmond J. Safra Brain Research Center for the Study of

Learning Disabilities, University of Haifa, Tel Aviv, Israel. ¹³⁵Department of Sport Management, Faculty of Physical Education and Sport Science, Urmia University, Urmia, Iran. ¹³⁶Department of Translation Studies, Faculty of Arts, University of Ljubljana, Ljubljana, Slovenia. ¹³⁷Developmental Behavioral Genetics Laboratory, Psychological Institute of the Russian Academy of Education, Moscow, Russia. ¹³⁸Discipline of Psychology, Faculty of Health, University of Canberra, Canberra, Australia. ¹³⁹Division of Psychology and Language Sciences, University College London, London, UK. ¹⁴⁰Psychology Department, Dominican University, River Forest, IL, USA. ¹⁴¹Dynamic and Clinical Psychology, Sapienza University of Rome, Rome, Italy. ¹⁴²Department of Industrial Engineering and Innovation Sciences, Eindhoven University of Technology, Eindhoven, The Netherlands. ¹⁴³Environment Center, Charles University, Prague, Czechia. ¹⁴⁴Facultad de Psicología, Universidad del Desarrollo, Concepción, Chile. ¹⁴⁵Clínica Alemana de Santiago, Santiago, Chile. ¹⁴⁶Sociedad Chilena de Desarrollo Emocional, Santiago, Chile. ¹⁴⁷Faculty of Arts, University of Presov, Prešov, Slovakia. ¹⁴⁸Dr Lazar Vrkatic Faculty of Legal and Business Studies, Novi Sad, Serbia. ¹⁴⁹Department of Psychology, Serbia Union University, Novi Sad, Serbia. ¹⁵⁰Faculty of Management, University of Warsaw, Warsaw, Poland. ¹⁵¹Faculty of Media and Communication, Singidunum University, Belgrade, Serbia. ¹⁵²Faculty of Medicine FMUC, Institute of Nuclear Sciences Applied to Health ICNAS, Coimbra Institute for Biomedical Imaging and Translational Research CIBIT, University of Coimbra, Coimbra, Portugal. ¹⁵³Faculty of Philosophy, University of Belgrade, Belgrade, Serbia. ¹⁵⁴Faculty of Psychology, Chulalongkorn University, Bangkok, Thailand. ¹⁵⁵Faculty of Psychology, Fundación Universitaria Konrad Lorenz, Bogotá, Colombia. ¹⁵⁶Department of Psychology, Federal University of Mato Grosso, Cuiabá, Brazil. ¹⁵⁷Ferdowsi University of Mashhad, Mashhad, Iran. ¹⁵⁸Center for Children and Families, Department of Psychology, Florida International University, Miami, FL, USA. ¹⁵⁹Center for Translational Behavioral Science, Florida State University, Tallahassee, FL, USA. ¹⁶⁰Department of Psychology, Fo Guang University, Yilan County, Taiwan. ¹⁶¹FOM University of Applied Sciences, Hildesheim, Germany. ¹⁶²Leibniz-Institut für Wissensmedien, Tübingen, Germany. ¹⁶³LEAD Research Network, Eberhard Karls University, Hildesheim, Germany. ¹⁶⁴Fox School of Business, Temple University, Philadelphia, PA, USA. ¹⁶⁵Department of Psychology, Franklin and Marshall College, Lancaster, PA, USA. ¹⁶⁶Florence, Italy. ¹⁶⁷Samarkand, Uzbekistan. ¹⁶⁸Friedrich Schiller University Jena, Jena, Germany. ¹⁶⁹Fundación Universitaria Konrad Lorenz, Bogotá, Colombia. ¹⁷⁰GC University, Lahore, Pakistan. ¹⁷¹Department of Psychology, Georgia State University, Atlanta, GA, USA. ¹⁷²Department of Experimental Psychology, Ghent University, Ghent, Belgium. ¹⁷³Grenoble Ecole de Management, Grenoble, France. ¹⁷⁴Department of Anesthesiology and Reanimation, Hacettepe University, Ankara, Turkey. ¹⁷⁵Higher College of Education and Training, Ibn Tofail University, Kenitra, Morocco. ¹⁷⁶Universidad del Desarrollo, Santiago, Chile. ¹⁷⁷Humboldt State University, Arcata, CA, USA. ¹⁷⁸Department of Surgery and Cancer, Imperial College London, London, UK. ¹⁷⁹Puebla, Mexico. ¹⁸⁰Ankara, Turkey. ¹⁸¹Department of Psychology, Indiana University of Pennsylvania, Saint Michael, PA, USA. ¹⁸²Department of Psychology, Indiana University of Pennsylvania, Indiana, PA, USA. ¹⁸³Indiana University Pennsylvania, Indiana, PA, USA. ¹⁸⁴INSEAD, Singapore, Singapore. ¹⁸⁵Institute for Linguistic Studies, Russian Academy of Sciences, Saint Petersburg, Russia. ¹⁸⁶Institute of Advanced Studies in Humanities and Social Sciences, Beijing Normal University at Zhuhai, Guangzhou, China. ¹⁸⁷Institute of Applied Psychology, Jagiellonian University, Kraków, Poland. ¹⁸⁸Institute of Cognitive and Evolutionary Anthropology, University of Oxford, Oxford, UK. ¹⁸⁹Calleva Research Centre for Evolution and Human Sciences, Magdalen College, University of Oxford, Oxford, UK. ¹⁹⁰Institute of European Studies and International Relations, Faculty of Social and Economic Sciences, Comenius University in Bratislava, Bratislava, Slovakia. ¹⁹¹Institute of Nuclear Sciences Applied to Health ICNAS, Coimbra Institute for Biomedical Imaging and Translational Research CIBIT, University of Coimbra, Coimbra, Portugal. ¹⁹²Institute of Psychology, ELTE Eötvös Loránd University, Budapest, Hungary. ¹⁹³Institute of Psychology, Leibniz University Hannover, Hannover, Germany. ¹⁹⁴Institute of Psychology, University of Hildesheim, Hildesheim, Germany. ¹⁹⁵Institute of Psychology, University of Pécs, Pécs, Hungary. ¹⁹⁶Institute of Psychology, University of Silesia in Katowice, Katowice, Poland. ¹⁹⁷Institute of Psychology, University of Wrocław, Wrocław, Poland. ¹⁹⁸School of Anthropology and Museum Ethnography, University of Oxford, Oxford, UK. ¹⁹⁹Instituto de Investigaciones Psicológicas (IIPsi), Universidad Nacional de Córdoba-Conicet, Córdoba, Argentina. ²⁰⁰Facultad de Psicología, Universidad Nacional de Córdoba, Córdoba, Argentina. ²⁰¹Instituto Tecnológico de Estudios Superiores de Monterrey, Hermosillo, Mexico. ²⁰²CIS-IUL, Iscte-Instituto Universitário de Lisboa, Lisbon, Portugal. ²⁰³Intelligent Agents and Synthetic Characters Group (GAIPS), INESC-ID, Lisbon, Portugal. ²⁰⁴Ithaca College, Ithaca, NY, USA. ²⁰⁵Jagiellonian University, Kraków, Poland. ²⁰⁶Department of Philosophy, Institute of Psychology, Jagiellonian University in Krakow, Kraków, Poland. ²⁰⁷Institute of Psychology, Jagiellonian University, Czeszochowa, Poland. ²⁰⁸Department of Psychology, Jose Rizal University, Pasig City, Philippines. ²⁰⁹Department of Psychology, Faculty of Humanities and Social Sciences, Josip Juraj Strossmayer University of Osijek, Osijek, Croatia. ²¹⁰Department of Psychology and Psychodynamics, Karl Landsteiner University of Health Sciences, Krems an der Donau, Austria. ²¹¹Department of Clinical Neuroscience, Karolinska Institutet, Solna, Sweden. ²¹²Department of Psychology, Stockholm University, Stockholm, Sweden. ²¹³Department of Psychological Sciences, Kent State University, Kent, OH, USA. ²¹⁴Institute for Globally Distributed Open Research and Education (IGDORE), Kingston University, London, UK. ²¹⁵Centre for Economic Psychology and Decision Sciences, Kozminski University, Warsaw, Poland. ²¹⁶Admission Center, Kyushu University, Fukuoka, Japan. ²¹⁷Faculty of Arts and Science, Kyushu University, Fukuoka, Japan. ²¹⁸La Trobe University, Melbourne, Victoria, Australia. ²¹⁹Lazaridis School of Business and Economics, Wilfrid Laurier University, Waterloo, Ontario, Canada. ²²⁰Carnegie School of Sport, Leeds Beckett University, London, UK. ²²¹Leiden University, Utrecht, The Netherlands. ²²²Institute of Psychology, Leipzig University, Heidelberg, Germany. ²²³Linguistics Department, Stockholm University, Stockholm, Sweden. ²²⁴Department of Psychology, Alex Ekweeme Federal University, Abakaliki, Nigeria. ²²⁵Institute of Asian and African Studies, Lomonosov Moscow State University, Moscow, Russia. ²²⁶London School of Economics and Political Science, London, UK. ²²⁷Department of Management, London School of Economics and Political Science, London, UK. ²²⁸Macedonian Academy of Sciences and Arts, Skopje, North Macedonia. ²²⁹Macquarie University, Sydney, New South Wales, Australia. ²³⁰University of Bristol, Bristol, UK. ²³¹Mannheim Centre for European Social Research, University of Mannheim, Mannheim, Germany. ²³²Department of Psychology, Michigan State University, East Lansing, MI, USA. ²³³Department of Psychology, Middle East Technical University, Ankara, Turkey. ²³⁴Department of Psychology, Middlebury College; Vermont Psychological Services, University of Vermont, Middlebury, VT, USA. ²³⁵Mohammed V University in Rabat, Rabat, Morocco. ²³⁶Sampurna Montfort College, Bangalore, India. ²³⁷Department of Psychological Counseling and Guidance, Muğla Sıtkı Koçman University, Muğla, Turkey. ²³⁸Multimodal Imaging and Cognitive Control Lab, Department of Psychology, University of Oslo, Oslo, Norway. ²³⁹Cognitive and Translational Neuroscience Cluster, Department of Psychology, University of Oslo, Oslo, Norway. ²⁴⁰College of Science, Health, Engineering and Education, Murdoch University, Lesmurdie, Australia. ²⁴¹National and Kapodistrian University of Athens, Athens, Greece. ²⁴²Faculty of Higher Studies “Iztacala”, National Autonomous University of Mexico, Mexico City, Mexico. ²⁴³Institute of Psychology, Jagiellonian University, Kraków, Poland. ²⁴⁴Department of Cognitive Science and Psychology, New Bulgarian University, Sofia, Bulgaria. ²⁴⁵Department of Applied Psychology, New York University, New York, NY, USA. ²⁴⁶NHH Norwegian School of Economics, Department of Strategy and Management, Bergen, Norway. ²⁴⁷Nic Waals Institute, Lovisenberg Diaconal Hospital, Oslo, Norway. ²⁴⁸Universidad de los Andes, Bogotá, Colombia. ²⁴⁹Norvel—Psychological Centre for Counselling and Research, Osijek, Croatia. ²⁵⁰Department of Cognitive Science, Occidental College, Los Angeles, CA, USA. ²⁵¹Paul Valéry Montpellier University, Montpellier, France. ²⁵²Prague University of Economics and Business, Prague, Czechia. ²⁵³PSA Psihesko, Skopje, North Macedonia. ²⁵⁴Psychology Department, DRC, University of Delhi, Delhi, India. ²⁵⁵Psychology Department, Swansea University, Swansea, UK. ²⁵⁶Purdue University, West Lafayette, IN, USA. ²⁵⁷Behavioural Science Institute, Radboud University, Nijmegen, The Netherlands. ²⁵⁸Behavioural Science Institute, Faculty of Social Sciences, Radboud University, Nijmegen, The Netherlands. ²⁵⁹Department of Psychology, Samsun University, Samsun, Turkey. ²⁶⁰Department of Psychology, Dokuz Eylül University, Samsun, Turkey. ²⁶¹Research Methods, Assessment, and iScience, Department of Psychology, University of Konstanz, Kreuzlingen, Switzerland. ²⁶²Saint Joseph’s University, Philadelphia, PA, USA. ²⁶³School of Communication and Culture, Aarhus University, Aarhus, Denmark. ²⁶⁴Department of Nordic Studies and Linguistics, University of Copenhagen, Aarhus, Denmark. ²⁶⁵School of Creative Arts Therapies, University of Haifa, Haifa, Israel. ²⁶⁶Emili Sagol Creative Arts Therapies Research Center, University of Haifa,

Haifa, Israel. ²⁶⁷School of Health and Behavioural Sciences, University of the Sunshine Coast, Brisbane, Queensland, Australia. ²⁶⁸School of Psychology and Centre for Brain Research, The University of Auckland, Auckland, New Zealand. ²⁶⁹School of Psychology, King's College, University of Aberdeen, Aberdeen, UK. ²⁷⁰School of Psychological Science, University of Western Australia, Perth, Western Australia, Australia. ²⁷¹School of Psychology, Nanjing Normal University, Nanjing, China. ²⁷²School of Psychology, National University of Ireland, Galway, Galway, Ireland. ²⁷³School of Psychology, University of Birmingham, Birmingham, AL, USA. ²⁷⁴School of Psychology, University of Nottingham Malaysia, Semenyih, Malaysia. ²⁷⁵School of Psychology, University of Nottingham Malaysia, Kuala Lumpur, Malaysia. ²⁷⁶School of Psychology, University of Surrey, Guildford, UK. ²⁷⁷School of Social Sciences, Singapore Management University, Singapore, Singapore. ²⁷⁸Department of Psychology, Senshu University, Tokyo, Japan. ²⁷⁹Sewanee: The University of the South, Sewanee, TN, USA. ²⁸⁰Department of Psychology, Bar-Ilan University, Ramat Gan, Israel. ²⁸¹Department of Psychology, Faculty of Media and Communications, Singidunum University, Belgrade, Serbia. ²⁸²Social, Cognitive and Affective Neuroscience Unit, Department of Cognition, Emotion, and Methods in Psychology, Faculty of Psychology, University of Vienna, Vienna, Austria. ²⁸³Department of General, Experimental, Developmental, and Health Psychology, Sofia University St Kliment Ohridski, Sofia, Bulgaria. ²⁸⁴School of Psychological and Behavioral Sciences, Southern Illinois University, Carbondale, IL, USA. ²⁸⁵School of Business, Stevens Institute of Technology, Hoboken, NJ, USA. ²⁸⁶Department of Linguistics, Stockholm University, Stockholm, Sweden. ²⁸⁷SWPS University of Social Sciences and Humanities, Warsaw, Poland. ²⁸⁸SWPS University of Social Sciences and Humanities, Gdansk, Poland. ²⁸⁹T A Pai Management Institute, Manipal, India. ²⁹⁰Department of Art Studies, Tarbiat Modares University, Tehran, Iran. ²⁹¹Department of Psychology, The Education University of Hong Kong, Hong Kong, Hong Kong. ²⁹²The Faculty of Arts, Psychology and Theology, Åbo Akademi University, Turku, Finland. ²⁹³The Institute of Psychology; Faculty of Humanities and Social Sciences, University of Osijek, Osijek, Croatia. ²⁹⁴Department of Psychology, The Pennsylvania State University, State College, PA, USA. ²⁹⁵The University of Adelaide, Adelaide, South Australia, Australia. ²⁹⁶Department of Psychology, The University of Alabama, Tuscaloosa, AL, USA. ²⁹⁷Laboratory for Experimental Psychology, Institute of Philosophy, Department of Psychology, Faculty of Philosophy, The University of Belgrade, Beograd-Stari Grad, Serbia. ²⁹⁸The University of Hong Kong, Hong Kong, Hong Kong. ²⁹⁹Faculty of Humanities and Social Science, The University of Osijek, Osijek, Croatia. ³⁰⁰Tilburg University, Tilburg, The Netherlands. ³⁰¹Department of Social Psychology, Tilburg University, Tilburg, The Netherlands. ³⁰²Department of Psychology, UiT The Arctic University of Norway, Tromsø, Norway. ³⁰³Universidad de Sonora, Hermosillo, Mexico. ³⁰⁴Department of Psychology, Universidad de Sonora, Hermosillo, Mexico. ³⁰⁵Centro de Apego y Regulación Emocional, Facultad de Psicología, Universidad Del Desarrollo, Santiago, Chile. ³⁰⁶Programa de Psicología, Universidad del Rosario, Bogotá, Colombia. ³⁰⁷Universidad Latina de Costa Rica, San Jose, Costa Rica. ³⁰⁸Grupo de investigación en Biogeografía y Ecología Espacial (BioGeoE2), Universidad Regional Amazónica Ikiam, Tena, Ecuador. ³⁰⁹Universidade Cruzeiro do Sul, São Paulo, Brazil. ³¹⁰Université de Lorraine; CNRS, BETA, Université de Strasbourg, Nancy, France. ³¹¹Université de Paris, Paris, France. ³¹²Université de Paris, Strasbourg, France. ³¹³Université Grenoble Alpes, Grenoble, France. ³¹⁴Université Paul Valéry Montpellier, Granada, Spain. ³¹⁵University College Cork, Cork, Ireland. ³¹⁶Department of Experimental Psychology, University College London, London, UK. ³¹⁷University of Alabama, Tuscaloosa, AL, USA. ³¹⁸Department of Psychology, University of Alabama, Tuscaloosa, AL, USA. ³¹⁹University of Amsterdam, Amsterdam, The Netherlands. ³²⁰Department of Psychology, University of Amsterdam, Amsterdam, The Netherlands. ³²¹Department of Psychology, Institute of Social Sciences, University of Başkent, Ankara, Turkey. ³²²Department of Psychology, Institute of Social Sciences, University of Başkent, Çankaya, Turkey. ³²³Laboratory for Research of Individual Differences, Faculty of Philosophy, University of Belgrade, Belgrade, Serbia. ³²⁴Department of Biological and Medical Psychology, Faculty of Psychology, University of Bergen, Bergen, Norway. ³²⁵University of Birmingham, Birmingham, UK. ³²⁶Department of Social and Work Psychology, University of Brasília, Brasília, Brazil. ³²⁷Institute of Psychology, University of Brasilia, Uberaba, Brazil. ³²⁸Department of Molecular and Cell Biology, University of California Berkeley, Berkeley, CA, USA. ³²⁹University of Cyprus, Nicosia, Cyprus. ³³⁰Department of Psychology, University of Cyprus, Nicosia, Cyprus. ³³¹Department of Psychological and Brain Sciences, University of Delaware, Newark, DE, USA. ³³²Department of Psychology, University of Denver, Denver, CO, USA. ³³³Department of Clinical Psychology, University of Dhaka, Dhaka, Bangladesh. ³³⁴University of Economics and Human Sciences in Warsaw, Warsaw, Poland. ³³⁵University of Essex, Colchester, UK. ³³⁶Department of Language and Linguistics, University of Essex, Colchester, UK. ³³⁷Department of Psychology, University of Essex, Colchester, UK. ³³⁸Department of Psychology, University of Florida, Gainesville, USA. ³³⁹Department of Psychology, University of Florida, New York, NY, USA. ³⁴⁰Institute of Psychology, University of Graz, Graz, Austria. ³⁴¹University of Hong Kong, Hong Kong, Hong Kong. ³⁴²School of Psychology, Keynes College, University of Kent, Canterbury, UK. ³⁴³Department of Psychology, Global MINDS, University of Limerick, Dhaka, Bangladesh. ³⁴⁴University of Louisiana at Lafayette, Lafayette, LA, USA. ³⁴⁵University of Milan-Bicocca, Milan, Italy. ³⁴⁶Department of Psychology, University of Minnesota, Twin Cities, Minneapolis, MN, USA. ³⁴⁷University of Minnesota, Twin Cities, Saint Paul, MN, USA. ³⁴⁸Department of Psychology, University of Minnesota, Twin Cities, Minneapolis, MN, USA. ³⁴⁹Institute of Psychology, University of Opole, Opole, Poland. ³⁵⁰University of Oxford, Oxford, UK. ³⁵¹Department of Philosophy, Sociology, Education and Applied Psychology, University of Padova, Zovencedo, Italy. ³⁵²Center for Psychology, University of Porto, Porto, Portugal. ³⁵³Center for Psychology, University of Porto, Amarante, Portugal. ³⁵⁴Institute of Psychology, Faculty of Arts, University of Presov, Prešov, Slovakia. ³⁵⁵Institute of Psychology, University of Presov, Prešov, Slovakia. ³⁵⁶School of Languages and Cultures, University of Queensland, Lucia, Queensland, Australia. ³⁵⁷Centro de Estudios Orientales, Pontificia Universidad Católica del Perú, Lima, Peru. ³⁵⁸School of Architecture, University of Sheffield, Sheffield, UK. ³⁵⁹University of Southern Indiana, Greenwood, IN, USA. ³⁶⁰University of Tabriz, Tabriz, Iran. ³⁶¹Department of Psychology, University of the Fraser Valley, Surrey, British Columbia, Canada. ³⁶²University of the Philippines Diliman, Quezon City, Philippines. ³⁶³Department of Psychology, University of the Philippines Diliman, Metro Manila, Philippines. ³⁶⁴Department of Cognition, Emotion, and Methods in Psychology, University of Vienna, Vienna, Austria. ³⁶⁵Department of Cognition, Emotion, and Methods in Psychology, School of Psychology, University of Vienna, Vienna, Austria. ³⁶⁶University of Warwick, Coventry, UK. ³⁶⁷Department of Psychology, University of Wisconsin-Stout, White Bear Township, WI, USA. ³⁶⁸Institute of Psychology, University of Wrocław; Social and Legal Psychology, Johannes Gutenberg University, Wrocław, Poland. ³⁶⁹Social and Legal Psychology, Johannes Gutenberg University, Mainz, Germany. ³⁷⁰Department of Psychology, University of Wuppertal, Witten, Germany. ³⁷¹Department of Psychology, University of Zadar, Zadar, Croatia. ³⁷²Department of Organization and Human Resources, School of Management, Université du Québec à Montréal, Montreal, Quebec, Canada. ³⁷³Department of Psychology, Üsküdar University, Istanbul, Turkey. ³⁷⁴Virginia Commonwealth University, Richmond, VA, USA. ³⁷⁵Faculty of Science and Engineering, Waseda University, Tokyo, Japan. ³⁷⁶Western Kentucky University, Bowling Green, KY, USA. ³⁷⁷Department of Psychology and Psychotherapy, Witten/Herdecke University, Witten, Germany. ³⁷⁸Department of Psychology, Wittenberg University, Springfield, OH, USA. ³⁷⁹School of Applied Psychology, ZHAW Zurich University of Applied Sciences, Winterthur, Switzerland. ³⁸⁰Athens University of Economic and Business, Athens, Greece. ³⁸¹University of Virginia, Denver, CO, USA. ³⁸²Department of Psychology, Ashland University, Ashland, OH, USA. ³⁸³Department of Psychology, Ashland University, Medina, OH, USA. ³⁸⁴Department of Psychology, Tufts University, Medford, MA, USA. ³⁸⁵Harrisburg University of Science and Technology, Bethlehem, PA, USA. ³⁸⁶Stanford University, Stanford, CA, USA. ³⁸⁷United States International University—Africa, Nairobi, Kenya. ³⁸⁸Université Grenoble Alpes; Institut Universitaire de France, Grenoble, France. ³⁸⁹Department of Psychology, University of Wisconsin-Madison, Madison, WI, USA. ✉e-mail: millerj@willamette.edu

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Our web collection on [statistics for biologists](#) contains articles on many of the points above.

Software and code

Policy information about [availability of computer code](#)

Data collection The data collection was implemented using the formr software framework. Details regarding implementation can be found here: <https://osf.io/shn5r/>.

Data analysis All data analysis was completed using R. Scripts are available at <https://osf.io/4yf9d/>.

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Behavioural & social sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	quantitative experimental
Research sample	We collected 27,989 responses from May 2020 to October 2020. After implementing preregistered exclusions (see details at https://doi.org/10.6084/m9.figshare.c.4878591.v1) and an additional exclusion of nine duplicate IDs, our final sample included 21,644 participants from 87 countries/regions (63.41% female, 35.34% male, 0.45% other genders, 0.56% preferred not to say, and 0.24% missing responses to the gender question; M age = 31.91, SD age = 14.52; see Supplementary Table 1 for sample size per country/region and Supplementary Table 2 for sample size per month). Of the 87 countries/regions represented, 37 had over 200 participants, surpassing our 95% power criterion based on simulations in our power analysis.
Sampling strategy	<p>We used a combination of convenience sampling and semi-representative panelling.</p> <p>We conducted a simulation study to estimate power for a variety of potential effect sizes ($d = 0.05$ to 0.29, separated by increments of 0.02), number of countries/regions ($N_{\text{country/region}} = 30, 35, 40, 45, 50, 55, 60$), within-country/region sample sizes ($N = 200, 400, 600, 800$), by-country/region intercept variances ($\sigma^2_{\text{intercept}} = 0.05, 0.30, 0.55, 0.80$), and by-country/region slope variances ($\sigma^2_{\text{slope}} = 0.0, 0.02, 0.03, 0.04$) at $\alpha = .017$. The lowest level of intercept variances in our simulation was chosen on the basis of an ongoing multi-country/region project tracking rates of depression ($\sigma^2_{\text{intercept}} = 0.04$) and worries about the COVID-19 ($\sigma^2_{\text{intercept}} = 0.06$) across countries/regions during the COVID-19 outbreak (See Supplementary Information for details). The lowest level of slope variances in our simulation was chosen on the basis of the average slope variance ($\sigma^2_{\text{slope}} < 0.01$) in a large multi-site, multi-country/region project involving 28 psychological manipulations¹²⁵. The slope variances capture the variability of the effect of psychological manipulations, and there is no apparent reason to expect that the effect of reappraisal interventions on emotions is more variable than most other psychological manipulations in Klein et al.. In fact, appraisal theories of emotion argue that the relationship between appraisals and emotions is culturally universal, suggesting low variability. As one example to show that similar appraisals associate with similar emotional experiences, we found the associations varied little across countries/regions between perceived insufficient government response and depression ($\sigma^2_{\text{slope}} = 0.003$) and between perceived insufficient government response and worries ($\sigma^2_{\text{slope}} = 0.003$) during the COVID-19 pandemic (See Supplementary Information for details), consistent with the observation of low slope variances ($\sigma^2_{\text{slope}} < 0.01$) in Klein et al. Despite expecting low variability from empirical findings and theories, we tested a variety of intercept variances and slope variances in our power simulation, some of which were much higher than those in the Klein et al. and Fetzter et al. to be maximally conservative. We conducted 1000 simulations for each set of simulation parameters using the <i>simr</i> package using computing power harnessed through the Open Science Grid.</p>
Data collection	Data was collected via an online survey, using the formr software framework. Participants clicked a single data collection link that led to either the current study or the other two studies in the COVID-19 Rapid Project. Participants completed the experiments at their own device and no experimenter was present during data collection.
Timing	Data collection began May 6, 2020 and finished October 23, 2020.
Data exclusions	We excluded 6345 responses after implementing preregistered exclusions (see details at https://doi.org/10.6084/m9.figshare.c.4878591.v1) and an additional exclusion of nine duplicate IDs.
Non-participation	We did not formally examine dropouts, but we preregistered to exclude participants who completed fewer than 50% of the questions in the study. We found that the passive control condition had fewer such participants (16.17%) than the other three conditions (23.86% in the active control condition, 24.41% in the reconstrual condition, and 23.90% in the repurposing condition), Holm's adjusted $P_s < 0.001$. One possible explanation for this difference is that the instructions given to participants in the passive control condition were shorter than those given in the other conditions, requiring less cognitive effort to read and less time to complete the study.
Randomization	Participants were randomly assigned to one of four conditions: passive control, active control, reconstrual, and repurposing.

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Population characteristics

See above

Recruitment

Participants were recruited by the PSA network. The PSA recruited 186 member labs from 55 countries/regions speaking 42 languages. Of the 27,989 participants recruited to complete the current study (not counting participants for the other two studies in the PSA COVID-19 Rapid Project), 4,050 of them were recruited through semi-representative paneling (based on sex, age, and sometimes ethnicity) from the following countries/regions: Egypt, Kenya, Nigeria, South Africa, Mexico, United States, Austria, Romania, Russia, Sweden, Switzerland, United Kingdom, China, Japan, and South Korea (270 participants per country/region). The remaining participants were recruited through the research groups by convenience sampling. Although the specifics of the consent procedure differed across research groups, all participants provided informed consent. The style and the amount of compensation varied with local conventions. More information regarding participant compensation and sample size can be found at <https://psyarxiv.com/x976j/>. Our sample was not nationally representative within each country/region, and it appeared to over-represent females, younger people, and people with internet access.

Ethics oversight

Primary ethics approval was provided by the Institutional Review Board at Ashland University, additional approvals were recorded as necessary depending on regional and national policies across our worldwide sample. Detailed information regarding IRB approval is available here: <https://osf.io/dq846/>. Each research group obtained approval from their local Ethics Committee or IRB to conduct the study, explicitly indicated that their institution did not require approval for the researchers to conduct this type of task, or explicitly indicated that the current study was covered by a pre-existing approval.

Note that full information on the approval of the study protocol must also be provided in the manuscript.